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TECHNOLOGY AND THE QUALITY OF LIFE

1996

45th Yearbook

Council on Technology Teacher Education

TECHNOLOGY AND THE QUALITY OF LIFE

EDITORS

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45th Yearbook, 1996

Council on Technology Teacher Education

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FOREWORD

Technology teacher educators and technology education teachers have understood that Technology Education includes the study of how technology has an effect on society and culture. The problem, for some, is understanding the subtle present day effects. This year's yearbook editors, Dr. Rodney L. Custer and Dr. A. Emerson Wiens, in the 45th Yearbook entitled *Technology and the Quality of Life* have attempted to extend the discussion beyond simply thinking about the changes that technology has brought to the quality of Western life. They have also attempted to explore ways in which institutions, social structures, and values have affected the shape and direction of technology.

The editors' approach is to explore (a) the complex interaction between technology and its Western ideological context, (b) technological development and change as a major force that affects society and culture in the recent past and today, and (c) how social values, institutions, and the pursuit of the quality of life today has affected technology. To accomplish their mission, the editors have used many authors outside of our profession. This required the careful selection of chapter authors and the editors carefully editing the Yearbook to make sure the authors' viewpoints were relevant to Technology Education. The editors' effort and hard work will result in this Yearbook helping our profession to better understand technology and its interface with the world in which we live.

This Yearbook has been divided into three parts. Part I of this Yearbook raises the question, is technology a social force or an institution, and examines several important aspects of Western ideology as a context for the development of technology. Part II identifies how contemporary technology, as it evolves, is developed and infused within society. In many cases this takes place without many or a majority of the people being aware of or understanding the process and/or the scope of how new technologies become part of our society. Part III illustrates that, even though social change is complex and sustains the interaction of a number of forces throughout the social system, technology is playing an increasingly more central role in the social change process. Cultural values need to be used to evaluate the social change that is brought about by technology and its effect on the quality of life.

The editors hope this Yearbook will stimulate thought, help the profession to better understand how technology has an effect on our life, and broaden our perspective. The profession thanks the editors for the fine job they have done and the contribution they have made to our profession.

Everett N. Israel
President, CTTE

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YEARBOOK PROPOSALS

Each year, at the ITEA International Conference, the CTTE Yearbook committee reviews the progress of yearbooks in preparation and evaluates proposals for additional yearbooks. Any member is welcome to submit a yearbook proposal. It should be written in sufficient detail for the committee to be able to understand the proposed substance and format. Fifteen copies of the proposal should be sent to the committee chairperson by February 1 of the year in which the conference is held. Below are the criteria employed by the committee in making yearbook selections.

CTTE Yearbook Committee

CTTE Yearbook Guidelines

A. Purpose:

The CTTE Yearbook Series is intended as a vehicle for communicating education subject matter in a structured, formal series that does not duplicate commercial textbook publishing activities.

B. Yearbook topic selection criteria:

An appropriate yearbook topic should:

1. Make a direct contribution to the understanding and improvement of technology teacher education.
2. Add to the accumulated body of knowledge of the field.
3. Not duplicate publishing activities of commercial publishers or other professional groups.
4. Provide a balanced view of the theme and not promote a single individual's or institution's philosophy or practices.
5. Actively seek to upgrade and modernize professional practice in technology teacher education.
6. Lend itself to team authorship as opposed to single authorship.

Proper yearbook themes *may* also be structured to:

1. Discuss and critique points of view which have gained a degree of acceptance by the profession.
2. Raise controversial questions in an effort to obtain a national hearing.
3. Consider and evaluate a variety of seemingly conflicting trends and statements emanating from several sources.

C. The yearbook proposal:

1. The Yearbook Proposal should provide adequate detail for the Yearbook Planning Committee to evaluate its merits.
2. The Yearbook Proposal should include:
   a. An introduction to the topic
   b. A listing of chapter titles
   c. A brief description of the content or purpose of each chapter
   d. A tentative list of authors for the various chapters
   e. An estimate of the length of each chapter

PREVIOUSLY PUBLISHED YEARBOOKS

*1. *Inventory Analysis of Industrial Arts Teacher Education Facilities, Personnel and Programs,* 1952.
*2. *Who's Who in Industrial Arts Teacher Education,* 1953.
*3. *Some Components of Current Leadership: Techniques of Selection and Guidance of Graduate Students; An Analysis of Textbook Emphases;* 1954, three studies.
*4. *Superior Practices in Industrial Arts Teacher Education,* 1955.
*5. *Problems and Issues in Industrial Arts Teacher Education,* 1956.
*6. *A Sourcebook of Reading in Education for Use in Industrial Arts and Industrial Arts Teacher Education,* 1957.
*7. *The Accreditation of Industrial Arts Teacher Education,* 1958.
*8. *Planning Industrial Arts Facilities,* 1959. Ralph K. Nair, ed.
*9. *Research in Industrial Arts Education,* 1960. Raymond Van Tassel, ed.
*10. *Graduate Study in Industrial Arts,* 1961. R. P. Norman and R. C. Bohn, eds.
*11. *Essentials of Preservice Preparation,* 1962. Donald G. Lux, ed.
*12. *Action and Thought in Industrial Arts Education,* 1963. E. A. T. Svendsen, ed.
*13. *Classroom Research in Industrial Arts,* 1964. Charles B. Porter, ed.
*14. *Approaches and Procedures in Industrial Arts,* 1965. G. S. Wall, ed.
*15. *Status of Research in Industrial Arts,* 1966. John D. Rowlett, ed.
*16. *Evaluation Guidelines for Contemporary Industrial Arts Programs,* 1967. Lloyd P. Nelson and William T. Sargent, eds.
*17. *A Historical Perspective of Industry,* 1968. Joseph F. Luetkemeyer Jr., ed.
*18. *Industrial Technology Education,* 1969. C. Thomas Dean and N. A. Hauer, eds. *Who's Who in Industrial Arts Teacher Education,* 1969. John M. Pollock and Charles A. Bunten, eds.
*19. *Industrial Arts for Disadvantaged Youth,* 1970. Ralph O. Gallington, ed.
*20. *Components of Teacher Education,* 1971. W. E. Ray and J. Streichler, eds.
*21. *Industrial Arts for the Early Adolescent,* 1972. Daniel J. Householder, ed.
*22. *Industrial Arts in Senior High Schools,* 1973. Rutherford E. Lockette, ed.
*23. *Industrial Arts for the Elementary School,* 1974. Robert G. Thrower and Robert D. Weber, eds.
*24. *A Guide to the Planning of Industrial Arts Facilities,* 1975. D. E. Moon, ed.
*25. *Future Alternatives for Industrial Arts,* 1976. Lee H. Smalley, ed.
*26. *Competency-Based Industrial Arts Teacher Education,* 1977. Jack C. Brueckman and Stanley E. Brooks, eds.
*27. *Industrial Arts in the Open Access Curriculum,* 1978. L. D. Anderson, ed.
*28. *Industrial Arts Education: Retrospect, Prospect,* 1979. G. Eugene Martin, ed.
*29. *Technology and Society: Interfaces with Industrial Arts,* 1980. Herbert A. Anderson and M. James Benson, eds.
*30. *An Interpretive History of Industrial Arts,* 1981. Richard Barella and Thomas Wright, eds.
*31. *The Contributions of Industrial Arts to Selected Areas of Education,* 1982. Donald Maley and Kendall N. Starkweather, eds.
*32. *The Dynamics of Creative Leadership for Industrial Arts Education,* 1983. Robert E. Wenig and John I. Mathews, eds.
*33. *Affective Learning in Industrial Arts,* 1984. Gerald L. Jennings, ed.
*34. *Perceptual and Psychomotor Learning in Industrial Arts Education,* 1985. John M. Shemick, ed.
*35. *Implementing Technology Education,* 1986. Ronald E. Jones and John R. Wright, eds.
*36. *Conducting Technical Research,* 1987. Everett N. Israel and R. Thomas Wright, eds.
*37. *Instructional Strategies for Technology Education,* 1988. William H. Kemp and Anthony E. Schwaller, eds.
38. *Technology Student Organizations,* 1989. M. Roger Betts and Arvid W. Van Dyke, eds.
39. *Communication in Technology Education,* 1990. Jane A. Liedtke, ed.
40. *Technological Literacy,* 1991. Michael J. Dyrenfurth and Michael R. Kozak, eds.
41. *Transportation in Technology Education,* 1992. John R. Wright and Stanley Komacek, eds.
42. *Manufacturing in Technology Education,* 1993. Richard D. Seymour and Ray L. Shackelford, eds.
43. *Construction in Technology Education,* 1994. Jack W. Wescott and Richard M. Henak, eds.
44. *Foundations of Technology Education,* 1995. G. Eugene Martin, ed.

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CONTENTS

PREFACE

This yearbook provides the reader with the opportunity to reflect on technology from a variety of perspectives. Our profession is at a critical juncture. The opportunities and the needs are many. We are living in a time when technology is growing and changing dramatically. In its various forms, it is certainly one of the most important ingredients and elements in modern life. Within education, there is a growing sense that technology must be included as part of the general education of all students since it will be an integral part of almost every aspect of their lives. Students must learn to think about technology, its influence on culture and on individuals. Citizens must learn to weigh and balance important issues related to the role of technology in a democracy as well as in a global community. They must develop some basic skills in the use of technology.

But this is also a time of serious challenge for technology education. In a time when more citizens, perhaps more than ever before, are becoming aware of technology, there are also some serious misunderstandings about what technology is. For many, technology is restricted to computers and computer-related devices. It is much more than that. Technology includes a wide range of artifacts. It can also be defined as knowledge (unique to technology) and process (problem solving and design). Also, within the educational community, there is a serious tendency to confuse technology education (a broad range of content and experiences designed to develop technological literacy within all students) with education technology (the use of technology—often computers—as tools to assist the delivery of concepts and content). One of the primary purposes of this book is to dispel these misconceptions and clarify the nature and meaning of technology.

The seeds for this book were planted over a decade ago when we were both teaching in two different, small, liberal arts colleges in Kansas. In those years, we began to talk with each another. In those days our conversations revolved around such things as solar energy, environmental concerns, philosophy of technology, and much more. But the most important conversations we were having were not with each other; they were with our liberal arts peers from a variety of different academic disciplines. Since our colleges were small, we worked closely with our colleagues from the social sciences and humanities on a regular basis. Some understood us. Others clearly did not and openly wondered about how technological pursuits fit within the context of a liberal arts college. This is one of the rich opportunities available to those who live and work in small colleges. As we both moved on to larger universities and extended our involvement into the larger technology education community, the conversations were extended even further.

Thus, many of the ideas presented in this book have had a long gestation period. Some of those with whom we have agreed and disagreed with over the years have been asked to share their thinking with you in this book. We are indebted to them and many others for extending, challenging and refining our thinking. It is our sincere hope that we will be successful in drawing you into the conversation as well.

There are several points that we consider to be of fundamental importance to this book and to the study of technology. First, we are convinced that technology cannot be appropriately and meaningfully understood apart from its broader cultural and social context. In other words, students of technology must also be students of society and culture. Technology, as we know it today, is shaped and formed as it is because of the values and priorities of our culture. This is somewhat the reverse of how we in technology education often think about technology's development. We are more prone to thinking about the ways in which the reverse has occurred, i.e., with how technology has influenced society. In this book, we have attempted to examine the complex, dynamic, and often fascinating interaction that occurs when technology intersects with various aspects of our culture.

A second point is that we have great faith in the importance of interacting with those from other disciplines. If the technology education profession is to fulfill its tremendous potential role as a curriculum integrator, and as our base of knowledge is forced to expand to understand technology, it is critical that we extend our reach beyond our own profession. We need to know what others are thinking about technology as well as what they are thinking about us. We need their perspective and we need their knowledge. In like manner, they need us and our knowledge and insight. Thus, we have invited a number of thinkers from outside of our profession to join us in writing this book. We hope that you will find their insights and ideas provocative, challenging, and enlightening.

Third, we believe that the study of technology should be an active and dynamic process. Much of the genius of our profession over the years has been that we have attempted to balance conceptual thought with active doing and involvement. At the end of each chapter in Sections Two and Three, you will find a series of questions designed to stimulate discussion about each of the chapter topics. Additionally, each author has also developed at least one scenario, designed to present students with a dilemma related to some aspect of technology in our culture related to the theme of the respective chapter. We encourage you to use these as a way of continuing this active, engaged, and applied aspect of technology education. The scenarios and discussion questions are intended to be used to stimulate classroom or small group discussions, but could work equally well for written assignments.

Finally, we have found that our growth as professionals has often occurred at those points where we have disagreed and debated with others. There will be points at which you may disagree with our authors and with us. If this occurs, then we have met one of our most important goals of this book—that of stimulating thought and generating discussion.

It is our sincere hope that you will find this yearbook useful and that your perspectives on technology will be extended and challenged. We deeply appreciate this opportunity to work with a diverse group of dedicated and competent scholars and thinkers. Each of them has invested many hours of effort into reflecting on the place of technology in culture. For many, if not most, writing this chapter represented something quite different from what they were accustomed to doing. It was a stretch. Finally, we wish to express our appreciation to the technology education profession for affording us this opportunity to serve. All of us are who we are because of the support, professional generosity, and opportunities for growth and service that others have extended to us. For these we are genuinely grateful. We hope that, through the efforts of this book, that we have been able to repay those who have done so much for us.

ACKNOWLEDGMENTS

We must begin our acknowledgments by recognizing the Council on Technology Teacher Education (CTTE) and the foresight of the Council's leaders some 45 years ago when they established this valuable yearbook series. We appreciate the opportunity we have had to serve as editors of this, the 45th Yearbook.

Ironically, the seed for this yearbook was planted in another professional organization, the Mississippi Valley Industrial Teacher Education Conference when Emerson Wiens made a presentation on teaching technology as a part of undergraduate liberal arts education. That paper sparked a lively discussion that has continued to this day. Present at that event was R. Thomas Wright of Ball State University, who, several years later, while chairperson of CTTE's Yearbook Committee, sent a letter to Emerson encouraging the development and submission of a proposal for a yearbook on technology as liberal arts. Although we two editors had already begun serious conversations regarding such a proposal, the encouragement from Dr. Wright was the impetus we needed to start the process that has culminated in this book. Although the name of the book and the chapter selection has gone through several iterations, the purpose of the book has not been compromised: it is intended for use as a text for teaching technology as a liberal arts or general studies course for undergraduate students, and, perhaps as importantly, as a reference for educators both in and outside the field of technology to expand their thinking about technology and its relationship to the quality of life. Thank you, Tom, and to all the other members of the Yearbook Committee for your unflagging encouragement and support in this venture. Your perceptive comments and persistent questions have sharpened our focus and made the task more realistic. We are also keenly grateful for the invaluable insights and advice provided by previous yearbook editors, especially Gene Martin.

Obviously, the most important contributors in the development of this book are the authors, without whose diligence, weeks of research, late nights of struggling over word choices and editor's *unreasonable* requests, and professional commitment, this book would never have been completed. As editors, we have found your chapters to be challenging and exciting beyond our own imaginations. We sincerely thank you!

We also extend our gratitude to the publisher, GLENCOE/McGraw-Hill, and its predecessor, McKnight & McKnight Publishing Company, whose generosity has made this yearbook series available to the profession. Trudy Muller has been especially helpful, answering our questions promptly and providing advice as appropriate.

The editing task was made much more manageable with the professional proofreading services of Nan Erickson, Cheryl Wiedmaier, and Bonnie Snyder. They saved us countless hours and provided a level of expertise and carefulness that clearly enhanced the quality of this book. We also thank Kenton Wiens and Dr. Grant Zehr for their willingness to share their expertise in reviewing several chapters. We both express our sincere appreciation to our wives and families who have supported us, sometimes putting their needs on hold while we finished editing a chapter, sent an e-mail message or traveled, once again, to the library to find a missing citation or to pursue a new lead. Emerson Wiens also wants to acknowledge the contribution that his children have made to his own thinking about this subject by recommending stimulating references and asking unanswerable questions.

Rodney L. Custer
University of Missouri, Coeditor

A. Emerson Wiens
Illinois State University, Coeditor

CHAPTER 1

Technology and the Quality of Life

INTRODUCTORY PERSPECTIVES

A. Emerson Wiens & Kenton S. Wiens

One knew that this spectacle was not the product of inanimate nature, like some aurora borealis, or of chance, or of luck, that it was unmistakably human—with "human," for once, meaning grandeur—that a purpose and a long, sustained, disciplined effort had gone to achieve this series of moments, and that man was succeeding, succeeding, succeeding! For once, if only for seven minutes, the worst among those who saw it had to feel—not "How small is man by the side of the Grand Canyon!"— but "How great is man and how safe is nature when he conquers it!"

(Ayn Rand, 1969, p. 6)

Why This Book?

The statement above is an expression of confidence and pride in human accomplishments felt by objectivist philosopher Ayn Rand when she, as a guest of NASA, observed the historic launching of Apollo 11. This was neither the first nor the last "conquering of nature" by humankind, although it was arguably the most extensive and spectacular to that moment in history. Conquering nature in an effort to extend human potential began when our ancestors learned to control fire, make tools, and build structures. Conquering or controlling nature continues to be a central purpose of technology. As a result, we live in and are surrounded by altered or artificial environments. Our clothes, automobiles, telephones, air conditioned buildings, lawns in Phoenix, theme parks, smog, underarm deodorant, refrigerated food, and plastic surgery all are a result of our effort to alter the natural world.

The Accelerative Thrust

The examples of environment-altering materials and devices are numerous, but they are also increasing at a phenomenal rate. It was not until the mid-nineteenth century that any mode of transportation was able to surpass the speed of a running horse. Humans achieved 100 miles per hour around 1880 on a steam locomotive; 400 mph in 1931 via airplane; and that speed was doubled only 20 years later. By the 1960s, rockets reached 4,000 mph, and satellites carrying humans were speeding around the earth at a remarkable 18,000 mph (Toffler, 1971, p. 26). One can also trace the improvements made in communication technology with equally astounding examples: from the beating of drums and use of smoke signals, through telegraph and telephone to our current ability to send words, graphics, and voice messages at the speed of light to any place in the world.

In looking at another accelerative aspect of technology, William O. Baker (in Toffler, 1974), vice president of Bell Laboratories, emphasized the reduction in time between invention and application when he noted that "while it took 65 years for the electric motor to be applied, 33 years for the vacuum tube and 18 years for the X-ray tube, it took only 10 for the nuclear reactor, 5 for radar and only 3 for the transistor and the solar battery" (pp. 43-44). A similar reduction in time has taken place between the commercialization of a new technology and its acceptance by the public. This point is illustrated in the United States by the almost immediate response to the commercialization of the compact disk and personal computer in the past 15 years, as compared to the much slower acceptance of the telephone and radio.

The Study of the Society-Technology Interface Ignored

Most of us have a very positive feeling regarding the role technology has had in making our lives more comfortable, easier, and healthier. We tend to have a *deterministic* view of how technology impacts our lives and society, but are less clear about how society impacts technology. Custer, in Chapter 2 of this book, discusses the perceptual distortion of oversimplifying the relationship of technology and culture. The focus of much popular literature is on the technology itself and what it can do for us, while the complex interaction between technology and society has, with a few notable exceptions, gone unexamined. Langdon Winner (1993) has observed that although we worry about physical health issues such as toxic wastes from industrial processes entering our ground water or carbon-dioxide emissions that affect global climatic change, "we find it difficult as a nation to discuss in any sustained way the relationship between important technological projects and the kind of society we want to build" (pp. B1-B2).

Questions about the societal effects of our technology use *are* difficult to address, even by those whom we would expect to do so. In the Preface of the fascinating book *The World of 2044: Technological Development and the Future of Society,* editor Kaplan (1994) supported Winner's view when he made this remark about the contributing authors in the book:

> I was impressed by the unwillingness of so many participants to anticipate the impact of technology upon culture, society, and politics, or even in some cases to take the coming technological revolution seriously enough to consider it. Even the best scenarios in this book, however, merely have scratched the surface...this supernally important topic is likely not to be taken seriously until we invoke dangerous problems that it then may be too late to solve...[such as] changes in how we view ourselves and our kind that may degrade what we now are, let alone what we might become. (p. xiv)

Why are so many experts reluctant to address the cultural consequences of our technological choices? Is it simply that they and we do not understand the interaction clearly enough, or is it that they are afraid of being wrong—or of being right?

We are, at our foundation, a technological society, a technological culture. People in the United States are fascinated with technology and cannot wait for the next generation computer or car model or kitchen appliance to be released, and we cannot wait to discard the *obsolete*. Our consumption of technology is cyclical and self-perpetuating, since, for every technology-induced problem, we look for a technological solution. Technology is so fundamental to our outlook and to our process of life that it is inseparable from our conceptions and understanding of life. Our use of and dependence on technology is pervasive, and yet our understanding of technology in society is elementary.

The purpose of this book is to enhance that understanding; to explore that "seamless web of activity," as Custer calls it in the next chapter, that occurs between technology, our social institutions, our culture, the environment, and other aspects of our lives. We want to focus particularly on the role that our technological choices have had in enhancing or diminishing our quality of life. In this introductory chapter, we begin by defining and discussing the key words used in the book. What are the different interpretations of technology? How is it like or unlike science? What do we mean by quality of life? Does life quality mean the same thing to all people?

After discussing the key words, the characteristics of modern technology will be examined. Is modern technology different from primitive technology? If so, in what ways? Are there characteristics that should be of particular concern to us? Then the discussion will shift to provide a broader perspective of how technological choices and use have affected our personal lives and society. Obviously, the chapters that follow elaborate on this perspective. This chapter concludes by suggesting that our understanding of technology will be enhanced if technology is seen as a *social institution* within Western society. What is an *institution,* and does technology meet the criteria for a social institution? What new insights or perspectives can be gained by viewing technology in this manner?

Definitions

Technology and quality of life are terms that we use frequently in our everyday conversation, yet many of us use them with only a vague meaning in mind. Various definitions have been presented, however, by writers who have given considerable thought and study to the meaning of these terms. Some of these definitions are considered here.

Technology

In the United States, the public, the media, and politicians appear to have difficulty defining technology and distinguishing between science and technology. Frequently, the terms are used together with no attempt to differentiate between the two. If asked to define technology, responses tend to run from *computers* and *things* (actual products of technology) to *applied science*. When reference is made to technology in the classroom, for example, the inference is not that the classroom uses lasers, jet engines, or magnetic resonance imaging devices, but that the classroom has a computer and special presentation hard and software. The press often uses the terms technology and computers synonymously. This ambiguity has made any in-depth understanding of technology difficult.

The word *technology* is formed by combining the Greek root word *techne* or *techno,* meaning that having to do with the technical aspects of the arts and crafts, with the suffix word *logia,* meaning theory, doctrine, science or *the study of.* It is obvious from our use of the term, however, that the meaning of *technology* has evolved far beyond that of its original formation. Like all words in a dynamic language, it will continue to evolve as the elements surrounding technology continue to evolve. If we are to understand the true role of technology in our lives, we must update and expand our definitions as well.

Let us begin by examining several other definitions drawn from writers with various backgrounds and perspectives.

- Mesthene (1970) saw technology as "the organization of knowledge for the achievement of practical purposes" (p. 25).
- McGinn (1978) believed that technology by definition was *fabricative* in nature and, therefore, dealt with "material" (pp. 181-182). However, one observes that the solution of a technological problem is not always an artifact or material. For example, determining the queuing formula for regulating the traffic over the Oakland-San Francisco Bay Bridge or any other heavily used, restricted trafficway, for that matter, does not result in an artifact. While traffic lights may be used to solve the problem, the technological solution is not the invention of the traffic light but the determination of the timing of the lights and the designation of in-going and out-going lanes at different times of the day (Wiens, 1988, p. 192).
- Donald Schon (1967) described technology more explicitly as "any tool or technique, any product or process, and physical equipment or method of doing or making, by which human capability is extended" (p. 1). This view, broader than McGinn's, includes the entire environment-altering interface which may not require a machine aspect at all; for example, this definition includes such nonmechanical activities as "well established procedures for scheduling meetings and writing reports" (Kraut, Fish, Root, & Chalfonte, 1990, p. 146).

- In an attempt to distinguish technology from art, Bell (1973) stated that he sees art and technology as similar endeavors—"a soaring experience of the human imagination,"—but described technology as a form of art "that bridges culture and social structure and in the process reshapes both," while art is an end in itself (p. 50). Artists would, no doubt, argue legitimately that art also bridges culture and social structure and reshapes both (see Foster's chapter for an expansion of the similarities and differences between art and technology).
- Mitcham (1980) suggested that technology can be understood in four ways: as object, as process, as knowledge, and as volition (having purpose and direction toward a desired end) (p. 306).
- Henryk Skolimowski (1966) stated simply, "Technology is a form of human knowledge" and explained that in the process of solving technical problems, knowledge is increased. Knowledge is the by-product, not the goal, but is precisely the by-product which will help solve the next technical problem by which new knowledge is gained (p. 372). Another type of knowledge that is generated in technological activity is the *knowledge of technique,* that knowledge, often unwritten, that makes the experienced craftsperson more efficient and more effective than the novice.
- The following definition by Stephen Cutcliffe (in Waetjen, 1987) acknowledges the often ignored role of society in forming technology: "Technology is a social process in which abstract economic, cultural, and social values shape, develop, and implement specific artifacts and techniques that emerge from the distinct problem-solving activity called engineering which is embedded in that process" (p. 30). But engineers are not the only people who develop and implement artifacts and techniques.
- Another view of technology is that it is an applied science. This point of view is given by John Truxal (1986) who is an engineer by training. He was Project Director of the New Liberal Arts Program, a program sponsored by the Alfred P. Sloan Foundation to teach technology as part of the general education core at the undergraduate level. Truxal defined technology as "simply the application of scientific knowledge to achieve a specified human purpose" (p. 12). To challenge this statement, one must understand the difference

between science and technology. In drawing the distinction between these two terms, Skolimowski (1966) made the oft-quoted statement, "In science we *investigate* the reality that is given; in technology we *create* a reality according to our designs" (p. 374). "In short," he added, "science concerns itself with what *is,* technology with what *is to be*" (p. 375). While technology is used to deliberately control and change nature for human convenience, science controls nature temporarily and categorically only for the sake of enhancing our understanding of the subject. This is, after all, what controlled scientific experiments are all about.

The applied science definition simply does not hold up historically. One can think of numerous examples of technology that preceded science: bows, arrows, and other weapons; elementary tools; and early implements were created without an explanation of the simple machinesandformulae for mechanical advantage. Fire was used for millennia before the chemistry of combustion and oxidation was understood and the laws of thermodynamics defined; wine was also fermented and cheese made with no knowledge of the biochemistry involved (fire, wine production, and cheese-making are natural processes; technology came into play when humans learned to control and modify these processes to meetspecific ends).

- Offering a view contrary to Truxal's, Rustum Roy (1990), a leader in the National Association for Science, Technology, and Society, argues that historically, technology led to science more often than science led to technology. Recent studies indicate that most technological knowledge is still built, not on science, but on previous technological knowledge. One study—Project Hindsight—conducted by the United States Defense Department examined 710 events which were essential in the development of 20 major weapon systems during the 20 years following World War II. The investigators found in the course of the study, that only two events (a minuscule .3% of the total) were the result of basic scientific research. Another study analyzing British firms reported similar findings. However, a more recent analysis found a median delay of nine years between a scientific finding and its conversion to technology, a finding that would have modified the results of Project Hindsight somewhat if the researchers would have included basic research which had been done a few years prior to the technology

> development period studied (Volti, 1992, pp. 56-57). While it is true that applied science is generally technology, it is also true that much if not most technology that exists and is practiced is *not* applied science in the strict sense of the term.

There is evidence now to support both Truxal's and Roy's views. The relationship between science and technology is not unidirectional but rather multidimensional and dynamic. We can give many examples where science and technology complement each other, where one does not consistently lead or follow the other. Hurd (1994) describes this symbiotic relationship in this way: "Science is a tool for generating new technologies and technology is a means for extending the frontiers of science" (p. 130). The use of more sophisticated technology such as the Hubble Space Telescope, often leads to "unexpected observations that will require new theories or the modification of older theories to provide a valid interpretation" (p. 130).

Before leaving this discussion about the distinction between science and technology, two final observations can be made. The first is that while science is culturally transferable, technology is less so. The fact that science is founded on universal laws establishes its applicability to all countries and cultures, and, indeed, to the oceans and skies as well; but technology grows out of the needs of a society and is, therefore, culture specific. Technology can not be transferred successfully between countries without careful attention to the *appropriateness* to the culture. The World Bank has had to learn this the hard way after seeing expensive construction equipment rusting in the fields of developing countries. Our experience with technology transfer appears to indicate that technology is not just a machine or a body of knowledge; it is *a way of thinking*, an approach to problem solving that presupposes both ends and means.

The second observation that can be made about the differences between science and technology concerns our predisposition toward the two words. We typically associate science with *nature* and with what is *natural,* while technology is associated with the human-made or *artificial* world. However, the words *nature* and *natural* can be used also to describe human behavior. Is it not as *natural* (human *nature*) for humans to solve problems and make artifacts as it is for them to walk erect or paint pictures? Technologists may work with artificial materials—meaning that these materials do not exist in that state naturally—or create artificial environments, but the technological process, i.e., the application of knowledge toward practical ends, is *natural* for humans. (Ferré, 1988, pp. 28-29).

In this section, a number of definitions have been examined and the concept of technology explored. Wright, Israel, and Lauda (1993), writing for the International Technology Education Association, developed this definition which encompasses most of the important elements.

Technology is a body of knowledge and actions used in:

- applying resources
- developing, producing, and using artifacts and systems
- extending the human potential
- controlling and modifying the natural and human-made environments (p. 2)

Artifacts which are considered by most people as technology, are more properly seen as the products of technology. We would add just one more part to this definition; the technologist has a specific mindset or view of the earth which dictates his/her relationship to the environment. It is a relationship that is best described as a drive to modify or control the environment for the convenience or comfort of humankind. While this mindset (volition) has brought us many conveniences, it has also brought us into conflict with our natural environment.

Quality of Life

In a 1995 television beer commercial, an actor makes the statement: "It doesn't get any better than this," implying that beautiful scenery, the right friends, and, of course, lots of the right brand of beer is *the* measure of quality of life. Certainly all of us can list attributes or conditions which we associate with *quality living*—for some, it is being able to eat in fine restaurants, having a closet full of fashionable clothes, or trading for a new Mercedes every year, while others might include factors such as health conditions and medical care, educational opportunities, and the quality of the natural environment (Peter Wright's chapter takes a closer look at consumerism and its relationship to quality of life). Families who have been victims of crime or violence may consider physical security and absence of fear as the most important factors, while sociologists may also include items such as alienation, power, and control as indices of quality of life.

The term *quality of life* has both subjective and normative meaning. In the normative sense, it is used in two contexts: 1) to indicate some measure of satisfaction or happiness of an individual at a given point or stage of life; and, 2) to indicate a somewhat comprehensive and comparative measure of living conditions of a group within a society or of a society as a whole. As an example of the first context, we would be inclined to say that a person who experienced brain damage and paralysis as a result of a car accident has a lower quality of life than a person in good health. In the second context, we might say that the peasant class in a developing country does not have the same quality of life as does the middle class of that country; or that the quality of life in Sweden ranks higher on some predetermined list of quality indicators than that of Mexico or some other country.

Researchers are still not in total agreement in regard to which measures to use to designate quality of life. Economists tend to prefer quantitative measures which are more objective, while psychologists are much more interested in qualitative indicators which are subjective and perceptual in nature (Mukherjee, 1989, p. 24). In comparative international studies of quality of life, the most widely used index has been the physical quality of life index (PQLI), which equally weights indices of literacy, infant mortality, and life expectancy (Slottje, Scully, Hirschberg, & Hayes, 1991, p. 2). But these measures do not include any qualitative factors. In 1987, Sen strongly recommended that subjective factors such as level of happiness, utility (satisfying desires), and choice be included in any measure of quality of life across cultures. Despite this recommendation, the Bread for the World Institute on Hunger & Development listed the following comparative indicators of quality of life in 1992, which are, once again, primarily quantitative:

- infant mortality
- female illiteracy
- female primary enrollment
- household with access to running water
- employment in some lists (Chelliah, 1992, p. 149)

In addition, Bread for the World developed a group of Human Welfare Indicators including:

- access to health facilities
- access to safe water
- absolute poverty level
- adult literacy, male and female (Cohen, 1992, p. 176)

These indices may be useful for providing comparative measures of *poverty* at a basic level across different cultures, but the focus of this chapter is on quality of life in a post-industrial society, specifically in the United States. According to Schuessler and Fisher (1985), quality of life research began in the 1960s with the *Report of the President's Commission on National Goals in the United States*. Given our propensity toward research and the availability of funding in this country, many rating scales and indices have been developed, although they are often developed for a specific area of our lives, such as some aspect of health. One reference, *Measuring Health* (McDowell and Newell, 1987), describes 47 rating scales and questionnaires. Of particular interest are those indices that are generalizable to the complex of quality of life factors that are important in our society.

For the sake of brevity, one index will be described here: the Quality of Life Index developed by Ferrans and Powers (1985). This index illustrates the complexity of characteristics and conditions that contribute to the quality of life which is defined as the *satisfaction of needs*. The authors of the index have dealt with the variation within society by dividing the instrument into two sections, one dealing with the *satisfaction* of needs, and the other with the *importance* of the various needs domains which were selected from the literature (in Williams & Wood-Dauphinee, 1989, p. 97). The organization of the index and the items for which information was collected is described here in more detail:

> Each [section] contains 32 items that assess health care, physical health and functioning, marriage, family, friends, stress, standard of living, occupation, education, leisure, future retirement, peace of mind, personal faith, life goals, personal appearance, self-acceptance, general happiness, and general satisfaction. (Williams & Wood-Dauphinee, 1989, p. 97)

By assessing these items in regard to an individual's satisfaction with each domain as well as by the individual's rating of importance, a personal profile of quality of life could be generated. This index differs dramatically from the Bread for the World index in its thoroughness and its attention to the affective domain, i.e., feelings and emotions. In a post-industrial society, *quality of life* measures are quite subjective in nature since our basic human needs—food, shelter, security, etc.—are met by government programs if not by ones own efforts. As a result, quality of life becomes a much more complex and personalized concept that focuses on *needs* higher up the human-needs pyramid such as self-fulfillment. In our culture, quality of life is a multidimensional matrix of domains that range from physical aspects through social, psychological, and spiritual conditions that are personalized by the importance that an individual places on each domain.

In our mobile society, we observe that people gravitate, to some degree, to the geographic locations which are perceived as offering a higher quality of life. In this regard, cities have typically been associated with a higher quality of life because of better available health care, improved infrastructure (roads, running water, sewage and waste disposal), better paying jobs, and a greater range of *cultural opportunities*. However, crime, drugs, smog, traffic snarls, and other negative aspects of the city have caused many people to reassess the advantages.

Naisbitt and Aburdene (1990) identified an interesting phenomenon that is reversing a trend of the last two or three centuries. The trend of urbanization became the fundamental demographic phenomenon of the late nineteenth century in the United States and continued into the latter part of this century. Just as technology made the factory system possible and lured workers to the city, new technologies are now allowing people to move out of the city without jeopardizing their income potential. Naisbitt and Aburdene (1990), themselves among those who have moved out, explain the current trend in this way (for a more comprehensive and fascinating study of the city, the reader is referred to the chapter by Britta Fischer):

> In the United States, for the first time in 200 years, more people are moving to rural areas than urban—many more. In the Northeast, West, Great Plains, and Southwest, everywhere, people are moving from cities and suburbs to rural areas. They are abandoning cities for quality-of-life reasons: low crime rates, comparatively low housing costs, recreational opportunities, and, perhaps most of all, a return to community values. (p. 305)

Quality of life and its relationship to technology is both intriguing and, as noted previously, complex. But it is a critical relationship that needs to be understood now more than ever because social good is not always the prime consideration in our introduction of new technologies.

After careful consideration, the editors of this book chose not to dictate to the authors of the chapters a precise definition of quality of life for two reasons: first, there is no one definition that fits all fields of study, and, secondly, the editors did not want to impose a model that might restrict the authors in addressing their respective topics. Instead, the authors were expected to use definitions that were appropriate to their specific discussions. For example, the authors of the chapter on the Health Care System consider quality of life as related to health issues, while Karian discusses quality of life as a measure of a healthy ecosystem and a wholesome relationship between humankind and nature. While a general understanding of the concept of quality of life is important, flexibility in definition allows for more breadth of discussion.

Characteristics of Modern Technology

Most people—including many futurists—conceive of tomorrow as a mere extension of today, forgetting that trends, no matter how seemingly powerful, do not merely continue in a linear fashion. . . .nothing will remain unchanged.

(Toffler, 1980, p. 129)

Does modern technology differ from primitive technology? Heidegger (1977) has argued that modern technology is different in two respects: on its greater demands on nature and in reference to its intimate relationship with science (pp. 28-30). Mitcham (1980) also claims that a difference exists in regard to how an artifact is made and how close to nature the craftsman is. He explained the difference in this way:

> Ancient technology incorporates individual objects fabricated with naturally available energies and materials on the basis of intuitive knowledge for the limited purposes of usefulness and pleasure within a variegated spectrum of activities. The ideal type for ancient or traditional technology is the handcrafted making and using of utensils; as such, a better word for it might be "technics" (from the Greek *techne*) or "art." Modern technology, by contrast, involves mass-produced objects designed to utilize abstract energies and artificial materials on the basis of scientific theories for purposes of efficiency, power, or profit. (p. 322)

Certainly, the modern technologist and craftsman are further removed from the end-product or object of focus. The medical doctor who observes a SPECT scan of a malfunctioning heart on a monitor may have never met the patient face-to-face, much less has opened the chest and examined the heart firsthand; or consider the artist who creates *paintings* on the computer without wielding a brush; or the military officer who uses laser or heat-seeking guidance systems to reach an enemy whom he has never seen.

While the distinctions made by Heidegger and Mitcham appear true, close examination would suggest that most, if not all, of the characteristics that follow were also true of technology historically at least to some degree. The reader will also notice that the characteristics are not mutually exclusive.

- *Modification or control of environment.* This characteristic has been true of technology from the time that the first shelter was made, but it is so central to the role of modern technology that it must be noted. The examples surround us: from the light switch and the thermostat, from the car in the garage, to a mechanical heart and the artificial culture of a theme park. We have become so accustomed to technology that we may confuse what is *natural* and what is *artificial.* Is it natural to live in a house; not natural to live outside? Is it natural to wear clothing; not natural to be unclothed? Mary Herte, a plastic surgeon specializing in breast implants, is amused when patients tell her they just want to look natural. "I smile and say, 'No you don't.' People don't understand that what they want to look like is a woman who has breast implants." (Martin, 1995, p. 84). The distinction between what is natural and what is artificial is becoming increasingly blurred.

- *Pervasive.* In our highly industrialized world, our environment consists of two layers with an *artificial* layer super-imposed over the *natural* layer. We spend our lives—from the delivery room to the mortician's lab—surrounded by technology. We cannot imagine living without it. If we want to speak to someone not present, we reach for the phone or the computer keyboard; if we need something from a store, we hop into the car; if we are hungry, we open the refrigerator and pop something into the microwave, or we call out for pizza, and it is delivered via automobile; if the house is too warm or cold, we reach for the thermostat; if we have a virus, we swallow pills. Technology is pervasive.

- *Irreversible.* Can you imagine going back to a pre-automobile era or even a pre-personal computer era? The personal computer in its current form came on the market less than 20 years ago, yet we already cannot live without it. Once we have the new technology, it becomes so embedded in society that reversibility is virtually impossible. However, we can think of examples where the government, in the best interests of society, has banned certain manufactured products (e.g., DDT, the Dalkan Shield, and chlorofluorocarbons) after life-threatening, unintended results of their use became obvious.

- *Cumulative.* Without question, a principal reason for the tremendous increase in the number of inventions and new technologies has to do with the cumulative nature of technology. Simply stated, when technological knowledge was limited, the number of ways that that knowledge could be combined to create new technology was very limited. Now, with the tremendous volume of technological knowledge available, the possible combinations of ideas and inventions is almost limitless. Imagine what the growth will be in 25 years, 50 years! The hundreds of uses of the laser show how one new technology can be used in very diverse fields, from leveling ceiling tile and vaporizing tonsils and gall bladders, to guiding *smart* bombs and carrying messages around the world at the speed of light. But the laser, as with other examples, must be coupled with other technologies to perform these tasks—the cumulative advantage.

- *Obsolescence—and often planned obsolescence.* In the fast-paced world of technology commercialization, we expect new features to be added as new product models enter the market, rendering the old products obsolete. Besides adding new features, companies that deliberately design products that will not last, are *planning* obsolescence. In his insightful treatise on the imperatives of technology, Galbraith (1972) described the need for product builders in a market economy to create and control the market. The cost of producing a new product is simply too great to risk failure. As an illustration of his point, he described the techniques used by Ford Motor Company to create a market (desire) for the Mustang long before the first model rolled off the assembly line. For a variety of reasons, people desire the new products, and their wants become *needs,* although they had gotten along fine without the products before they existed. New technology creates new needs. As consumers, we often buy products because of their marketed capabilities which we seldom fully utilize—for example, the personal computer and the VCR. The concept of obsolescence is considered a necessary component of a *healthy* market economy (see Wright's chapter on consumerism for more discussion on this topic).

- *Centralization or centralized control.* In modern technology, centralization or central control are typical modes of operation. Most people do not know where their electricity is generated, nor do they care, so long as it does not go off. Obviously, it would be inefficient for every home to have an electric generating station, a septic system, and a coal mine or gas well. However, increased centralization brings with it, decreased personal control; for example, the consumer does not set the utility rates—the utility company does—and the consumers must rely on a government regulatory board to look after their interests.

- *Dependency.* One of the ironies of modern technology is that we gain certain *freedoms* (e.g., in travel and communication) at the same time that we become more dependent on centralized systems. Although centralization can be more efficient and convenient, it engenders a high level of dependency. This author (the elder) lived on a farm in Central Kansas in the 1930s and 40s. A huge garden supplied canned and dried fruits and vegetables; cattle, hogs, chickens, and sheep supplied meat, milk, eggs and wool. We lived with a great deal of independence. By contrast today, even most farmers have become so specialized that they are as dependent as urban dwellers on centralized suppliers of foods, utilities, and services.

- *Systems.* All technology is part of some system. The fuel injector in the automobile is part of the fuel system of the car which, when coupled with other subsystems, allows the car to move down the highway and be controlled by a driver. In turn, the car and highway are parts of the transportation system which includes other modes of transportation as well as many supporting services and suppliers, from car wax manufacturers to insurance companies. Typically, systems consist of inputs, processes (throughputs) and outputs in addition to feedback mechanisms which can modify inputs and processes. The thermostatically controlled central heating system in our homes is an excellent example of a system which relies on feedback to maintain a state of homeostasis or equilibrium.

- *Powerful.* The power of modern technology is incomprehensible. For the first time in recorded history, humankind has the ability to alter the atmosphere and to destroy civilization. The two atomic bombs of World War II which killed 140,000 people in Japan, were small by comparison to the thermonuclear devices available now. The explosion of a number of such devices could bring on a nuclear winter as a result of the smoke and dust generated. This situation could destroy vegetation the world over and trigger an immediate ice age. On the other hand, global warming caused by fossil fuel combustion may increase deserts and violent storms, or also usher in the next ice age. However, we do not need to look to something so extreme to see the power of modern technology. Consider the space program and shuttle launches, or witness the huge dams and hydroelectric plants constructed around the world; or consider the computer's ability to solve problems in mere fractions of seconds that would take a person days to complete.

- *Apraxia.* This word is borrowed from the biological sciences where, according to Webster (Merriam-Webster, 1990), it refers to "loss or impairment of the ability to execute complex coordinated movements." This concept is visible at two levels. At the personal level we observe that as people have become increasingly dependent on technology, they have lost the ability and the knowledge to do many of the basic physical and thinking processes that most people did in the past. For example, people increasingly cannot do basic mathematical calculations without a calculator. Also consider the parking lot attendant who formally calculated your parking fee now pushes your ticket into a machine and the fee is displayed. The design of our products has substituted meaningless movements for the physical aspects of the procedures.

Toles-Patkin (1988) believes that our overall obsession with technology is already causing some difficulties of concern which he described in this fashion:

> ...the imbecilization of culture can be described as a process by which people come to depend so heavily on technology to conduct their every day lives that they become slowly but systematically stripped of their fundamental intellectual integrity, initiative and human dignity. (1988, p. 519)

Was not Taylorism the embodiment of the imbecilization of the work culture in the factory? Does not this describe the trend in our broader culture? Our conveniences are reducing our human responses to meaningless motions.

Apraxia is seen at the systems level as well. As a technology *matures,* the system and the components within the system become increasingly rigid. This is illustrated well by the personal transportation sector: the four-wheeled automobile powered by a gasoline or diesel internal combustion engine, designed within certain size and other constraints has become the standard; the highway system with lane widths to fit stereotypical cars; service stations supplying the typical fuels, etc. Everything has become standardized, and any radically different solution to private transportation has little chance of succeeding unless mandated by legislation.

- *Alters our perception of time and space.* Present communication technologies shrink the world and give all cultures access to news around the world instantaneously. Wenk (1986) notes that the results are not all positive. He stated, "...cultures that were previously isolated by geography have been brought into contact and into conflict; remember the enigma of Americans held hostage in Iran" (p. 12). On a personal level, the internet allows us to connect with people around the world, but it is not the same as a face-to-face contact.

  Air travel, more than any other mode of transportation, alters the perception of both time and space for the traveler. Despite the astounding accomplishment of leaving Egypt and arriving in New York on the same day, passengers, if they have any thought about the trip at all, are more likely to be annoyed with its length and inconvenience than amazed by the miracle of flight. Without question people in the industrialized countries travel more often and visit more places than was ever possible before in history, but is it possible that they are getting a fragmented knowledge of places at the expense of understanding the whole? Although one has flown numerous times from Chicago to New York City does not mean that one understands how Chicago becomes New York City, an understanding that was more likely to occur on a two-lane highway or a wagon trail.

- *Specialized knowledge; specialized language.* Increasingly, emerging technology is based on quantitative models and requires specialized knowledge which is not understood by most people, in part because of the specialized language that is used. Electrical engineers, auto mechanics, civil engineers, foundry workers, quality assurance managers, nuclear medicine technicians all use words and concepts at their work that are not common to the person on the street.

- *Ecological.* In nature, the addition or deletion of an element in the environment changes the ecosystem for that environment. For example, adding caterpillars to an environment where none had existed changes the conditions of survival in that ecosystem. Applied to technological society, Postman (1992) observed:

  A new technology does not add or subtract something. It changes everything. In the year 1500, fifty years after the printing press was invented, we did not have old Europe plus the printing press. We had a different Europe. After television, the United States was not America plus television; television gave a new coloration to every political campaign, to every home, to every school, to every church, to every industry. (p. 18)

This list of characteristics is not all-inclusive, but it should provide the reader with insight into the nature of modern technology. Yes, modern technology is different from earlier technology primarily in that its defining characteristics are now more pronounced, and it is more powerful. Our technological choices are also changing everything in ways we cannot fully comprehend nor predict.

Technology and Social Change

Technology is neither good nor bad; nor is it neutral.

(Kranzberg, 1995, p. 5)

The social transformations that have taken place during this century have been strongly influenced by new technologies. In 1900, the agricultural sector constituted nearly half of the work force in the United States. Improvements in agricultural technology, a growing population, and a wealthier middle class saw a reduction in the number of people required to feed the country and an increase in factories producing consumer products. Industry was also becoming vastly more efficient as a result of applied technology, only part of which was *hard* technology. Drucker (1994) explained the change this way:

> Beginning in 1881...the systematic study of work, tasks, and tools raised the productivity of manual work in making and moving things by three to four percent compound on average per year—for a fiftyfold increase in output per worker over 110 years. (pp. 61-62)

By mid-century, the blue collar industrial worker had grown to be the largest group in the work force, but automation has caused a steady drop in those numbers. In looking at the closing decades of this century, Drucker observed: "the industrial work force has shrunk faster and further in the United States than in any other developed country—while industrial production has grown faster than in any other developed country except Japan" (p. 62). Meanwhile, the percentage of workers in agricultural production has dropped to between 2 and 3% of the work force. (For a more comprehensive analysis of the evolution of work, refer to Bjorkquist and Evan's chapter; for a discussion of the social transformation in rural America, see Hobbs' chapter.) In this century, the huge changes that occurred in the job market have not caused serious social unrest primarily because other, often better-paying jobs have replaced the ones that were lost.

The New Age: Less Sweat

The social transformations described here began with the industrial revolution, but no century in history has seen so many dramatic social transformations for so many people. Nor are the changes over. Drucker

(1994) describes the technological age we have now entered as the *knowledge age,* an age in which the knowledge worker will be the dominant work group. He explained the emerging society as:

> . . . the first society in which ordinary people—and that means most people—do not earn their daily bread by the sweat of their brow . . . . This is more than a social change. It is a change in the human condition. What it means—what are the values, the commitments, the problems, of the new society—we do not know. But we do know that much will be different. (p. 64)

Social transformations have taken place throughout human history for a variety of reasons. Toffler (1971), in reviewing these changes, suggests that a somewhat lop-sided balance currently exists between natural causes of social change and human-made causes:

> This is not to say that technology is the only source of change in society. Social upheaval can be touched off by a change in the chemical composition of the atmosphere, by alterations in climate, by changes in fertility and many other factors. Yet technology is indisputably a major force behind the accelerative thrust. (pp. 41-42)

This indeed has been an exciting and wonderful time to be alive—at least for most of us, but it should also be a time for concern and reflection. The socio-psychological impacts of nineteenth and twentieth century technological developments were not fully anticipated if anticipated at all, and certainly society did not discuss their ramifications and make calculated preparations for them in advance. It is as if we are accelerating down a road, the destination of which we cannot know. Since no one has taken this journey before, we have *no map, no master plan.*

Let us return to the opening statement in this chapter in which Ayn Rand expressed her confidence in humankind's control of nature. Just how safe is nature when we conquer it? Several decades before the Apollo launch, Charles Kettering and associates determined that to be efficient and safe, a refrigeration gas needed certain properties, but no naturally occurring gas contained these properties. So a gas was created, and it was named after the three elements of its composition—chlorofluorocarbon. This, too, was a human triumph over nature; but little did the team of inventors know that the *perfect refrigerant* would play a major role in depleting the ozone layer. Nor did the developers of tetraethyl lead additives to gasoline to raise its octane rating know that the auto exhaust would carry enough lead that U.S. diplomats in Mexico City would be warned not to have children while living there. Seven of ten children born in that city have lead levels in their blood that exceed the World Health Organization's thresholds (French, 1990, p. 103). Two decades after PCBs were banned, the level of the chemical found in the breast milk of native American women living in Canada's Hudson Bay area is nearly four times the average level of that found within industrialized countries (Misch, 1993, p. 13). The reader is referred to Karian's chapter for a more systematic look at the environmental effects of technology development and use.

Technological Consequences: Unintended, Delayed, Indirect

Although technology can fail in highly visible and dramatic ways, as in the partial meltdown of the Chernobyl nuclear power plant, the collapse of the Tacoma Narrows bridge, and the explosion of the space shuttle Challenger, the examples previously described are particularly troubling because the dangers occurred years after a chemical was removed from circulation, to people who were typically oblivious to its use. Acid rain, global warming, and ozone depletion are other examples where the technology decisions of the more industrialized countries negatively impact many inculpable people around the world.

These examples illustrate the point that *perfect* technological solutions may have negative effects that are *unintended, delayed,* and *indirect* that outweigh the benefits that were originally sought by the technology's developers. With the implementation of a new technology, we tend to anticipate only its positive, intended impacts on society, and tend to underestimate the extent of its application.

But a technology is seldom limited to its *intended* uses. To comprehend the full potential of a technology, we need to imagine it in the hands of a criminal. In other words, we need to understand that the technology will be used in ways not originally planned. We should also, in our assessment of a new technology imagine its use multiplied a million-fold. The real effect of a technology is related to the extent of its application. Even the most friendly of technologies may have profound effects.

Technology and Social Issues

Our society seems to be plagued with issues in which technology is a player. In some cases, technology has rather innocently contributed to the debate by rendering a process easier or safer. For example, it was easier to argue against abortions when they were unsafe. In other cases, our appetite for energy resources (a factor in the Persian Gulf War) and materials (the logging of forests that are the habitat of the spotted owl) has divided us. Contributing factors to these divisions and conflicts may reside 1) in the fact that there is less unanimity or agreement on issues within society than in the past; 2) in the tendency of special interest groups to cloak issues in value-laden, ethical terms; and/or 3) in *cultural lag,* a concept popularized by Ogburn (1933).

Cultural lag implies that technological innovation moves faster than values, habits, thoughts, and social interactions in society, causing alienation, frustration, and conflict. This concept is indeed the central thesis of Toffler's (1971) work, *Future Shock.* Volti (1992) argues that while the concept of cultural lag is appealing on the surface, it has some shortcomings (pp. 234-235). In some cases, cultural lag is obvious as in the reduction in infant mortality throughout the world as a result of improved sanitation and medical technology; yet, the tendency in many traditional cultures to continue to raise large families. The resulting population increases are straining limited resources. On the other hand, given the complexity of society, identifying a cause-and-effect relationship between technology and some social change is extremely difficult. Volti also reminds us that "social, economic, political, and cultural arrangements strongly influence the course of technological change. It is therefore a mistake to think of technology as an independent source of social change" (p. 234).

What Is Being Lost?

Little thought is given to the meaningful social patterns that are being lost as our technological society moves onward: the young may have never experienced these patterns, and the elderly are accused of romanticizing the past. When college students were asked to evaluate the effects of the microwave oven and TV dinners on home life, most saw only benefits in the convenience and speed of meal-making. With these two modern additions to the kitchen, anyone could fix a meal at any time. Apparently few students had experienced or valued the more traditional mealtime ritual as a social time where family members worked together in preparing the food and where they could connect with others, process ideas, and share the events of the day (refer to Jean Hendrick's chapter for an extended discussion on the relationship of technology to social and personal interaction). What other social patterns or rituals have been or are being lost due to our technological choices? Technology has significantly altered almost every aspect of our day-to-day lives. In recent years, due to the increasing emphasis on electronics, it has tended to have a *leveling* effect on our lives.

> Whether I squeeze an orange or chop an onion, whether I put on music or warm-up leftovers, my responses are the same—I push buttons. I no longer feel the flesh of the orange give way, nor do I feel my knife as it parts the onion; all has been blended into a techno-world of uniformity, in which we play a diminishing role. (Wiens, 1993, pp. 35-36)

Wiens (1993) described the loss of ritual in these words:

> ... the uniform application of technology across our lives has homogenized our activities and, with the elevation of *end/convenience* criteria, has largely supplanted ritual. Rituals require human activity (thinking and doing), and they require the passage of time; but the majority of our current products have as their primary criteria the minimalization of human activity and the reduction of the task's time requirement. Where people once were engaged in the sequential and repeated actions which comprise ritual, they now push a button. (p. 37)

The presence of technology affects our behavior in many ways. People with cars rarely walk to the store. One can argue that because of cars, the neighborhood stores have disappeared in most cities since people would rather drive to the mall to shop. When television was moved into the pubs, people stopped singing (Caplan in Wiens, 1993, p. 38). Was this a tradition, a ritual worth preserving? Are any rituals worth preserving? What rituals, if any, have replaced the old ones? Clicking icons on the monitor screen? Have we, in the name of *progress,* tended to *quantify* our lives at the expense of *quality*? Stivers (1994) addresses this point in a very provocative manner:

> Consumption cannot offset the loss of tradition, the loss of function at work....Technology...makes human relationships abstract and impersonal and destroys the efficacy of symbolically-mediated experiences. (p. 171)

The loss of ritual and tradition in our lives is a topic that is difficult to address for several reasons. First, we have difficulty predicting the effect of a new technology on traditional practices. Secondly, even if we could identify the rituals that would be affected, we could not reach consensus regarding the meaningfulness of various rituals. While most people who grew up without indoor plumbing did not find the trek to the outhouse in the middle of winter to be a particularly meaningful ritual, there are other rituals, particularly of a social nature, that were meaningful to many people. Many of these rituals have been lost or are threatened by our use of technologies like electronic games, the microwave oven, and the automobile, that have allowed us to be more individualistic. Simply stated, new technologies are not discussed in terms of their potential socio-psychological effects.

On Whom Should We Rely: the Experts, the Government, or the Public?

Thus far in this introductory chapter, the focus has been on the rapid changes that have taken place in our technological society. Some of these changes have negative side effects. Can these be averted? On one level, a more careful analysis of each new technology needs to be conducted prior to and following its implementation. In the early 1970s, Congress saw the need for such analysis and established the Office of Technology Assessment. While technology assessments have been helpful in identifying direct environmental effects, they rarely consider the many social ramifications of new technologies, nor do they consider those of a more ethical, philosophical, or emotional nature. In discussing the difficulty of technology assessment, Morison (1990) describes the dilemma in this fashion:

> When all the numbers are added, subtracted, correlated, chi-squared, and otherwise processed, there comes the inevitable moment of truth when someone must make some value judgments about the purposes to be fulfilled. What, after all is a benefit? Who gets it? (p. 17)

Currently, we lack effective mechanisms for addressing the many issues discussed here. Academicians and social scientists can debate the issues at conferences, but the decisions are not made in the halls of ivy, but in boardrooms, in the marketplace, and sometimes by policymakers in Washington.

As a society which has tremendous faith in science and technology, we have tended to leave technological decisions too much in the hands of the *experts:* the scientists and the technologists. But we do not always realize that the *technology makes the user,* i.e., if I own only a hammer I see most problems as needing a nail; if I am a surgeon, I tend to see solutions that are surgical; if I am a nuclear physicist, I am not likely to promote the solar option, etc. Experts tend to have a built-in bias. This is not to say that the bias is wrong or harmful, but to simply acknowledge that it exists. Not only has the typical citizen deferred to the *experts* to answer our questions about the value and effects of technology, but so have our political leaders. This complete faith in experts is demonstrated by this remark by President Nixon (in Steinhart, 1978) in 1971, upon awarding the National Medals of Science, in regard to the papers submitted by the honorees:

> I have read them, and I want you to know that I do not understand them, but I want you to know, too, that because I do not understand them, I realize how enormously important their contributions are to this nation. (p. 245)

This blatant veneration of the words of the experts is shocking, but understandable. However, these papers, for the most part, were technical papers that did not address social implications of technology use. Winner (1993) believes the answer lies in re-democratizing the process. He states:

> ...I believe that we need to include ordinary citizens in the oversight of federally supported research-and-development projects. We should involve people from all walks of life in special commissions set up to study potential new types of infrastructure. (p. B3)

Again, we must remind ourselves that the course of technological change is strongly interwoven with the economic, political, social, and cultural elements; but, if we want to be in control of changes within our society, just because something is technically possible, does not necessarily mean it should be done, or that "people should submit to it and make the necessary alterations to their lives" (Volti, 1992, pp. 234-235).

The power that we are now capable of exerting over our environment and over other people, intentionally or not, should make us aware of the importance of the technological decisions and choices we make and the need for a citizenry that understands the dynamics of society-technology interaction.

Technology and Social Institutions

Definitions introduced earlier in this chapter suggested that our understanding of *technology* should include not just its product (e.g., computers, skyscrapers, etc.) and its process, but also the notion that it is a body of knowledge (Mesthene, Skolimowski) and volition (Mitcham). Certainly the meaning of technology has changed over time, and like all words in a living language, its meaning will continue to change as the elements of this field continue to change. If we are to understand the true role of technology in our lives and in our society, however, it may be necessary to expand our conception of the field still further.

Within the study of sociology, an *institution* is loosely defined as a set of values, norms, activities, communications and interactions that have as their underlying purpose, the accomplishment of some macro social requirement or need (Goode, 1977, p. 527). Lenski and Lenski (1974) add that an institution is a "large structure of customary practices" (p. 53). In its sociological usage, *institution* is an abstract concept. While it is true that the *players* within institutions include formal organizations—for example, banks are part of the economic institution just as Southern Baptists are a formal organization within the institution of religion—and affiliations as well as individuals, the institution itself is not formalized. It does not have a presiding director or dedicated bureaucracy through which conscious and stated objectives are pursued. Nor does it have facilities, buildings and equipment that can be identified as its property. While all institutions come into existence and evolve as social needs change, their *establishmen*t and evolution are not typically the product of conscious decision-making and manipulation.

The five institutions most often identified by sociologists are religion, economics, politics, education, and the family (Denisoff & Wahrman, 1983, p. 101; Lenski & Lenski, 1974, p. 53). Each of these, consistent with our definition for institutions, has evolved to address specific macro social needs; and together, these five sets of activities provide the core structure of our society. Not all sociologists, however, are in complete agreement over what should be recognized as an institution and what is really a subset of another institution. *Art,* for example, is often included in the list of institutions as is *the military* (although the military is most often considered to be a subset of the political and economic institutions). Our understanding of the concept of institutions, therefore, should not be *tight* or restrictive, but should rather be capable of incorporating the complexity and evolution that we observe in society.

Since institutions are not closed cells of activity that recognize some boundary governing their area of concern, it stands to reason that there is a great deal of overlap in the activities and interactions of institutions. Consequently, sometimes the distinctions between institutions become blurred. Who can say, for example, how the activity of the Federal Reserve Bank should be classified (political or economic), or to what institution should we attribute the activity of religion-affiliated schools (religion or education). There is, then, a matrix of activity (see Figure 1) in which each institutional pod is connected through its interactions, etc. with the other institutional pods.

With respect to this matrix, two observations can be made. The first is that whereas this matrix shows that each institution is connected to all

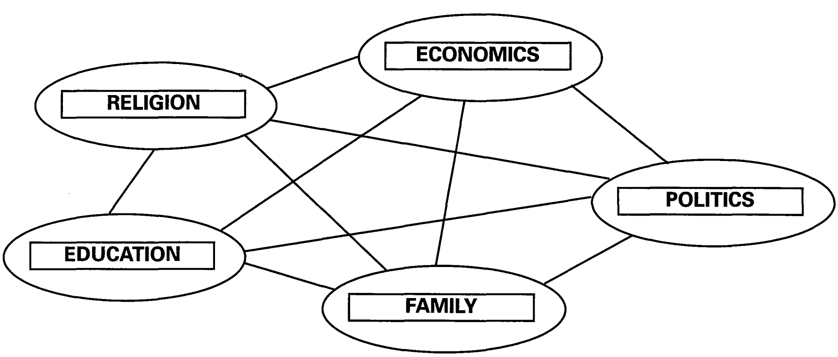


Figure 1. Matrix of traditional social institutions.

others, it does not presuppose interconnections of equal strength, intensity, or intimacy. There is no question that the level of interaction shared by the institutions of politics and economics is much greater today than that shared by the institutions of politics and the family. Therefore, which institutions can be characterized as having *intimate* relationships, and which ones as having *less-intimate* relationships? Can the closeness of institutional relationships be defined or quantified?

A second observation about the matrix is that it does not presuppose any particular dominance/subdominance ordering or hierarchy of institutions or groups of institutions, nor does it presuppose their equality. Our model of institutions is multi-directional and, although we are limited here to crude two-dimensional graphics, the matrix would perhaps best be illustrated in three dimensions as a somewhat spherical composition of overlapping elements and pathways (not unlike the many models of molecular structure found in chemistry labs). Therefore, which institutions and combinations of institutions have been *dominant* (most influential in forcing their *modus operandi* on other social entities) during different historical periods? We know that religion played a dominant role in the Middle Ages, dictating acceptable thought (consider the fate of Galileo) as well as activities. Which ones are dominant today? President Dwight Eisenhower (1961), in his farewell address, warned America against the collaboration between the economic, political, and military institutions. In his warning he coined the term *military industrial complex* to refer to this collaboration (p. 1036). Has this become the dominant institutional force of our day?

It may appear that we have gotten off track. After all, what do social institutions and multi-dimensional matrices have to do with technology? The authors of this chapter are suggesting that technology *is* a social institution; and that an institutional approach to the study of technology is critical to our understanding of its real role in our lives. If we see technology as an institution we will likely gain a greater awareness of its intricate connections with other institutions (e.g., economics and politics), and we are more likely to appreciate Mitcham's concept of *volition,* for a social entity that contains values, and that has as its purpose the accomplishment of some need, certainly suggests volition. We are also more likely, if we recognize the institutional character of technology, to understand that its evolution, including the growth of its influence and perhaps dominance, is not necessarily the conscious and deliberate product of some leadership. Institutions have, to a certain extent, a life of their own; an impetus and momentum that extends far beyond any one organization or group of individuals; a life that is grounded deep within our individual and cultural belief systems.

Finally, an understanding of technology as an evolving institution suggests that it is both proactive and reactive; that it responds to social variables, and at other times is the impetus to change in those variables. This is a controversial topic in the literature surrounding technology (i.e., does it create social policy or just reflect it?), and it is peripherally related to another topic of heated debate, technology and ethics. But in the day-to-day interrelationships of institutions, there are no unidirectional influences. The inner workings of each and every institution impacts all others, and each is in turn impacted by the others. This is, however, not to say that the exchange between institutions is necessarily egalitarian, but just that it is unavoidable and that it is influential.

But does technology fit the definition of institutions? To establish technology as an institution we might first attempt to identify its *underlying purpose,* the social need or requirement that comprises its fundamental logic. For the political institution, the purpose that forms the basis of its existence is the distribution and control of authority and power, while the basis of the economic institution is the distribution of resources. For technology we can argue that its purpose is the extension of human capability or potential through the control and modification of environments (both natural and artificial).

Such a proclamation is likely to draw fire from those who take the position that technology is but a benign if not inert reflection of social values and inclinations. After all, to talk of *purpose* is to imply *intention,* and how can we argue that the simple product of our problem-solving industry *intends* to control anything. On the other hand, the conclusion that technology contains an inherent perspective, a worldview, or a *volition,* and that that perspective involves the control of nature, is not a particularly novel revelation. It is a position that is expressed, in one form or another, repetitively, within the literature of this field. As Spier (1968) writes, technology "embraces the means by which man controls or modifies his natural environment" (p. 131); and, in the words of Bunge (1979), "We take technology to be that field of research and action that aims at the control or transformation of reality whether natural or social" (pp. 263-264). In discussing Heidegger's 1977 work, *The Question Concerning Technology and Other Essays,* Ferré (1988) writes:

> Here is what could be called the technological *a priori,* which is not itself a machine or anything overtly technological but is the "machine way of thinking" that allows nature to be approached as something to be mechanized. This characteristically modern way of thinking and experiencing, Heidegger holds, rather than any overt techniques or artifacts, is the essence of modern technology; and this *a priori* framework of manipulation, control, and "setting-in-order" is what modern technology reveals. (p. 66)

Is it necessary for this technological perspective to be overtly stated and consciously pursued for us to recognize its prevalence? How many of us are consciously aware of the perspective or *purpose* that is fundamental to the institution of religion, or to the institution of art? This is not to say that the *purpose* of technology is detrimental to the environment or to our culture, or that it is beneficial; but simply that it exists, and that its impact warrants our attention.

To explore further the idea that technology is a social institution, we can attempt to identify its norms and values, or its customary practices and interactions. Just as we might argue that the principal values of the institution of the family are security, identity, and intimacy, or that the values of the institution of economics include opportunity, independence, and even parity, we can suggest here that the institution of technology contains values such as survival, efficiency, pragmatism, speed, convenience, power, control, and mastery. These are the values, after all, that we find implicit in the products of technology, from hair dryers to satellites. And these are the values that we find inherent in the operative mindset of technology fields such as engineering.

To delineate the *norms* of technology, it is necessary to look at its *members* (both individuals and organizations) and their method; for norms are *codes* of acceptable behavior, "rules" of conduct. In other words, norms are standardized, recognized, and approved approaches. *Norms,* unlike more stringent social requirements (e.g., laws), are typically understated and informal, and they seldom impose specific or official penalties when breached. So norms are sometimes difficult to identify. In the political institution we might argue that party loyalty is a norm, or within the educational institution we might argue increasingly that the *evolutionist* point-of-view (as opposed to the *creationist* perspective) is normative. When we look at the collection of technology fields, what norms appear to be generally applicable? What are the *rules* of behavior that govern these fields, however implicit?

A full exploration of these questions is not possible within the scope of this chapter, but even a glance at the practice of technology reveals some operative *rules* that might be considered norms. Technology is grounded on the quantitative/numeric method that is traditional for its predominant profession, engineering. One notes also that this method is increasingly computer based. Although this quantitative approach may not be *formally* required, it is so firmly established within the practice of technology that it is instrumental in setting the boundaries of that field, and in dictating its *membership.* Indeed, the utilization of this approach, along with the pursuit of "technological solutions" that use "technological materials" (characterized by the same quantitative criteria) may be the *a priori* essential requirement for inclusion under the technology rubric. While individuals and organizations that work within this normative framework are members in good standing, those that deviate run the risk of ostracism. Stated differently, it is a norm within technology fields to look at things in certain ways just as it is a norm within other institutions to look at things in certain *other* ways.

The following, humorous example illustrates the point. In 1971, spokesmen for the American auto industry testified under oath before Congressional committees that it would take five years of development to produce a front bumper that would be collision-proof at 10 mph. They also argued that its implementation would add an unacceptable cost of $500 to each automobile. In response to the manufacturers' claims, and to make a point about our technological method, industrial designer Victor Papanek (1984) fabricated a bumper out of two wooden bookshelves that were 12 inches wide by seven feet long, with about 80 empty beer cans sandwiched on-end between them. Papanek, who had spent about an hour on research and development of the bumper, then lashed his $14 bumper to the front of his car and drove into the side of the Senate Office Building at 15 mph without inflicting any damage to the car or the Senate office building (pp. 76-77).

The point of this story is not that our safety bumpers should be made of beer cans (although that might not be a bad idea), or that the traditional technological approach to product development is not capable of providing solutions to technical problems. Without question, the proficiency of our technological method has been proven many times on problems far more complex than automobile bumpers. The point of the story (and this was probably Papanek's intention as well) is simply to demonstrate that the technology fields are predisposed to approaching problems in a tightly circumscribed and homogenous way that dictates *acceptable* processes, materials, and solutions. This is essentially why we see engineered plastics and hydraulic cylinders as *technology,* but have other less-lofty terms to describe two pieces of wood and a pile of empty beer cans.

There are, of course, other *norms* in the institution of technology, some of which are related to its strong quantitative emphasis. We could argue that computers, or some type of computing, and the knowledge and use of the language of computers is increasingly a norm in the *practice* of technology, just as a concentration on electronic, computer-based solutions, as opposed to mechanical ones, is increasingly a norm in the *focus* of technology. But in leaving this discussion of the norms of technology to further study, we should point out the close relationship that exists between institutional norms and values and the development of *proprietary* institutional language. Just as members of the religious institution have terms that are unique to its area of concern, or that have special or contextual meaning appropriate to that institution (e.g., redemption, sacrament, salvation, eternity, or revelation), the technology institution has developed an elaborate language replete with acronyms that reflect its norms, values and practices. This language, which includes terms such as CAD, CNC, tolerances, interface, RAM, byte, resonance, SPC, MRI, alloy, polymer, PET, etc., is typically understood only by those that live and work in the technology fields, and further serves to help delineate the boundaries of those fields.

We could go on in our analysis of technology as an institution by considering its key interactions and activities, but these facets of its institutional character are more self-evident, and require little explanation. Let us instead revisit the last definition given for technology in the definition section. The definition reads:

Technology is a body of knowledge and actions used in:

- applying resources
- developing, producing, and using artifacts and systems
- extending the human potential
- controlling and modifying the natural and human-made environments (Wright et al, 1993, p. 2)

This definition is interesting for two reasons not yet discussed. The first is that it is strikingly parallel to our definition for social institutions. The second reason is that its source is the International Technology Education Association (ITEA), a member in good standing of what we have been calling the institution of technology. This *official* definition for technology, like the one given for social institutions, states that this thing we call "technology" is best understood as an abstraction ("a *body* of knowledge and actions") rather than any specific profession or product. The ITEA definition also alludes to a macro social need or purpose as the basis of technology: "controlling and modifying the natural and human-made environments." In addition, the ITEA definition implies a great number of values, norms, activities, and interactions. So even if the notion of a *technology institution* sounds unusual or somewhat hypertrophic, it is a notion that has been expressed within the literature of core technology groups.

Why is the concept of *institution* helpful in the study of technology? Because it redirects our inquiry, and because it offers a conceptual model that is both broader and more intricate than those often used in the study of technology. Definitions and concepts are critical to our understanding of the whole. If we see technology as simply product (e.g., automobile), or even process (e.g., engineering), our perceptions of its role in society are substantially different than if we see it as an evolving institution.

Technology is a dynamic force within society today more than ever before, and like most *social forces,* it is as grounded in our individual and cultural ethos as it is in any technical laboratory or manufacturing assembly line. If we see technology as an institution, the whole structure of its relationships with other social entities is presented in a new light, and all questions of cause and effect must be reconsidered. If we see technology as an institution, we become aware that we are each involved to a greater or lesser degree in the *work* of technology; as we are in that of all institutions. We are involved, not just as users of the products of technology (a rather unidirectional, reactive role), but as creators and purveyors of those ethics and values around which the institution evolves (a multi-directional, proactive role). The second scenario is not only a more agreeable living condition, it is a more accurate representation of what is happening around us.

Concluding Remarks

Stivers (1994), in *The Culture of Cynicism,* writes: "By the twentieth century technology was beginning to supersede money as the *chief sacred* of western civilization...technology as ultimate power is the solution to all problems" (p. 9) (italics added). Stivers' reference to religion is no doubt intentional, for technology exhibits all the characteristics that we would expect to find in a modern-day, cultural deity. In our devout feelings of reverence, we see technology as all-powerful, yet merciful; we see it as the source of our salvation; and we see it as our caring and protective *father*. But technology is also our brainchild. As such it basks in our parental admiration. Perhaps it is for this reason that our faith and love for technology, if not blind, is at least a little nearsighted. How can we expect to be objective in our assessment of a child? Or of a deity?

We have attempted in this chapter to broaden that assessment. For this reason, we may appear to have treated technology too critically, to have been too hasty and cursory in our analysis of its influences on society, or to have given too little attention to its many positive contributions. But, as the lead-off chapter of a volume of contributing authors, each with countering perspectives, the purpose here was to introduce a range of issues and questions that could be pertinent to subsequent chapters. The purpose here was also to *stir up the soup,* for little is gained by a rehashing of conventional wisdoms.

In our effort to raise issues, this chapter has traveled some distance, from introducing simple definitions of terms, to discussing the characteristics of technology, to postulating an institutional conception of technology. There is, within the space limitations of textual compilations such as this book, an inevitable trade-off between breadth and depth. Within this chapter, the authors have opted for breadth. Furthermore, our intention here was not to fortify the walls between traditional fields of study, but to transcend them in an effort to gain the many benefits of cross-fertilization. The convergence of many diverse fields, after all, comprises the spirit of this volume. Such a convergence is required if we are to reach the next level in our understanding and use of technology.

In *Technology and Social Institutions,* Alpert (1974) referred to this "next level" when he wrote: "Our problems today are not related to whether 'technology' is good or bad; the pertinent question is whether our current technology is functional or dysfunctional" (p. 20). Alpert continues to describe our current situation:

> To rebuild our cities, to develop and recycle our human resources, to deal with the pollution of our lakes and streams: these problems are far more complex than sending a man to the moon. The solution does not consist of assembling a product but of building a process, a process that will interrelate the contributions of many existing institutions and of some new ones. (p. 22)

This is the essential challenge for technology in the new age of *less sweat;* not the conquering of isolated, technical frontiers, but to functionally address complex, multi-disciplinary problems through a process of interdisciplinary collaboration. The building of a collaborative process is, inevitably, a social endeavor. It is an endeavor that requires an accurate and honest understanding of the role of technology. The stakes are high. Our ability, or inability, to incorporate technology into a broader social agenda may well determine the future survival and success of our society, and this is certainly relevant for any discussion regarding our quality of life.

REFERENCES

Alpert, D. (1974). Technology and regional institutions. In K. Chen (Ed.), *Technology and social institutions,* (pp. 20-35). New York: IEEE Press.

Bell, D. (1973). Technology, nature and society. In S. Bellow and others, *Technology and the frontiers of knowledge,* (pp. 23-71). Garden City, NY: Doubleday & Company, Inc.

Bunge, M. (1979). Philosophical inputs and outputs of technology. In G. Bugliarello & D. B. Doner (Eds.), *The history and philosophy of technology* (pp. 262-281). Urbana, IL: University of Illinois Press.

Chelliah, D. (1992). Middle-east hunger update. In M. J. Cohen (Ed.), *Hunger 1993: Uprooted people* (pp. 148-153). Washington, DC: Bread for the World Institute on Hunger & Development.

Cohen, M. J. (Ed.). (1992). Appendix, Table 3 Human welfare indicators. In *Hunger 1993: Uprooted people* (pp. 175-176). Washington, DC: Bread for the World Institute on Hunger & Development.

Denisoff, R. S., & Wahrman, R. (1983). *An introduction to sociology* (3rd ed.). New York: Macmillan Publishing Co., Inc.

Drucker, P. F. (1994, Nov.). The age of social transformation. *Atlantic Monthly, 173*(11), 53-80.

Eisenhower, D. D. (1961). Farewell address, speech delivered 1/17/1961. *Public papers of the presidents of the United States*. Washington: U. S. Government Printing Office, 1035-1040.

Ferrans, C. E, & Powers, M. J. (1985). Quality of life index: Development and psychometric properties. *Advances in Nursing Science*, *8*(1), 15-24.

Ferré, F. (1988). *Philosophy of technology*. Englewood Cliffs, NJ: Prentice Hall, Inc.

French, H. F. (1990). Clearing the air. In L. Brown (Ed.), *State of the world—1990* (pp. 98-118). New York: W. W. Norton for World Watch Institute.

Galbraith, J. K. (1967). *The new industrial state*. Boston: Houghton Mifflin.

Goode, W. J. (1977). *Principles of sociology*. New York: McGraw-Hill Book Company.

Heidegger, M. (1977). *The question concerning technology and other essays,* trans. W. Lovitt. New York: Harper & Row.

Hurd, P. D. (1994). Technology and the advancement of knowledge in the sciences. *Bulletin of Science, Technology & Society, 14,* 125-131.

Kaplan, M. A. (1994). Preface. In C. Sheffield, M. Alonso, & M. Kaplan (Eds.), *The world of 2044: Technological development and the future of society* (pp. vii-xv). St. Paul: Professors World Peace Academy.

Kranzberg, M. (1995). Technology and history: Kranzberg's laws. *Bulletin of Science, Technology & Society, 15*(1), 5-13.

Kraut, R. E., Fish, R. S., Root, R. W., & Chalfonte, B. L. (1990). Informal communication in organizations: form, function, and technology. In S. Oskamp and S. Spacapan (Eds.), *People's reaction to technology* (pp. 145-199). Newbury Park, CA: Sage Publications, Inc.

Lenski, G., & Lenski, J. (1974). *Human societies* (2nd ed.). New York: McGraw-Hill Book Company.

Martin, N. (1995, September). Farewell perfect breasts. *Health, 9*(5), 82-87.

McDowell, I., & Newell, C. (1987). *Measuring health: A guide to rating scales and questionnaires*. New York: Oxford University Press, Inc.

McGinn, R. E. (1978). What is technology? In P. T. Durbin (Ed.), *Research in philosophy & technology,* Vol. I., (pp. 179-197). Greenwich, CT: JAI Press Inc.

Merriam-Webster. (1990). *Webster's ninth new collegiate dictionary*. Springfield, MA: Merriam-Webster Inc.

Mesthene, E. G. (1970). *Technological change*. New York: Mentor.

Misch, A. (1993, March-April). Chemical reaction. *World Watch, 6*(2), 10-17.

Mitcham, C. (1980). Philosophy of technology. In *A guide to the culture of science, technology, and medicine* (pp. 282-363). New York: The Free Press.

Morison, R. S. (1990). Visions. In A. H. Teich (Ed.), *Technology and the future* (pp. 15-28). New York: St. Martin's Press.

Mukherjee, R. (1989). *The quality of life valuation in social research.* New Delhi: Sage Publications.

Naisbitt, J., & Aburdene, P. (1990). *Megatrends 2000: Ten new directions for the 1990's.* New York: William Morrow and Company, Inc.

Ogburn, W. F. (1933). *Living with machines.* Chicago: American Library Association.

Papanek, V. (1984). *Design for the real world.* New York: Van Nostrand Reinhold Company, Inc.

Postman, N. (1992). *Technopoly.* New York: Alfred A. Knopf.

Rand, A. (1969, Sept.). Apollo 11. *The Objectivist, 8*, 1-15

Roy, R. (1990). The relationship of technology to science and the teaching of technology. *Journal of Technology Education, 1*(2), 5-15.

Schon, D. A. (1967). *Technology and change.* New York: Delacorte.

Schrage, M. (1995, July). Revolutionary evolutionist. *Wired,* 120-124, 172-173.

Schuessler, K. F., & Fisher, G. A. (1985). Quality of life research and sociology. *Annual Review of Sociology, 11,* 129-149.

Sen, A. (1987). *The standard of living.* Cambridge: Cambridge University Press.

Skolimowski, H. (1966). The structure of thinking in technology. *Technology and Culture, 7,* 371-383.

Slottje, D. J., Scully, G. W., Hirschberg, J. G., & Hayes, K. J. (1991). *Measuring the quality of life across countries - a multidimensional analysis.* Boulder: Westview Press.

Spier, R. F. G. (1968). Technology and material culture. In J. A. Clifton (Ed)., *Introduction to cultural anthropology.* Boston: Houghton Mifflin.

Steinhart, J. S. (1978). Impact of technical advice on the choice for nuclear power. In L. C. Ruedisili & M. W. Firebaugh (Eds.), *Perspectives on energy* (pp. 239-248). London: Oxford University Press.

Stivers, R. (1994). *The culture of cynicism.* Oxford, UK: Blackwell Publishers.

Toffler, A. (1971). *Future shock.* New York: Bantam Books.

Toffler, A. (1974). Futureshock. In N. Cross, D. Elliott, & R. Roy (Eds.), *Man-made futures* (pp. 39-48). London: Hutchinson & Co.

Toffler, A. (1980). *The third wave.* New York: Bantam Books, Inc.

Toles-Patkin, T. (1988). The imbecilization of culture. *Bulletin of Science, Technology & Society, 8,* 519-523.

Truxal, J. (1986). Learning to think like an engineer: Why, what, and how? *Change, 18* (2), 10-19.

Volti, R. (1992). *Society and technological change* (2nd ed.). New York: St. Martin's Press, Inc.

Waetjen, W. B. (1987). The autonomy of technology as a challenge to education. *Bulletin of Science, Technology & Society*, *7*(1 & 2), 28-35.

Wenk, E., Jr. (1986). *Tradeoffs*. Baltimore: John Hopkins University Press.

Wiens, A. E. (1988). Technology education as a part of undergraduate liberal education. In D. C. Householder (Ed.), *Industrial teacher education in transition* (pp. 191-218). Mississippi Valley Industrial Teacher Education Conference.

Wiens, K. S. (1993, May). *Product design, user alienation, and the design of possibilities.* An unpublished thesis for the Master of Industrial Design, Pratt Institute, Brooklyn, NY.

Williams, J. I., & Wood-Dauphinee, S. (1989). Assessing quality of life: measures and utility. In F. Mosteller & J. Falotico-Taylor (Eds.), *Quality of life and technology assessment* (pp. 65-115). Washington, DC: National Academy Press.

Winner, L. (1993, August 4). How technology reweaves the fabric of society. *The Chronicle of Higher Education,* B1-B3.

Wright, R. T., Israel, E. N., & Lauda, D. P. (1993). *A decision maker's guide to technology education.* Reston, VA: International Technology Education Association.

DISCUSSION QUESTIONS

1. What is your explanation of the statement: If you want to understand a new technology, you must imagine it in the hands of a criminal?
2. What do the authors mean with the question: Have we, in the name of *progress,* tended to *quantify* our lives at the expense of *quality*? How is this related to the topic of rituals?
3. A quote in the chapter refers to the unwillingness of most people "to anticipate the impact of technology upon culture, society, and politics." Why do you think this is the case?
4. Other than those discussed in this chapter, name five technologies which have both positive and negative effects. What are those effects?
5. The concept of *cultural lag* states that progressing science and technology cause friction in society because their growth out-paces that of our social values, ethics, behaviors, and thoughts. Can you think of examples where these aspects of society have led technology?
6. Several examples were given of rituals which have been lost because of, or in conjunction with, the introduction of new technologies. Name three more rituals that have been abandoned, replaced, or altered; and discuss whether the changes in these rituals were related to technology. Why is this a difficult topic?
7. How do *you* define quality of life? How has technology changed that *quality* or your conception of that quality?
8. What did Henry David Thoreau mean when he wrote in *Walden* (1854), "We do not ride the railroad; it rides upon us"?
9. How would you explain Mitcham's concept of volition?
10. With respect to the sociological definitions, how do associations or organizations differ from institutions?

11. Where do you think technology fits within our institutional matrix? To which other institutions is technology most closely connected? How dominant is the institution of technology with respect to other institutions?

12. What did Kranzberg (1995) mean when he wrote, "Technology is neither good nor bad; nor is it neutral" (p. 5)?

13. Explain the statements and show how they relate to each other: "Technology makes its own user" and "If my only tool is a hammer, I'll see every problem as a nail."

14. A quote used in this chapter by former President Nixon, suggests a reluctance on the part of our political leaders to become informed in and involved with technological issues and decisions. Should we leave these issues to the *experts*? Why or why not? What should be the role of the public in technological issues?

15. The argument is often made that technology, rather than benefiting all people equally, often widens the gap between lower and upper classes of people *within* industrially developed countries like the United States. Using the example of computer technology, can you explain why technology may have this effect?

CHAPTER 2

Examining Cultural Ideologies

Rodney L. Custer

The story is told of Henry Ford's visit to a slaughterhouse in Chicago during the early days of Model T Ford production. The scene was typical of what would be observed in similar operations around the country at that time. Carcasses were suspended from moving, overhead conveyors. As they snaked through the workers' stations, portions of the carcasses were removed and further processed. As Ford observed the process it is said to have occurred to him, "Why could not the process be reversed to become an automated assembly line instead of an automated disassembly line?" To prototype the notion, a heavy tow rope was tied to an unassembled automobile chassis. Wheels were installed and a single worker supplied the power, towing the skeleton chassis past assembly workers who installed selected components. The moving assembly line was born. Records indicate that in less than a year, the production time for a single Model T Ford was slashed from 12 hours and 28 minutes to 1 hour and 33 minutes (Rae, 1969). The results of this rather simple technological innovation were dramatic and persist, for better or worse, to this day.

Nearly 20 years and a World War later, in 1933, the United States was reeling under a devastating economic depression. General unemployment had escalated to 25.2% (U.S. Dept. of Commerce, 1975) and up to 80% in some industrial cities (Staudenmaier, 1989). In the midst of an era of profound economic collapse and national despair, Chicago hosted the International Exposition under the theme, *A Century of Progress*. In expansive and effusive terms the official guidebook touted:

> the dawn of an unprecedented era of discovery, invention, and development of things to effect the comfort, convenience, and welfare of mankind...an epic theme! You grasp its stupendous stature only when you stop to contemplate the wonders which this century

> has wrought. Should you gasp with amazement as, with the coming of night, millions of lights flash skyward a symphony of illumination, reflect again that it is progress speaking with exultant voice of up-to-the-second advancement. (Chicago Century of Progress International Exposition, 1932, p. 12)

This profound sense of optimism and belief in technology in spite of tremendous economic and political upheaval conveys something of how technology is viewed in the United States and, to a considerable degree, throughout the Western world. The incongruity of the experience illustrates something of how pervasive some of the fundamental ideologies are that permeate our culture. Among these, two of the more persistent are the idea of progress and the influential (and even deterministic) nature of technology. And, perhaps the optimism was warranted. In the 60 years since the Chicago fair, jet travel has become routine, computers have become commonplace, technology and science have taken us to the moon, and polio was cured. We have learned how to share organs with other people and our cows give more and better milk. Through TV, fax, e-mail, telephone, fiber optics, video, and microelectronics, the world continues to shrink in size.

But, it is just as easy to catalogue technology and science run amuck. We have polluted rivers and streams. Many feel overwhelmed with information. A space shuttle disintegrates and space is becoming cluttered with debris. Astro turf is being returned to natural grass due to a spate of athletic injuries. Yet, within the Western psyche, certain notions and beliefs persist about technology and science. In a real sense, technology is one of the defining dimensions of our time. It is woven seamlessly into the very fabric of our culture. At times, its presence is obvious, stark, and even harsh. More often, it simply hums along under the hood, behind the screen, or within our bodies.

Basic Assumptions

When the growth and development of technology are traced, carefully and honestly, through its historical development, we begin to become aware of the diverse mix of popular notions, mythology, and ideology throughout culture. For example, there is the notion of the hero inventor, of linear cause and effect impacts of technology on society and the environment, etc. A deep sense of ambivalence exists in the rich mix of culture, values, technology, and society. There is a sense of awe and amazement with technology. We are amazed by computer-laden automobiles capable of providing individually controlled climate regulation, *on-the-fly* ignition and emissions control, centralized diagnostic capabilities, and more. Shuttle launches continue to draw large crowds even as the missions have become routine. Shrinking microchips propel computers at incomprehensible rates of speed.

Yet, there is also the sense of being overwhelmed by technology. Too much information coming too fast! Global politics is confounded by the politics of fossil fuel distribution. There are prospects of massive and catastrophic climatic changes resulting from CO_2 pollution. Once simple devices can no longer be understood because visible cause-and-effect mechanisms (like springs, levers, and gears) have been replaced by tiny electronic *black boxes*. As phrased by theologian Richard Penniman, many are plagued by a nagging sense that "they got what they wanted, but they lost what they had" (as cited in Winner, 1993, p. 371).

The primary purpose of this book is to explore the interaction and interrelationship between two key concepts; *technology* and *quality of life*. We do not perceive this to be a simple task. The first reason the task is complex is because these concepts themselves have different meanings for different people in different contexts (as you will see as you read through the various chapters of this book). Technology has been defined as everything from artifacts (tools, computers, automobiles, rockets, etc.) to knowledge (from tacit to formulaic) to process (problemsolving, inventing, developing, etc.). What is meant by quality of life is no less complex given the huge range of differences in values and experiences among individuals and cultures. In the initial chapter Wiens and Wiens explored technology and quality of life separately, presenting basic definitions and various perspectives that can appropriately be used to think about both the essence and meaning of technology and the quality of life.

A second reason for the complexity of the task is due to the nature of the interaction between technology and culture. Technology does not simply *impact* culture. A host of other factors such as global economics, political structures, and accidents of nature interact with technology and society and exert their influence on both. The mix is inherently interactive, complex, and dynamic and should be explored in that way. Thus, our task is complex because the nature of the topic is complex. We have deliberately encouraged our authors to resist the tendency to reduce complex issues and interactions to simplistic and unidirectional cause and effect. We have asked each of them to explore the interface of technology with a selected component or aspect of culture. They have been encouraged to do so in ways that are alert to the best scholarship on their topics, and sensitive to the complexity of the issues. We also have encouraged them to be appropriately controversial and personal. To this end we have challenged our authors and we extend to our readers the same challenge.

The third reason why this task is complex is because there are so many misconceptions about how technology and culture interact. Numerous misconceptions, abstractions, and mistaken notions have been woven into, and have come to comprise, the fabric of Western ideology. Throughout this book, we will attempt to lay these out for view and critical examination.

It is also important from the outset to reveal some of our own assumptions and, perhaps, biases. This is the primary purpose of this chapter. First, we must be clear that the order of the concepts in the book's title should not be taken to imply influence, causality, direction, or singularity. In other words, the sequence of *Technology* before *Quality of Life* should not be taken to imply that technology somehow exerts control over individuals, societies, institutions and the meanings and values that evolve out of that mix. Rather, our intent is to provide a more balanced and sensitive treatment of technology and its relationship to culture. At times this will be done by revealing some of the myths and incorrect assumptions that are held by popular culture. More often we will *lay out for view* our synthesis of the dynamic that has evolved in modern scholarship related to how technology and society interface with one another. As will be seen shortly, technology, while a major and even powerful force in society, will be viewed as only one component in a complex and integrated mix of factors that interact with people and cultures to generate meaning.

The discussion will consist largely of an examination of two of the most persistent ideas in modern Western thought—the notion of technological determinism and the idea of progress. We will discuss these in turn. Technological determinism will be presented and discussed within the broader context of the relationship between technology and society. This discussion is intended to counter and extend the discussion of the *impacts* of technology to exploring ways in which the process occurs in reverse;

because society also exerts a powerful influence over technology. To this end we will describe the rich body of work of the Social Constructivists that has grown out of the history and sociology of technology (Bijker, Hughes, Pinch, 1987; Callon, 1987; MacKenzie & Wajcman, 1985; Staudenmaier, 1985; Woolgar, 1991; and numerous others).

The second ideology that will be discussed in some depth is the idea of progress. Since the Enlightenment, the notion that history is moving in a generally positive direction in a linear fashion has persisted. In general, the notion is that, through time, ignorance, disease, poverty, and other barriers to sustained improvement and enjoyment of life have systematically been removed and dismantled. In the West, the idea of progress has historically come to be closely associated with the development and expansion of science and technology. As the discussion will show, the idea of progress is quite complex and multidimensional. Its viability depends on the choice of criteria, frame of reference, and type of activity. For example, it makes intuitive sense to think of progress in the treatment of infectious disease. But it seems absurd to speak of the *progress* of art from Michelangelo to Picasso or of the *progress* of morality from the 18th to the 20th century.

The chapter will close with a brief overview of some additional myths, views, and perspectives that, in our view, coalesce to characterize Western culture. It is important that we lay these out for view and examination because they affect the ways in which we think about technology and its interaction with and participation in culture. For the interaction between technology and the quality of life to be understood in any depth, it is critical that some basic assumptions be examined and challenged; that we move beyond simplistic notions of technology's impacts on society to more sensitive awareness of how technology and many other factors are woven seamlessly throughout this mix that we call Western culture.

The Relationship Between Technology and Society

Back in the 1930s, American sociologist, W. F. Ogburn (1933) popularized the idea of cultural lag. The core of the idea was that changes in technology were followed by cultural and social adaptations. Technology is viewed as an innovative, and often singular, force on culture and cultural values and social change *lags* behind its leadership. To illustrate his theory, Ogburn cited numerous examples of the direct influence of technology on social change. One such example had to do with the impact of technological improvements made to steam locomotives on Black migration to the North. As the logic unfolds, the technological innovation consisted of automating the coal stoking process in steam locomotives. This facilitated the development of more powerful steam engines that were capable of pulling longer trains. Longer trains resulted in longer platforms and extended walking distances for passengers which in turn created a need for additional porters. Since many Southern Blacks were attracted to these occupations, it thus can be demonstrated that this technological innovation (automated coal stoking) *caused* social change (Black migration to the North). In like manner, the institutionalization of slavery has been attributed to Whitney's cotton gin and the invention of the typewriter has been credited with liberating women from the home to the office (Burlingame, 1938).

While the logic is rather tenuous and the connections remote, these stories illustrate an ideology that has persisted since the dawn of the industrial age...technological determinism. Daniels (1970) has observed that:

> despite the lack of evidence, most scholars who have concerned themselves with the relations between technology and society have implicitly adopted the point of view of Ogburn and Burlingame by framing their research questions in such terms as: What was the effect of the automobile, the railroad, the typewriter, or the radio, on society? They have then observed the uses of such single innovations and assumed that the innovation was the direct cause of the uses. (p. 4)

In like manner, Pannabecker (1991) asserts that "the notion of technological impacts is simple to comprehend" and permits a readily understandable interpretation of technology "in the context of society and culture." He continues by observing that the notion of impacts "has also contributed to a simplistic and inflexible view of the relationship between technology and society" (p. 43).

Before exploring the ideology of technological determinism, its problems and its alternatives, it first will be important to establish the context for the discussion. It should be apparent that the concept of technology is meaningless in the abstract. How could nuclear power be meaningfully discussed abstracted from its context of international economics, demands for public safety and environmental protection, and long-term energy policy? What sense would it make to think of kitchen appliances isolated from changing family patterns and advances in food preservation? Technology (no matter how defined) is inherently contextual. It only becomes meaningful when placed within a context of society and culture. Technologies are created in response to certain needs and wants and thus are situated within a context of social systems and values. Needs and wants reflect the value systems of diverse communities, cultures and subcultures. Technology affects the ways people live and the values they hold. In turn, the cultural values spawn new technologies and influence the rate of their development.

Given the contextual nature of technology, it is also important to comment briefly on the nature of that context—that is, society. Layton (1970) has correctly observed that "societies...are seldom wholly at peace with themselves...they contain many conflicting tendencies" (p. 28). In other words, societies (particularly in the West) tend to be structurally and culturally diverse, and consist of individuals and communities with contrasting and conflicting values and beliefs. Societies are comprised of a variety of tastes, political views, economic stations, social status, and political power. Thus, it is practically meaningless to reduce the relationship between technology and society (its context) to simple cause and effect. Neither technology nor society is a discrete *object* or *event* that can readily be reduced to an independent or dependent variable. Instead they represent complex and dynamic combinations of institutions, ideas, values, behavioral patterns, and events. Certain social forces may influence technological development which may, in turn, promote changes to some, but not all, aspects of the social system (Layton, 1970). In short, the relationship between technology and society is seldom as direct, unidirectional (technology on society), or as simple (empirically observed cause and effect) as the *technological impacts* metaphor would imply. Rather, the relationship is more appropriately characterized in terms of human dynamics; such as conflict, success, failure, compromise and mutual interdependence.

We will now turn to an examination of two different perspectives from which the technology-society relationship can be viewed. The discussion will begin with a presentation and examination of technological determinism. While this view has been critiqued and largely discredited by critical scholarship, the theory persists and has deep roots in Western thought (frequently encouraged in the popular press and typically held by those most acquainted with and enthusiastic about technology). In spite of this, some aspects of the theory nevertheless ring true and should be explored for their value in promoting critical thinking about technology. Following the discussion of technological determinism, we will then explore some alternative views that have grown out of an important body of scholarship largely centered around the examination of technology by the social scientists (most notably historians and sociologists). The term *social constructivism* describes this alternative perspective.

Throughout both of these sections, the intent will not be to promote the relative merits of one position over the other. That will be up to you to decide. Rather, we are convinced that the technological determinist/social constructivist continuum is an essential frame of reference and foundation within which many of the ideas contained in the remaining chapters of the book must be examined. As such, our intent is to provide our readers with some alternative perspectives from which to view and critically examine the various ideas that are encountered in subsequent chapters (as well as, hopefully, in their daily lives).

Technological Determinism

Technological determinism, called "the single most influential theory of the relationship between technology and society" (MacKenzie and Wajcman, 1985, p. 4), holds that technology is a primary causal factor affecting social change. In its more extreme forms, the theory purports that technology is *the* single most influential determinant in culture and that the influence is not reciprocal (technology affects society but not vice versa) (MacKay and Gillespie, 1992; Winner, 1977).

This extreme view is incapable of withstanding critical scrutiny on both methodological and moral grounds. Regarding method, a central challenge of social science research has to do with isolating causes. Certainly, the difficulties associated with singling out any single causative factor as the origin of social change are well known. The idea that technology (or anything else) could be *the* primary determinant of social change is impossible to prove. Stated differently, "the idea of technology having straight-forward social 'effects' is altogether too simple" (MacKenzie and Wajcman, 1985, p. 6). Rather, social change (itself a complex and multi-dimensional concept) tends to represent a dynamic interaction of numerous factors over time. Furthermore, many technologies reflect the influence and conditions of the societies in which they exist (Mesthene, 1970). In other words, technology does not just *affect* society. The reverse is also equally true. For example, compare the European and American passenger railroad systems. Throughout Europe, public transportation is heavily accessed, reliably scheduled, and electrically operated, whereas in the United States the use is relatively low and the source of power is diesel. While some of the differences have to do with resources and geography, many of them can appropriately be attributed to a contrast in value systems.

There are problems with the theory on moral grounds as well. Throughout the West, and certainly in the U.S., determinism in any form is suspect in light of cherished values of independence and free choice. People want to feel like they are free to choose their modes of transportation, their entertainment, religion, political views, vocation, and even, in some extreme cases, the gender of their children, the continuation or termination of pregnancy, and their right to choose death when faced with serious illness. The notion that engineers, technicians, designers and others comprising the inner circle of the *technologically elite* exercise a determinative influence on society is greeted with resistance in light of the high premium placed on free choice and individual autonomy.

Yet, there are what have been termed *softer* forms of technological determinism that contain merit and that should be explored. Bimber (1990), in an attempt to explore the extent to which Karl Marx held to, and was responsible for, developing the ideology of technological determinism, has constructed a useful model that identifies three variations of technological determinism (TD): (a) Norm-based TD; (b) Unintended Consequences TD; and (c) Logical Sequence TD. While all three emphasize the significance of technology as an agent of social change, they vary substantially in terms of the degree and nature of the influence. As such, they provide a balanced and useful framework within which to reflect more appropriately on the theory of technological determinism. Each will be briefly discussed in turn.

Norm-Based Technological Determinism

According to the Norm-based variation, many of the decisions that are being made throughout culture are heavily influenced by *technological values*. In an industrialized society, values such as efficiency, logic and productivity have become normative. In this view, those possessing technological expertise are in a position to infuse and impose those values throughout culture. Additionally, since most people generally have positive feelings about the enrichment of their quality of life through technology, there is a strong tendency to tacitly approve of whatever the system of values was that brought TVs, VCRs, computers, automobiles, and more to the consumer shelves.

Among those who have signaled concern are Ellul (1964) who decried the dominance of logic and efficiency over social, political and economic life. In a similar tone, Emberley (1988) suggested a redirection of compass points away from the rigid processes of optimal efficiency and total functionality to the broader concerns for "diversity and depth of human experience, possibility, and meaning" (p. 466). In a somewhat more colorful manner, Marcuse (1964) in his *One-Dimensional Man* signaled much the same concern stating that:

> one of the most vexing aspects of advanced industrial civilization [is] the rational character of its irrationality...people recognize themselves in their commodities; they find their souls in their automobile, hi-fi set, split-level home, kitchen equipment. [Their] prevailing forms of social control are technological. (p. 9)

This *softer* norm-based form of technological determinism could perhaps be more appropriately termed *technological influence* where the goals and values of engineers and technicians hold significant, formative influence within the larger context of our cultural value system. Certainly this rings true to most of our experience. There is some sense in which culture does mirror the reason, efficiency, and productivity that are embodied in the industrialized and technological sectors. The *influence* is there. But then, so too are competing values (often equally strong), many of which appear inefficient, irrational, and nonproductive—such as those embodied in the depths of human relationships, leisure for its own sake, involvement in hopeless (although just) causes, and the freedom to pursue a sense of vision.

Unintended Consequences Technological Determinism

A second variation of technological determinism hinges on the notion of control. The idea is that since certain unintended consequences stem from technology (that is, uncontrolled by those who are supposed to be able to control technology) then technology, rather animistically, must be in control. For example, in the early days of the automobile, when the noise, smoke, and stench of the machine had triggered the anger of the horse-powered public, proponents of the innovation pointed to a vision of the clean city, free of the filth of horse manure. Little did they foresee the cloud of smog that was hovering just over the horizon. Examples of the unintended effects of technological innovation abound from agricultural fertilization, fossil fuel depletion, the use of chlorofluorocarbons (CFCs), electromagnetic frequency emissions, and more that we may wish not to know about.

At the core of this understanding of technological determinism is the notion that technology is somehow, and at least partially, autonomous. Further, something outside of the scope of human control is able to affect the quality of the human experience. While certainly more theoretical than its norm-based cousin, there is nevertheless a ring of truth. It is quite possible that those things that are beyond our control and understanding could, in return, control *us*. The robot, refined to Star Trek or Jurassic Park proportions, could run amuck and develop a mind of its own. On a less philosophical level (and with serious implications for education), we relinquish freedom at our points of ignorance. More specifically, the less that citizens understand about the technology that they own and use, the more likely it is that that technology will own and use them. Consider, for example the homeowner who replaces an expensive appliance because *it just quit working* or an automobile owner who is unable to interpret the explanations of the mechanic or to conceive of how what was so incomprehensible became so expensive to repair.

It is clear that we live in a world that is becoming increasingly more technologically sophisticated. But this does not mean that *we* are more technologically sophisticated. The more complex the technology becomes, the less the average citizen understands. To the extent that this occurs, technology becomes autonomous and deterministic.

Logical Sequence Technological Determinism

The logical sequence approach is the most mechanistic of the three forms of technological determinism. The notion here is that technology itself exercises causal influence on social practice (Cohen, 1978). This is *hard* technological determinism. As the name implies, the logical sequence approach asserts that social structures, institutions, and values evolve and adapt in ways that are responsive and reactive to technology. Technological development drives social and cultural development. Changes in technology lead to corresponding changes in society. In its extreme form, technology is seen to be the *single* most powerful, formative force in modern culture.

This approach has both an internal and an external dimension. Viewed internally, technology begets technology. Certain technological innovations logically and naturally extend to the subsequent development and innovation. For example, advances made in iron and steel production rather directly led to the development of the railroad industry which in turn spawned the need for the development of the telegraph. Thus, the direction and rate of technological development are to some extent functions of (or determined by) previous technological development. A similar logic is present with the external view where technological development impinges directly on the direction and nature of society and culture. From this view, the development of the automobile broke down the isolation of rural America and facilitated urban development. Refinements in farm machinery enabling single individuals to perform operations that formally required groups, when coupled with the development of radio and TV, served to erode strong, interdependent community bonds in favor of more individualistic social patterns. This form of technological determinism also carries a sense of inevitability or fate. Once the key technological ingredients are in place, there is a sense in which an invention *must* occur. For example, in Ogburn's (1933) words, "Given the boat and the steam engine, is not the steamboat inevitable" (p. 90)? Simply stated, cultural and social change follow from, and are determined by, technology.

Section Summary

Technological determinism is a powerful and appealing idea, particularly in a culture that has been profoundly influenced by technology and where people have generally responded in positive ways to the technological artifacts that surround them. In a world where medical technology has defeated polio, controlled infection, replaced joints and much more, the clear tendency is to appreciate technology. People continue to be enamored with space travel, with an array of household gadgets, toys with onboard electronics and all of the amazing things computers can do. We are told that we are living in a technological world. It is easy to believe because we feel its presence all around us.

Thus, for those who like technology as well as those who are baffled and even somewhat fearful of technology, the notion of technological determinism holds a subtle and logical appeal. Yet, it is important that we also learn how to think carefully about technology and its influence on our lives and culture. Should technology really be allowed to be *the* defining dimension of our culture? Is this appropriate and is it what we really want? We must ask ourselves, "Do we surrender something essential to our humanity and our various cultures when we come to be defined in terms of the technology we create?" Is it really appropriate to trace our movement through history in terms of how we make a living—for example, the agricultural age, the industrial age, the information age, and now the service age? What about other characteristics such as democracy and freedom? Shouldn't we instead trace movement in terms of the ways communities have evolved? What are the other alternatives? What about the deeper impulses that drive humanity to reach beyond and deep within ourselves to touch that which we cannot create—that which creates us? What about the other variables that have a profound influence on our lives?

Social Constructivism

The discussion will now turn to an important alternative to technological determinism that has emerged largely in Western Europe over the past decade. This body of scholarship has grown out of the work of sociologists and historians of science and technology and is broadly termed *social constructivism.* Social constructivism challenges the basic assumptions of technological determinism and explores some important alternatives to understanding the relationship between technology and society. Winner (1985) has observed that social constructivism "serves as a needed corrective" and "an antidote to naive technological determinism" (p. 26).

Considerable evidence exists to suggest that technology is a function of the values, successes, compromises, accidents and failures that comprise culture. For example, the vast interstate highway system in the U.S. reflects something of the importance placed on independence and freedom as cultural values. Skyscrapers reflect something of competitiveness. The color and shapes of household appliances are designed to reflect and appeal to gender stereotypes. In plain words, social forces and cultural values have a powerful influence over the technologies that are selected for development as well as the ways in which those technologies evolve. MacKenzie and Wajcman (1985) reverse the question of technological determinism and ask, "What has shaped the technology that is having the 'effects'? What has caused and is causing the technological changes whose 'impact' we are experiencing" (p. 2)?

However, it is critically important to note that social constructivism should not be viewed as the direct and extreme counterpoint to technological determinism. This would be social determinism and would make the determinist mistake in reverse. Such a view only promotes the same kinds of logical and conceptual mistakes that plague technological determinism, shifting the focus to the *impacts* of society on technology. The social constructivist approach rather offers a kind of middle ground, where the emphasis is shifted away from direct cause, effect, and impacts of one thing (or force) on another, to a more comprehensive and sensitive examination of the *seamless web* of technical, social, political, and economic forces that comprise the dynamics of social and technological change.

Basic Assumptions of Social Constructivism

In what ways does social constructivism represent a viable alternative to linear and deterministic models? What are the key ideas? Why are the distinctions important?...to scholars?...to the average citizen? It will be useful to address these questions by outlining and describing some of the basic ideas and assumptions that define the social constructivist point of view. These basic assumptions will be presented in three broad categories.

The Seamless Web. According to conventional wisdom, Edison invented the light bulb, Franklin discovered electricity, Ford invented the Model T, McCormick invented the reaper, Juan Valdez invented coffee, and more. The notion is that great inventions occur when brilliant individuals create new technologies, almost ready-formed and ready for market. MacKenzie and Wajcman (1985), note that "this way of thinking is reinforced by popular histories of technology, in which each device is attached a precise date and a particular man (few indeed are the women in such lists) to whom the inspired invention 'belongs'" (p. 9).

While popular heroes make for great fiction, the social constructivist approach presents a more complex, integrated, and historically appropriate approach. The primary emphasis is shifted away from invention (which tends to focus on heroism) to technological development which occurs over time and is subject to a host of forces. The emphasis is instead placed on *black boxes, thick description,* and *seamless webs* of activity (to employ terminology typical of the social constructivist scholars). The notion is that a number of social institutions (often competing with one another) influence, and are influenced by, technological development. For example, tracing the history of the development and use of computers cannot be reduced to a few historical names, dates and places. Rather, the story of computing is more appropriately understood as a complex and seamless web of interests including economic (banking, marketing, credit, etc.), political (surveillance, military intelligence, etc.), and social (entertainment, interactivity, education, etc.). The boundaries between these institutions and their activities are not only impossible to draw; the attempt to forge clear distinctions borders on meaninglessness. The emphasis instead shifts to better understanding the nature of highly interactive and complex systems. As the systems are better understood, technology, its role, history, and influence are also better understood.

A primary contribution of social constructivist scholarship has been at precisely this point. If technology and its development are to be understood in any meaningful, correct, and appropriate way, reductionism of all types must be avoided. Reductionism manifests itself in various ways including the heroic view of invention, oversimplified notions of technological impacts, and an insensitivity to the complex and interactive nature of social institutions as both context *for* and as a shaping force *on* technology. From this contextual perspective, the boundaries between technology and science and technology and society become less distinct. A similar softening also occurs to the boundaries between the economic, political, and social forces that interact with technology. Technological change is best explained when all of the technical and social components are seen as they are, woven together and interactive rather than as separate forces impinging on each other in only one direction. MacKenzie and Wajcman (1985) remind us that "technology is not outside of society, as technological determinism would have it, but is inextricably part of society" (p. 14).

Systems vs. Linear Models. A second emphasis of the social constructivist point of view is a direct extension of what has already been said regarding the integrated nature of social and technical systems. This point also strikes at the root of the problem with technological determinism. The point to be made is that technology and its development are best understood as dynamic systems rather than as a linear process. Von Bertalanffy's (1968) pioneering work with systems theory in the biological sciences is well known and has been applied extensively to the notion of technological systems. For example, technology has been conceptualized in terms of transportation, communication, production, and construction systems. Nuclear power plants can be seen as an interaction among electrical distribution, chemical and mechanical conversion, cooling, instrumentation and control system technologies. Automobiles are systems comprised, in part, of fuel, electrical, emissions, cooling, and power train subsystems.

In effect, the contribution of the social constructivists in this area has been one of extending the notion of technological systems and subsystems into the social arena. This systems model is thus expanded to include political, economic, religious, military, etc., as well as technical components. The argument is that interactive systems models present more complete and appropriate representations of how social systems actually work as opposed to linear or impact models. Winner agrees (1985), asserting that the systems view allows for the construction of a systems-oriented, empirical model that more accurately reflects the process of technological development rather than the simplistic notions of heroic inventors, and linear development.

Bijker, Hughes, and Pinch (1987) have provided a rather intriguing insight that the nature of contemporary technological development has itself contributed to an enlarged (and more appropriate) view of social systems. In the past, the bulk of technological development was mechanical and linear. The invention and development of engines, clocks, machines, household appliances, and many other devices, focused largely on figuring out how to combine gear trains, cams, wheels, and levers together. By contrast, much of the more recent technological development has been electrical and chemical. Terms like circuits, networks, interactivity, and systems are used to describe these technologies. Whereas mechanical development tended to focus on observable and linear cause and effect, electrical and chemical development tend to focus on interconnectivity, feedback, and relationships. Mechanical development tends to reinforce technological determinist thinking whereas electrical and chemical technologies are inherently systemic. The point to be made is that the systemic nature of modern technological development tends to promote a broader view of technology as a component of a larger and interactive social system.

Thomas Hughes (as cited in Bijker, Hughes, and Pinch, 1987) uses the concept of *reverse salient* to describe how technology works within the larger social system. Hughes' notion follows a military analogy where the growth of a particular technology lags, like a military front line that has been pushed forward but where one part has lagged behind (the enemy still holds out). Like military generals, technologists load their effort into eliminating the point of lag and to bringing the front line (or technological deficiency or problem) into line. A prime example of this is the effort that is currently being loaded into the development of storage and replenishing systems for electric-powered automobiles.

Thus, a systems view of technological development emphasized contingency, choice, and complexity rather than linearity and impacts. Social constructivist thinkers emphasize the spectrum of possibilities out of which technologies develop rather than heroism or the forces of necessity in the history of technology. Technologies grow out of systems of technologies and must be viewed within those contexts.

Nature of Knowledge Development. Another contribution of the social constructivists has to do with their view of the development of knowledge. One of the key challenges that has confronted and intrigued thinkers throughout history has had to do with the identification and classification of knowledge (the epistemological challenge). Classical scholars developed the liberal arts core consisting of the *trivium* (grammar, logic, and rhetoric) and the *quadrivium* (philosophy, arithmetic, geometry, and music) (Simpson, 1980). More specifically related to technology has been the challenge of how to describe and classify practical technological knowledge. Throughout history, distinctions have been drawn between pure and practical knowledge. In *The Republic*, Plato (as cited in Annas, 1981) refused to recognize the practical activities of the artisan as knowledge, reserving the concept for the pursuit of truth and beauty through poetry, literature, music, etc. Since the Renaissance and certainly throughout the modern age, epistemological thinking has, in many forms, grappled with and sanctioned practical knowledge.

One solution, related to the specific nature of technological knowledge, is to deny that there is anything unique about it at all. The suggestion here is that technological knowledge amounts to little more than the application of scientific knowledge (physics, mathematics, biology, etc.) to real world activity. In other words technology is nothing more than applied science. In direct contrast, others have argued that there is some knowledge that is inherently technological (Custer, in press; Frey, 1990; Mitcham & Mackey, 1972; and Vincenti, 1990) (also, see Wiens and Wiens' discussion of this topic in Chapter 1). Vincenti (1990), for example, describes the development of knowledge of flush riveting systems in aircraft assembly. Indeed, much of the history of technological development could be described in terms of practical problemsolving where tinkerers, builders, fixers, and inventors applied their ingenuity to *making something better*. More often than not, this has occurred independent from, and in the absence of, formal scientific knowledge.

From the view of social constructivism, two important shifts in thinking occur with respect to epistemology. First, distinctions among various classifications of knowledge become less important. The emphasis shifts away from attempting to draw careful distinctions between types of classifications of knowledge. Knowledge is instead viewed more holistically and the distinctions (particularly between technological and scientific knowledge) are minimized or even erased. Rustum Roy (1991) once quipped that the term *uni-versity* is almost totally inappropriate given what we do with knowledge in our institutions of formal academic learning. The term university suggests synthesis and integration of knowledge. Instead, in most academic institutions, knowledge tends to be delivered (and thought of) in courses and departments that seldom interact with one another. Again, using the metaphor of the seamless web, Bijker, Hughes, and Pinch (1987) have concluded that economic, political, and social factors comprise a seamless web of activity that has fundamentally softened the boundaries between scientific, technological, and other classifications of knowledge. They note that to have asked most of history's "problem-solving inventors if they were doing science or technology would have brought an uncomprehending stare" (p. 10). So, the social constructivist view has employed evidence from the social sciences to suggest that knowledge is, at least in practice, fundamentally integrative and interconnected rather than classified into distinct categories with clear boundaries.

The second important epistemological shift promulgated by the social constructivists is somewhat more theoretical; that is, that knowledge is socially constructed rather than epistemologically pure. Historically, the argument promoted largely in the sciences has been that the epistemological problem has to do with ignorance. From this perspective, knowledge and understanding are sort of out there in nature, awaiting discovery. Once *discovered*, then ignorance is eliminated. For example, once polio was understood, vaccinations were developed. Infections were discovered to be related to cleanliness. In another arena, it was discovered that the world is round, that lightning is electrical, and that matter is comprised of tiny elements consisting of protons, electrons, and neutrons. Thus, from this perspective, the primary epistemological challenge has to do with ignorance and the challenges of discovering what remains shrouded in the mysteries of nature.

The social constructivist view presents an important alternative. Drawing largely on the insights gained from the history and sociology of science, this perspective asserts that knowledge is something that is a function of the beliefs and value systems of a given culture. In other words, knowledge can itself be understood appropriately as a social construction. Kuhn (1970), in his seminal work *The Structure of Scientific Revolutions* asserted this to be true, noting that the knowledge structures of the scientific community fail to evolve in parallel with the growth in scientific knowledge. For example, doctors who possessed knowledge of the connection of bacteria and infection persisted for a time with the practice of bleeding their patients, even after antibiotics had been developed and had proved to be effective. Wide use of antibiotics was forced to wait until consensus had been established throughout the medical community. Kuhn's key insight is that paradigmatic shifts tend not to occur naturally and commensurate with the progressive unveiling of knowledge and truth. Rather, the shifts tend to be abrupt and discontinuous, happening only after a body of knowledge or evidence has become accepted by a given community of scholars. Thus, the constructivist view is that explanations for the genesis, acceptance, and rejection of knowledge claims should be sought in the domain of the social world as well as in the natural world. As Winner (1993) has observed, "it is important to engage in the study of major components that comprise our culture, e.g., economics, sociology, politics, and religion if we are to understand the development of technological knowledge" (p. 364). In a similar vein, Marx (1968) once wrote that people "make their own history, but they do not make it just as they please; they do not make it under circumstances chosen by themselves, but under circumstances directly encountered, given and transmitted from the past" (p. 97).

Thus, from the social constructivist perspective, technological knowledge should be viewed as something that evolves out of its broader social context (including politics and economics in particular). The direction, shape, and substance of technological knowledge draws from, and cannot be understood abstracted from, the political, economic, and social contexts out of which it grew. MacKenzie and Wajcman (1985) illustrate the point with reference to the influence of the military on technological development.

> The single most important way that the state has shaped technology has been through its sponsoring of military technology. War and its preparation have probably been on a par with economic considerations as factors in the history of technology. Like international economic competition, war and the threat of war act coercively to force technological change, with defeat the anticipated punishment for those who are left behind. (p. 20)

Section Summary

Social constructivism presents an important alternative perspective to technological determinism. Broadly stated, the thrust of this body of scholarship is that technology and its development are most appropriately understood as woven inseparably into the fabric of larger political, social, and economic contexts. Through a careful and sensitive reading of the history of social and technological development, several important perspectives emerge. The hero inventor yields to a view of technology as a long-term developmental process. Technical impacts give way to thick and sensitive descriptions of the complex and interactive nature of the relationship between technical and social forces. Instead of one factor (usually technology) impacting another factor (typically culture in some broader and more inclusive sense) in a unidirectional, singular, and deterministic fashion, technology is understood as an indistinguishable part of a larger complex and interactive social system. Finally, there is the view that social and cultural values exercise a powerful influence on technology; on the technology that is selected for development, on its form, and on the role that it plays in a given culture. Technology assumes various forms for transportation, weaponry, manufacturing, agriculture, computing, and the like. In every case, these technologies reflect the larger context within which they were developed.

Prior to shifting the focus of the chapter to a discussion of the idea of progress, it first will be important to note some limitations of social constructivist scholarship. Clearly the strength of the body of work has had to do with the development of historically accurate and contextually grounded descriptions of technological innovation and development. This represents an important corrective to the technological determinist position. However, as Winner (1993) has noted, social constructivism suffers from some important limitations. First, there tends to be a relative lack of focus on value judgments or social consequences, preferring instead to maintain a focus on *how* technologies evolved out of the complexity of culture. But the discussion tends to stop short of carefully examining the implications of technology for individuals or society. More explicitly, there is a clear reluctance to deal with questions of right and wrong related to such issues as weapons development, energy consumption, and the social consequences of automation. In Winner's (1993) words, "What the introduction of new artifacts means for people's sense of self, for the texture of human communities, for qualities of everyday living, and for the broader distribution of power in society—these are not matters of explicit concern" (p. 368).

A second critique of the social constructivists also has to do with focus. One of the key ideas of social constructivism is to carefully examine the influence of *relevant* social groups on the development of technology. As discussed earlier, this has provided an important corrective to simplistic, linear, and heroic notions of technological development. The inherent weakness of this approach, however, is the relative silence with regard to *irrelevant* social groups. Consider, for example, the displacement of blue collar manufacturing workers by automation. The story can be (and has been) told in terms of the technical prowess of the engineering community (certainly a relevant group). Alternatively, Noble (1985) has argued effectively that the development of numeric control technology (NC) represented the desire of management to maintain control of the manufacturing process (and, in effect, the workers), rather than allowing a shift of control to workers. The choice of NC technology was made in spite of the superiority of the record-playback technology which was vetoed because it placed the decision-making at the machine floor level. The point that needs to be made is that an exclusive focus on how relevant social groups influenced the development of technology tends to conceal from view those forces, groups, and individuals that did *not* contribute. Certainly, a critical examination of the influence of technology on the quality of life also must strive to examine the impact of technological development on the disenfranchised.

In sum, the focus of the social constructivists clearly tends to be on description of what is and how it came to be. Alternatively, technological determinists tend to simplify description in favor of the larger moral and ethical implications of technology in culture. Thus, while it is important to hear what the social constructivists have to say about the contextual nature of technological development, it is also important to listen to views such as Marx's thinking on human liberation, Ellul's concerns about technological idolatry, and Heidegger's warnings about the perils of modernity.

The Idea of Progress

One of the most distinctive components of Western ideology has to do with progress. Deeply embedded in the cultural fabric and historic consciousness of the West is the prevailing sense that progress is being made. A century ago, our grandparents were still traveling, cultivating the land, and fighting their wars from the backs of horses. In their lifetime, they have seen the invention of the automobile, the development of routine air travel, and witnessed trips to the moon. During the 20th century, science and technology have yielded spectacular achievements such as nuclear-powered submarines, automated factories, global computer networks, satellite communications, virtual reality, routine space travel, test-tube babies, and much more. When the historical frame of reference is extended backward from the Enlightenment, to the Renaissance, the Dark Ages, the Classical Golden Age into prehistoric time, the whole notion of progress appears to be very well founded indeed! Furthermore, the rapid expansion of knowledge promises to propel us into, and perhaps even beyond, the world of the Starship Enterprise. Thus, when conceived generally in terms of the expansion and application of knowledge, particularly in those areas closely related to science and technology, the idea of progress is compelling indeed and, in the minds of many, perhaps even irrefutable.

But, there is smog on the horizon. In some important respects, the smooth continuity of history in the direction of progress does not seem to have occurred. Over the last century, the grandparent who went from horse to rocket ship also witnessed (and perhaps even experienced) two devastating world wars, Korean and Vietnam conflicts; the horrific destructive power of the atomic bomb; the Holocaust; environmental and ecological threats (and devastation); Chernobyl and Three Mile Island; and more. The hope spawned by the fall of the Berlin Wall and corresponding dismantling of the Soviet Union was followed quickly by a devastating civil war in the former Yugoslavia and Iraq, and politically-induced famine in Africa. Much in the Western lifestyle threatens to make us sick (stress, electromagnetic radiation, food additives, and more). The AIDS virus and many cancers stubbornly refuse to yield to the best that medical science has to offer.

When viewed from within this larger and more balanced perspective, it is appropriate, and indeed important, for citizens in the West to think critically about and carefully examine the fundamental assumptions of the idea of progress. In what sense is it appropriate (and inappropriate) to use progress as a defining metaphor for our culture? What is the relationship between scientific and technological growth and the quality of the moral and spiritual fabric of our culture? What are the most meaningful criteria for defining quality of life? Are we moving toward or drifting away from those markers? How do we balance life (both personally and collectively) on a spectrum from unbridled hope in future progress to life grounded in realistic expectations, restraint, and a search for deeper values and a moral center for life?

This section of the chapter will trace the development of the ideology of progress through history and then provide an overview of its key dimensions and assumptions. Throughout the discussion, the reader is encouraged to remember that scientific and technological progress should be viewed as existing within a much wider social and cultural context. Whether something is viewed as progress or a step backward depends, to a considerable degree, on one's frame of reference and point of view. This kind of balance tends to be difficult for those of us who rather enjoy technology; who eagerly anticipate the unveiling of next year's model; and who are intrigued by the ingenuity that has gone into solving complex technological problems. For those of us who like technology, the idea of progress is rather natural and its assumptions tend to go unexamined. This section is designed to explore progress from a *wider angle*, to examine some of the dilemmas, problems, and critiques associated with thinking about the relationship between technology and the state of humankind.

Historical Overview

For many in the West, progress is conceptually obvious. We tend to take it for granted. No matter what criteria we choose to mark it by, most people assume that life in our modern world is *better* when compared with life 100, 1,000, or 3,000 years ago (health, longevity, knowledge, technology, etc.). While *progress* may seem obvious to us (with some worrisome exceptions, i.e., the persistence of war, barbarism, prejudice, etc.), its development as a formal concept is actually relatively young. Bury (1960), in a seminal study entitled *The Idea Of Progress: An Inquiry Into Its Origin and Growth*, notes that the idea of progress failed to crystallize until the European Enlightenment of the seventeenth and eighteenth centuries. In the broader scale of time, this is recent history.

It is also somewhat surprising to note that the forces that drove the development of the idea of progress were something other than the development and expansion of science and technology. That direct linkage, resulting in what has been termed a *technocratic* view of progress (Marx, 1987), emerged a century later with the rapid expansion of industrialization (Bury, 1960; Hopper, 1991). Rather, the primary focus of *progress ideology* was a profound sense of optimism, that a rapidly expanding base of knowledge would contribute to an increase in the quality and virtue of the social and human condition. This Enlightenment view of progress was transported directly into the ideology of colonial America in what has come to be termed the Jeffersonian Ideal. In his *New Republic*, Jefferson promoted a vision of knowledge in the service of an enhancement of personal virtue and political liberation. Progress was primarily conceived of as a political ideology. Thus a view of history emerged that assumed a "steady, cumulative, and inevitable expansion of human knowledge over nature...where scientific knowledge and technological power were expected to make possible a comprehensive improvement in all the conditions of life—social, political, moral, and intellectual as well as material" (Marx, 1987, p. 35). Jefferson wrote that:

> science had liberated the ideas of those who read and reflect, and the American example had kindled feelings of right in the people. An insurrection has consequently begun, of science, talents, and courage, against rank and birth, which have fallen into contempt...science is progressive. (as cited in Marx, 1987, pp. 35-36)

It is important to note the somewhat subservient position of science and technology. The primary emphasis resided in the larger social and political goals. In fact, as Staudenmaier (1989) notes, Jefferson actively resisted the early industrialization of the colonies, asserting that that kind of activity would be best conducted in the Old World and then shipped to the New. This primary focus of social and political reform was firmly grounded in the thinking of the 17th and 18th century philosophers (Condorcet, Comte, and others), the European Encyclopedists, and the utopians who viewed education and the expansion of knowledge as the key to social progress (Hopper, 1991).

With the further development of industrial capitalism and the continued surge of scientific knowledge, the overt focus of progress ideology gradually drifted away from goals of political liberation and religious freedom to a concentration on individual wealth and economic power (Marx, 1987). Yet another subtle shift occurred in the late 19th and early 20th centuries, with the development of innovations such as scientific management (Taylor), the interchangeability of parts (Whitney), and mass production (Ford). This technocratic conception of progress promoted power, efficiency, and rationality as ends in themselves, prompting Marx (1987) to observe that the Jeffersonian ideal had been stood on its head. What began as primary values and overt focus (justice, freedom, harmony, beauty, self-fulfillment, etc.) have been relegated to secondary status in favor of technocratic goals. More pointedly, he states that:

> the initial Enlightenment belief in progress perceived science and technology to be in the service of liberation from political oppression. Over time that conception was transformed...to the view that innovations in science-based technologies are in themselves sufficient and reliable basis for progress. (Marx, 1987, p. 71)

Philosophical Foundations—Primary Criteria

At the most basic level, the notion of progress philosophically hinges on the ability to mark movement or advancement from some historical (or present) condition toward some worthy goal. Stated differently, progress denotes movement from inferior to superior; from undesirable to desirable; from ignorance and malaise to wisdom. It is the embodiment of hope in a better future. This way of thinking demands a set of criteria if movement *from* something *toward* something else is to be detected and evaluated. Historically, two broad sets of criteria have provided the context for benchmarking this type of movement. As we will see, these two criteria are often in open conflict with one another. They fail to strike a comfortable balance. This inherent tension serves to reject superficial notions of progress.

Knowledge

The first of these markers is *knowledge*. From the philosophical traditions of Greek and Roman thought, through St. Augustine, into the Enlightenment and the scientific awakening (Galileo, Newton, Boyle and more), accelerating into the knowledge explosions of the 19th and 20th centuries, the thread is absolutely clear. The totality of what is known to humankind has expanded, almost beyond imagination, particularly in the areas of objective knowledge represented by science and technology. Thus, when knowledge (of the positivist type) is used as the criteria for historical progress, the verdict tends to be essentially positive.

Moral and Spiritual Condition

The second fundamental marker against which progress can be measured has to do, broadly speaking, with the *moral and spiritual condition* of humankind. More specifically, this criterion examines progress against aspects of the human condition such as freedom, depth and meaning of life, hope and hopelessness, moral resolve, human community, and spiritual understanding and centeredness. Simply stated, this criterion focuses on the progress of human nature. Against this criterion, the assessment is much more difficult and clearly is open to debate.

Much of the source of the tension between these two broad sets of criteria is embodied in the philosophical traditions of Western thought. Throughout the Golden Age, the Greeks and Romans placed high value on the development of knowledge. The hope of the future lay in overcoming disease, ignorance, and wretchedness with knowledge. This high valuation of knowledge by the Greeks was tempered by the ambivalence embodied in the traditions of the Judeo-Christian faith. From this perspective, knowledge was viewed as the root of sin and the source of the degradation of the human condition. The Garden became a metaphor for a loss of innocence and the decline of the human condition. At the same time, the doctrines of salvation and redemption speak to the fundamental sense of hope for the ultimate perfection of humankind.

The fundamental tension between the knowledge and moral criteria also is grounded in the perceptions and introspectiveness about life in the modern world. The knowledge that led to nuclear power, the exploitation of natural resources, the development of devastating instruments of war, and the pollution of the natural environment has, in some important respects, served to degrade the human condition. Technological and scientific knowledge have yielded gadgets, tools, and devices that have made life in the West easier, safer, and more luxurious. At the same time, many have decried the prevailing sense of boredom, a loss of meaningful community, an unfocused rush to stimulate the senses, and a loss of a moral and spiritual center. Nevertheless, as Nisbet (1980) has aptly observed,

> the history of all that is greatest in the West—religion, science, reason, freedom, equality, justice, philosophy, the arts, and so on—is

> grounded deeply in the belief that what one does in one's own time is at once tribute to the greatness and indispensability of the past, and confidence in an ever more golden future...this idea has done more good over a twenty-five hundred-year period, led to more creativeness in more spheres, and given more strength to human hope and to individual desire for improvement than any other single idea in Western history. (p. 8)

Progress—Essential Premises

Nisbet (1980) has identified a set of five basic premises that are essential to the maintenance of the idea of progress. In fact, he asserts that "either belief in these premises is restored...or else faith in the once powerful idea of human progress must die altogether" (p. 318). Briefly summarized, these primary premises are: (a) high valuation of history, (b) belief in the nobility of Western civilization, (c) support for economic and technological growth, (d) faith in reason and knowledge, and (e) belief in the intrinsic worth of life on this earth. These five premises provide a useful frame of reference and conceptual framework for thinking about progress and will be used to structure the discussion that follows.

Valuation of History

The historical premise makes sense on purely logical grounds. At the simplest level, progress cannot be measured in the absence of the passage of time. Progress simply makes no sense without a point of departure or comparison. Something cannot be said merely to be *better* or *improved.* It must be better than something else. On a deeper level, it is critically important that peoples and cultures be equipped to examine themselves, their values, ideas, aspirations, and accomplishments from within and against a rich context of history. This is important, of course, because of the valuable lessons that history brings to contemporary situations.

More important, a rich understanding of history is needed because it broadens the perspective from which we are able to view life and experience. History, in this sense is *story.* Consider, for example the tremendous power that Alex Haley's storytelling in *Roots* had in rekindling a sense of ethnic identity and broadening the perspective of the African-American community. In like manner, a friend shares his lingering stories of life in

Vietnam. A grandfather explains why, years ago, he declined an invitation to become a minister, or a politician, or a farmer. As we tell and listen to these stories, we learn something about ourselves. The stories are an important part of our larger context of meaning. Nisbet (1980) has aptly observed that "without the past as represented by ritual, tradition, and memory, there can be no roots; and without roots, human beings are condemned to a form of isolation in time that easily becomes self-destructive" (p. 323).

Throughout the remainder of this book, most of the issues and ideas that will be explored demand a historical perspective. Daugherty and Wicklein's reflections on technology and the military (Chapter 4) should extend back from the Persian Gulf War and be placed within contexts such as the 50th anniversary celebrations of the end of WWII. These events signal more than a tribute to bravery and a chance to further heal the memories of war. They serve as important markers against which to measure the use of military power and to contemplate the important lessons of history. Hobbs' reflections on technology and rural America (Chapter 5) serve to provide a sense of important transformations that have occurred with the shift from an agrarian to an urban culture. The reader will need to decide whether progress has, in fact, been made. We hope you will also be prompted to think critically about the criteria that you choose to assess progress (or perhaps, decline) against. Of course, we hope that you will be prompted to think carefully about the infusion of technology within various aspects of culture that we have selected to examine and that you will do so within a historical context.

Finally, thinking about progress from within a historical perspective should reach far beyond history as names, places, dates, and events. It is critical that our scientific, political, technological, and economic interests and achievements be embedded within a rich historical context that maintains the full complexity and multiple interpretations and meanings that tend to get attached to history.

Belief in Western Civilization

What does it mean to *believe in* Western Civilization? For that matter, what do we mean when we say that we believe in America, the presidency, the church, the press, technology, or the Chicago Cubs for that matter? Each of these embody and institutionalize a set of values, ideas and qualities that we believe to be fundamentally important. Historically, Western Civilization has been comprised of many of these institutions—city-state, republic, empire, church, family, monarchy, democracy, and more. Nisbet (1980) notes that historically there has been a high degree of correlation between the "efflorescence, growth, and diffusion of the idea of progress" and periods of "popular trust in reigning institutions." In like manner "the idea of progress languished or lay dormant during those periods of substantial popular indifference to or distrust of such institutions" (p. 334). Witness for example, the chaos and deep-seated mistrust of the sixties with Vietnam, the political assassinations, drug overdoses, and Watergate. On a more personalized level, the values of Western Civilization are embodied in our views of leadership, the relative prestige that is attached to doctor, lawyer, minister, farmer, secretary, teacher, etc. To *believe in* Western Civilization demands a definition and clarification of the values attached to institutions, leaders, and guiding principles during each phase of history.

Thus, it is important to embed the study of engineering and technology within a context where aesthetics are valued. Concerns for efficiency and function should never be allowed to be the sole criteria for *good design*. Technology should be studied. Citizens should know something *about* it, and they should be able to *do* something with it. Technology is such an important part of our culture that any credible orientation to culture must include its study. But the study of and thinking about technology must be embedded firmly within discussions of freedom and democracy because the reality of highly specialized technical expertise in the hands of the few affects us all. As Hoover and Sanders note in their discussion of technology and the media (Chapter 3), it is important to think about information technologies within a context of values such as free speech, privacy, and economic exchange. In like manner, Wright, in his discussion of technology and consumerism (Chapter 14), notes that there is great risk of an inversion of values where consumption and technology become ends in themselves.

The Smithsonian Institution's Air and Space Museum in Washington, D.C. is one of the most frequently visited museums in the world. In some important respects, the artifacts housed there have come to symbolize technology and progress. It is in the space museum that one encounters the enthusiasm, the excitement of the young. But what of the monuments to Washington, Jefferson, and Lincoln? What about the Vietnam Memorial and the Kennedy Center? We must ask whether:

> the adventure of space, the capitalistic commitment to technological innovation and profit, the simple fascination with the new, which have superseded, if they have not subtly subverted the goals of a humane, social harmony. It is technology that has come to provide the meaning of the term *progress*. (Hopper, 1991, pp. 32-33)

In like manner, Mishan (1981) has argued that the criteria for the good life should extend beyond food, health, security, and shelter to include family, religion, tradition, custom, friendship, love, and mutual aid.

As technology becomes more pervasive, it is important for all citizens to learn how to think deeply and critically about cherished institutions, values, and beliefs. When these values are clear, a context develops within which choices can be made about the technologies that are chosen for development, purchase, and use. In the absence of larger political, cultural, and social goals, there is a great risk of making decisions about technology in the absence of rational and humane criteria. As Marx (1987) has asked, "Do improved technologies mean progress? Yes, it could mean that. But only if we are willing and able to answer the question: progress toward what" (p. 71)?

Support for Economic and Technological Growth

Nisbet's (1980) third premise focuses on the essential connection between the *idea of progress* and economic and technological growth. Certainly, if any one trend has characterized (and even dominated) life in the 19th and 20th centuries, it has been the corresponding expansion of technology and the economy. Examples abound including the steady, westward march of the Iron Horse, major innovations in the manufacturing of goods (robotics, numeric control, mass production, flexible systems, etc.), the major strides in the development of electronic communications systems (digital computers, fiber optics, satellite transmission, and telecommunications), and much more. From a Western perspective, the close alliance between technology, economic growth, and quality of life has been consistent, progressive, and obvious.

As discussed previously, the use of technological and economic factors as criteria for progress can be challenged from a broader perspective of what quality of life means (spiritual and moral condition). This point is not at issue here. The issues that must be explored have to do with the distribution of resources across the global community, the complex problems associated with the balance of trade, and the economic and political power associated with possessing certain technologies (for example, nuclear). Witness, for example, the complexities associated with negotiating the GATT and NAFTA treaties and the narrow miss of a trade war with the Japanese over auto parts.

We are on the verge of living in an age of scarcity. Karian, in the chapter on *Technology and the Environment* (Chapter 11), focuses on the limits of natural resources and the damage that has occurred to the environment as the result of our use of technology. It is important to learn how to live with less because natural resources are limited. In the West, we will increasingly need to adapt to the reality that we cannot sustain our domination of the use of these resources and at the same time support and foster the notion of an expanding global community. There are simply not enough resources to go around. Brooks (1982) characterizes the situation as one where:

> material gains have been unevenly distributed and economic growth has produced luxuries for a minority while generating barely perceptible improvements for as much as a third of the human population. At the same time, progress in agriculture and public health has helped to produce a population explosion. (p. 281)

Taken a step further Rosenburg (1982) has posed the more perplexing question of whether the Western economies have the "collective wisdom to modify our institutions in ways which will incorporate these relatively neglected concerns without at the same time destroying that complex balance of incentives upon which efficiency and growth depend." He goes on to quip rather darkly that "The evidence so far is not totally reassuring" (p. 318). Thus, viewing the idea of progress from the wider angle of global political and economic realities will continue to pose serious challenges to life in the 21st century. It will become increasingly important to balance our competitive spirit with a tempering of our America *as #1* rhetoric. It likely will be a time of learning how to maximize resources in an age of relative scarcity. At the same time, it is likely that information and other *softer* forms of human capital (management, services, etc.) will continue to serve as important components of the economy. When compared with the giant strides made in the transportation, communications, and production sectors (which have tended to be physical, objective, and tangible), these *softer* indicators of economic progress may be less obvious and more difficult for the public to assess and appreciate.

Faith in Reason and Knowledge

The fourth grounding premise of progress is reason and knowledge. As noted earlier, the expansion of knowledge is one of the two major criteria against which progress has been marked since the idea emerged during the Enlightenment. From our late 20th century perspective, it is difficult to appreciate just how profound this change in belief structure was. The world was flat no longer. The root causes of sickness and disease began to crawl out from a cloak of superstition and ignorance. There was a growing sense that the mysterious work of the gods was being shifted to humankind through the powers of knowledge. Daniel Bell (1982) noted that:

> at the end of the eighteenth and to the middle of the nineteenth century, almost every enlightened thinker expected religion to disappear in the twentieth century. The belief was based on the power of Reason. Religion was associated with superstition, fetishism, unprovable beliefs, a form of fear which was used as protection against other fears and which they believed, in fact, had arisen in the "childhood" of the human race. (p. 501)

We will address this secularization of the idea of progress more directly in the next section. But suffice it to say that the Enlightenment triggered a sense of optimism in the power of reason to advance the state of the human condition.

In the modern world, progress remains closely linked to the type of knowledge that can be delivered through the powers of reason. Certainly much of this is typified by the close alliance of mathematics, science, and technology. An incredible array of knowledge of computers, physics, electronics, propulsion systems, materials science and much more has delivered men to the moon and back. Even in failure (as with the ill-fated Apollo 13 mission) reason and logic prevailed. The current emphasis on, and high valuation of, problem solving as a key academic and life survival skill is grounded in the premise that the world is subject to the forces of structure and reason.

However, the lessons of history provide a necessary corrective and sobering perspective. In short, the advance of reason has failed to make us collectively more reasonable. Intelligence does not necessarily yield maturity. Difficult decisions cannot always be made by rational criteria....indeed, perhaps they should not be. Bell (1982) has illustrated the point with an old Medrashic parable where it is asked who discovered water? The reply is that "We do not know. But one thing we do know: the fish did not!" Bell pursues the point that:

> we may be in the position of the fish, for the world of religion is the world of the nonrational, and we can only go so far in our understanding, for the realization of the nonrational is the recognition that the existential predicaments we confront derive from a mystery, one that we may never be able to penetrate. (p. 522)

It is true. Much of the progress of the human race will depend on the continued expansion of knowledge. Hopefully medical science will soon eliminate the human tragedies associated with diabetes, AIDS, and cancer. New sources of fuel must be developed and refined if the lights are going to continue to burn. There is much to be learned about cognition, memory and the inner-workings of the human mind. Each of these and more has tremendous potential for enhancing the quality of human life. Still, there are limits to knowledge. There are dimensions to the human condition that will always defy reason...the existential dilemmas like the meaning of death, the source and meaning of courage, the nature of obligation, the character of beauty and more. It remains to be seen whether and how technology will make progress in probing at these existential boundaries of human existence.

Belief in the Intrinsic Worth of Life on this Earth

The core of this final premise for progress has to do with the essence of hope. Hope takes shape in many different ways for different people because all of us find meaning and inspiration in different ways. For some, it's the richness of family life. For others, life is worth living because of their work, position, or possessions whereas the lives of others take on color through challenge, competition, difficulty, and sacrifice.

Some value community membership or perhaps ground their hope in religious faith.

This premise is fundamental. In the face of despair, progress stops. The concept of progress simply makes no sense in the absence of meaningful goals, worthwhile causes, and a sense of the fundamental worthwhileness of existence (unless, of course, progress consists solely of moving from despair to hope). Certainly progress, from this perspective, is more existential, philosophical and perhaps even theological than it is technological. However, in some important respects, it is precisely because of technology's promise to enhance the quality of life that it must be discussed in this context. It is a very short and precarious step from technology as life *quality-enhancer* to a belief in technology's ability to deliver meaning to life. More dangerous still is the notion that technology and the ingenuity of the human mind are of ultimate importance and value. This is idolatry!

Within this context, technology is thrust into a unique position. At once, it has improved the human condition; providing for leisure, entertainment, convenience, and safety. These are quite meaningful and serve to bring value to life. In many respects, technology has come to symbolize the unleashing of human power and potential. However, as Boorstin (1987) notes, we are left with the challenge of "how to do a thousand still un-imagined works of machine magic without becoming the servant of the Machine or allowing the sense of novelty to pall or the quest for the new to lose its charm" (pp. 59-60). In other words, there are serious limits to the ability of technology to deliver on the ultimate promises of life. Hopper (1991) worries that with our technological view of progress we run the risk of settling for a lesser statement of what it is to be human. In a similar vein, Tillich states that:

> there is great risk that our technology and the goods it creates will cease to be a matter of "to be or not to be" for the person. They become matters of entertainment, sensation, sentimentality, learning, weapons of competition, or social prestige, and lose in this way the power of mediating a spiritual center to the person. (cited in Hopper, 1991, p. 106)

In a culture where technology is becoming increasingly important, where it promises to further enhance the quality of life, it is critically important that we not lose sight of its limits. We can expand our technical powers. We will continue to extend our scientific knowledge. But the existential questions will persist. Technology cannot deliver ultimate meaning. It cannot provide answers to the core questions of existence. Ultimately it cannot address the need for meaningful ritual, lofty goals, dignity, and a sense of community. As Bell (1982) has observed

> When there are few rituals to mark the turns in the wheel of life, if all events become the same with no ceremony to mark the distinctions—when one marries in ordinary dress, or receives a degree without a robe, or buries one's dead without the tearing of cloth—then life becomes gray on gray, and none of the splashiness of phosphorescent pop art can hide that grayness when the morning breaks. (p. 522)

In short, technology has tremendous potential for enhancing the quality of life until it is allowed to become an end in itself. As an ideology, the idea of progress has always reached for roots that are deeper than what humans have been able to create for themselves. In fact, as Meyer (1982) has observed, as an ideology, progress has always rested on "assumptions, convictions, and beliefs that are fundamentally religious" (p. 67). In a culture filled with rich promise of exploring and boundaries of human knowledge and potential, we must continue to preserve a sacred place for mystery, sentiment, love, intuition, and yes, even irrationality! We must remember that technology can enhance...but it can also numb our senses and bore our minds to more fundamental sources of richness and meaning. Thus, while the idea of progress affirms the worthwhileness of life, it is important to be careful not to place excessive hope in technology to deliver on that promise.

Section Summary

Nisbet's (1980) premises provide a useful conceptual framework for exploring the idea of progress from a variety of different angles. When thinking about technology within the context of Western ideology, it is important to remember that technological progress does not necessarily equate with progress in its broader sense. Just because something is feasible and more efficient does not necessarily mean that it is better. It is essential that technological issues be explored within a broader context of the deeper meanings of social and human progress.

Additional Myths, Ideologies, Beliefs

It must be stated clearly that the essence of Western ideology extends far beyond the elements that have been described thus far in this chapter. There are many more that color the ways in which we tend to perceive technology. As with those discussed in this chapter, most of these perspectives and ideas tend to operate behind the scenes. They tend to inform our views through the subconscious. Yet, they are very powerful. Before moving on to the presentation of the various topics that have been developed in this book, we will suggest a few additional ideological threads that bear examination. When woven into the larger cultural tapestry of thought, they also impact how we think about technology.

One of the most active and important areas of research over the past decade has been in the area of women and technology. Gender stereotypes continue to dominate our views of what technology is as well as informing (or perhaps more accurately, misinforming) our children about who should be engaged in what kinds of occupations. Much has been written about automobiles, factories, military might, steel, and sweat. These tend to be distinctively male in orientation and flow from an ideology that emphasizes power, control, technical virtuosity, and conquest of nature. The time has come to reflect with equal clarity on the technologies of the household, child care, bio-related technologies, and much more. In these arenas, a different set of ideologies is at work including sustenance, nurturing, harmony, and the management of natural processes. Notable examples include pieces by Ruth Schwartz Cowan entitled *The Industrial Revolution in the Home* (1985) and *More Work for Mother* (1983). Another outstanding example is Arnold Pacey's (1984) chapter entitled *Women and Wider Values* in his *Culture of Technology.*

Another important aspect of Western ideology has to do with our spirit of competitiveness and maintaining our place as a super-power within the international community. To a considerable extent, technology has played a key role in defining and maintaining those structures. One of the serious challenges of the 21st century will be to learn how to divert and redirect technology and energy to a redefinition of what it means to collaborate with others on a global scale. Through instruments of war and forces of production, technology has served to preserve power structures that may not be viable in the future.

In a related vein, we must learn to rethink our assumptions about resources. With the exception of now-rare gas lines, ominous warnings of the need to conserve fossil fuels, the gradual reduction of forests, and more, we have tended to retain an ideology of abundance. More is better. The parking lots of *all you can eat* buffets remain full. There remains a prevailing sense of optimism that by the time our current sources of fuel run out, technology will have engineered a way to power us almost for free with the sun or water from the sea. It is quite likely that we and our children will find ourselves confronting this aspect of our ideology in some painful ways in the years to come.

These are but a few of the additional threads that serve to comprise our Western ideology, particularly as it relates to how we think about technology. Mackay & Gillespie (1992) have argued that any meaningful explanation of technology "requires a coherent model of the society within which the technology is imbedded" and further, "without ideology, you do not have such a model" (p. 691). Finally, as Forty (1986) has observed, technological designs tend to embody our ideas and values by casting "ideas about who we are and how we should behave into permanent and tangible forms" (p. 64). Thus the creation of technology can, at its best and if we are sensitive and aware, help us reflect on the larger set of values we hold.

Concluding Comments

The purpose of this chapter has been to establish a context within which to think about the various aspects of life which are presented in the chapters that follow. If we have been successful, you should be better equipped to think about those issues from a broader perspective. This is extremely important. All of us bring sets of assumptions, beliefs and perspectives to everything we do and see. In most cases, these lie in the background and filter and color the way we see things. Only rarely are our senses jarred awake to view the *machinery* that is powering our views. Our sincere hope is that this book will promote that reflective process and have that effect. Only as we parade our basic assumptions and ideologies out for examination will we begin to see things more completely and clearly. More important, our clarity of vision will help us as we make critical decisions about technology that will affect us all, indeed the future of the world.

REFERENCES

Annas, J. (1981). *An introduction to Plato's Republic.* Oxford: Oxford University.

Bell, D. (1982). The return of the sacred: The argument about the future of religion. In G. A. Almond, M. Chodorow, & R. H. Pearce (Eds.), *Progress and its discontents* (pp. 501-523). Berkeley and Los Angeles, California: University of California Press.

Bijker, W. E., Hughes, T. P., & Pinch, T. J. (1987). *The social construction of technological systems: New directions in the sociology and history of technology.* Cambridge, Massachusetts: The MIT Press.

Bimber, B. (1990). Karl Marx and the three faces of technological determinism. *Social Studies of Science, 20,* 333-351.

Boorstin, D. J. (1987). *The republic of technology: Reflections of our future community.* New York, NY: Harper & Row.

Brooks, H. (1982). Can technology assure unending material progress? In G. A. Almond, M. Chodorow, & R. H. Pearce (Eds.), *Progress and its discontents* (pp. 281-300). Berkeley and Los Angeles, California: University of California Press.

Burlingame, R. (1938). *March of the iron men: A social history of Union through invention.* New York, NY: Grosset & Dunlap.

Bury, J. B. (1960). *The idea of progress: An inquiry into its origin and growth.* New York: Dover Publications.

Callon, M. (1987). Society in the making: the study of technology as a tool for sociological analysis. In W. E. Bijker, T. P. Hughes, & T. J. Pinch (Eds.), *The social construction of technological systems* (pp. 83-106). Cambridge, Massachusetts: The MIT Press.

Chicago Century of Progress International Exposition (1932). *Official book of the fair.* Chicago: A Century of Progress, Inc.

Cohen, G. A. (1978). *Karl Marx's theory of history: A defence.* Princeton, NJ: Princeton University Press.

Cowan, R. S. (1983). *More work for mother.* New York: Friendship Press.

Cowan, R. S. (1985). The industrial revolution in the home. In D. A. MacKenzie, & J. Wajcman (Eds.), *The social shaping of technology* (pp. 181-201). Philadelphia, PA: Open University Press.

Custer, R. L. (in press). Examining the dimensions of technology. *International Journal of Technology and Design Education.*

Daniels, G. H. (1970). The big questions in the history of American technology. *Technology & Culture*, *11*(1), 1-35.

Ellul, J. (1964). *The technological society.* New York: Vintage Press.

Emberley, P. C. (1988). Values and technology: George Grant and our present possibilities. *Canadian Journal of Political Science*, *21*(3), 465-494.

Forty, A. (1986). *Objects of desire: Design and society 1750-1980.* London: Thames & Hudson.

Frey, R. E. (1990). Thinking about technology education. *Journal of Industrial Teacher Education*, *27*(4), 67-71.

Hopper, D. H. (1991). *Technology, theology, and the idea of progress.* Louisville, KY: John Knox Press.

Kuhn, T. S. (1970). *The structure of scientific revolutions.* Chicago, IL: The University of Chicago Press.

Lasch, C. (1980). *The culture of narcissism: American life in an age of diminishing expectations.* New York: Warner Books.

Layton, E. T. (1970). Comment: The interaction of technology and society. *Technology & Culture*, *11*(1), 27-31.

Mackay, H., & Gillespie, G. (1992). Extending the social shaping of technology approach: Ideology and appropriation. *Social Studies of Science*, *22*, 685-716.

MacKenzie, D. A., & Wajcman, Judy. (1985). *The social shaping of technology.* Philadelphia, PA: Open University Press.

Marcuse, H. (1964). *One-dimensional man.* Boston: Beacon Press.

Marx, K. (1968). The eighteenth Brumaire of Louis Bonaparte. In K. Marx and Engels, F. *Selected Works in One Volume*. London: Lawrence & Wishart.

Marx, L. (1987). Does improved technology mean progress? *Technology Review, 90*, 33-41.

Mesthene, E. G. (1970). *Technologial change: Its impact on man and society*. New York: New American Library.

Meyer, A. G. (1982). The idea of progress in communist ideology. In G. A. Almond, M. Chodorow, & R. H. Pearce (Eds.), *Progress and its discontents* (pp. 67-82). Berkeley and Los Angeles, California: University of California Press.

Mishan, E. J. (1981). *Economic efficiency and social welfare: Selected essays on fundamental aspects of the economic theory of social welfare*. London: G. Allen & Unwin.

Mitcham, C., & Mackey, R., (Eds.). (1972). *Philosophy and technology*. New York, NY: The Free Press.

Mumford, L. (September 6, 1933). *New Republic 76,* p. 106.

Nisbet, R. (1980), *History of the Idea of Progress*. New York: Basic Books, Inc.

Noble, D. F. (1985). Social choice in machine design: The case of automatically controlled machine tools. In D. A. MacKenzie, & J. Wajcman (Eds.), *The social shaping of technology* (pp. 181-201). Philadelphia, PA: Open University Press.

Ogburn, W. F. (1933). *Living with machines*. Chicago: American Library Association.

Pacey, A. (1984). *The culture of technology*. Cambridge, Massachusetts: The MIT Press.

Pannabecker, J. R. (1991). Technological impacts and determinism in technology education: Alternate metaphors from social constructivism. *Journal of Technology Education*, *3*(1), 43-54.

Rae, J. B. (1969). *Great lives observed Henry Ford*. Englewood Cliffs, NJ: Prentice-Hall.

Rosenberg, N. (1982). Natural resource limits and the future of economic progress. In G. A. Almond, M. Chodorow, & R. H. Pearce (Eds.), *Progress and its discontents* (pp. 301-318). Berkeley and Los Angeles, California: University of California Press.

Roy, R. (1991, February). The sciences' approach to conceptualizing technology. In R. Custer (researcher), *Conceptualizations of technology colloquium.* Colloquium conducted at the meeting of the National Association for Science, Technology, and Society; Washington, DC.

Simpson, M. (1980). The case for the liberal arts. *Liberal Education, 66*(3), 315-320.

Staudenmaier, J. M. (1985). *Technology's storytellers: Reweaving the human fabric.* Cambridge, Massachusetts: The MIT Press.

Staudenmaier, J. M. (1989). *Perils of progress talk.* In Steven L. Goldman (Ed.), Science, Technology and Social Progress, Research in Technology Studies, Vol. 2. Bethlehem, PA: Lehigh University Press.

U.S. Department of Commerce, Bureau of the Census (1975). *Historical statistics of the United States: Colonial times to 1970.* vol. 1, series D 1-10.

Vincenti, W. G. (1990). *What engineers know and how they know it.* Baltimore, MD: The Johns Hopkins University Press.

von Bertalanffy, L. (1968). General systems theory: Foundations, development, applications. New York, NY: Braziller.

Winner, L. (1977). *Autonomous technology: Technics-out-of-control as a theme in political thought.* Cambridge, Massachusetts: The MIT Press.

Winner, L. (1985). Do artifacts have politics? in MacKenzie, D. A. & J. Wajcman. *The social shaping of technology.* Philadelphia, PA: Open University Press.

Winner, L. (1993). Upon opening the black box and finding it empty: Social constructivism and the philosophy of technology. *Science, Technology, and Human Values, 18,* 362-378.

Woolgar, S. (1991). The Turn to Technology in Social Studies of Science. *Science, Technology, and Human Values, 16,* 20-50.

DISCUSSION QUESTIONS

1. What percent of the population do you think would claim to understand technology?
2. What kinds of objects are technology? How would you classify these into categories?
3. Many people believe that technology is the application of knowledge from other areas (science, mathematics, etc.). Is there such a thing as knowledge that is uniquely technological? Give some examples.
4. Technology has been defined in terms of processes such as problem solving, design, innovation, invention, and trouble-shooting. Are these really technology or are these just processes that technologists use to accomplish their work?
5. Do you believe that technology is a force that is changing society? Give some examples of how this has occurred over the past 30 years. 20 years. 10 years. 5 years. What additional *cultural* and *social* changes do think will happen in the next 20 years as a result of technology?
6. In what ways is technology a reflection of cultural values and beliefs? Cite some examples.
7. Is it more correct to say that technology has influenced society and culture or to say that culture and society have influenced technology?
8. Would you say that more people in our culture are technological determinists or social constructivists? Explain and illustrate your answer.
9. In what ways has technology contributed to social progress? to social decline? Cite some examples of each.
10. Would you say that the quality of life in the West is generally better or worse as the result of technology? Explain and illustrate your position.

11. Has technology generally served to promote or erode democracy and democratic values?

12. Do you believe that there is a technological fix for most technological problems? for most social problems? Explain and illustrate your answers.

13. Is technology more male than female? Explain your answer.

14. How would you react to the assertion that technology is morally neutral?

15. Is there such a thing as autonomous technology? Explain why or why not.

SECTION 2
TECHNOLOGY AND SOCIAL CHANGE

One of the most prominent characteristics of contemporary technology is how rapidly new technologies are developed and infused into society. Certainly, the number of new technologies and artifacts have grown at an apparently exponential rate as they are combined with existing technologies, and as new uses are discovered for these emerging processes and products. Witness the hundreds of uses for lasers in fields as diverse as communications, construction, materials fabrication, medical procedures, engineering, and more.

On one level, technology is welcomed and absorbed into the fabric of society; extending life, providing entertainment, increasing production, or providing some other service. At closer view, society is changed as it accommodates these technological developments. The social milieu out of which technology emerges is indeed complex, fueled in part by economic, religious, and other cultural differences that abound throughout the multicultural mix of society. There is no single "voice of the people" in the United States as there would be in an older, culturally isolated society. Often a new technology acts as a catalyst that excites the debate over a social issue. Consider, for example, the debate which continues to rage over abortion. Yet another technology, the abortion pill RU 486 - serves to intensify the debate. Or, consider the changes in warfare which have resulted from new technologies, allowing the enemies to be reduced to video game dots on a screen which can be targeted by a heat-seeking explosive. Perhaps no sector of American culture has been affected more by technology than has the rural Midwest.

In 1956, C. P. Snow, an eminent British scientist aroused considerable attention when he described the disparity between two major intellectual groups, the scientists (/technologists) and the humanist. His discussion of these "two cultures" was insightful in helping us understand how our different orientations affect our views of the world and our proposed solutions to the human condition. However, society consists, in the main, of people who are neither literary intellectuals nor scientists, but who are, nonetheless, trying to succeed at what they do while searching for meaning and fulfillment in their personal lives.

Depending on our childhood influences, education, and inherited characteristics, we vary in our ability to cope with change. For many of us, social changes are threatening. They challenge and disrupt the social and mental constructs and belief systems which have provided structure, security, and meaning to our lives. We like the security of closure. But frequently, our dogmas, based on a limited view of the world, are raised to the level of truths which prevents us from considering new perspectives. Often our adoption of new technologies, which we have willed into existence and have anticipated with eagerness, has created new possibilities which have forced us to reconsider some of our values.

In this section, the authors look at the role technology has played as social change agent. The social and ethical issues that have been raised by the acceptance and/or imposition of technology will also be examined. The authors were not instructed to find solutions to the issues identified in their topic areas, but they *were* instructed to identify the issues. They were also asked to provide a balanced report, addressing how technology contributes to and distracts from quality of life. This they have done.

Stewart Hoover and Mark Sanders begin this section by reviewing the emerging trends in communication technology and in examining the role of the media in a number of social, political, legal, and cultural contexts. Then, Michael Daugherty and Robert Wicklein discuss the pervasive role of the military in regard to employment as well as in creating technology for military use with spin-off benefits that accrue to the public. The authors also examine the future direction of military practices and mission and discuss the impacts these may have on military activity and world peace.

Daryl Hobbs reminds us in chapter 5 that transportation and communication technology along with the "dominance of specialization, centralization, and standardization" triggered a transformation of the rural environment from community control to "the era of the mass society." These changes have essentially obliterated the differences between rural and urban society. Yet, there are some differences which are noted by Britta Fischer in the following chapter. Dr. Fischer traces the history of American cities and shows how technology contributed to the divisions that have developed in the urban environment. She also examines the sociological and structural causes of urban violence and draws attention to the gender-biased urban landscape.

In the final chapter of this section, W. Tad Foster discusses the nature and purpose of art. He also explores the interrelationships that seem to exist between art and technology and how these two fields function as social change agents.

CHAPTER 3

The Media

Stewart M. Hoover and Mark Sanders

Few technologies interact as regularly and intimately with daily life as do the instruments of mediated communication. Two of these, the telephone and the television, are nearly ubiquitous in American homes, with near-universal telephone service having been achieved as a matter of public policy, and near-saturation television ownership achieved as a matter of market economics. In the typical home, the television set is in use over seven hours a day, according to some estimates, and the average occupant watches over three of those hours. Children watch slightly more, a matter of some concern to parents and teachers.

The importance of technologically-managed communication has grown over most of this century. America has always been a media-dominated culture. Alexis de Toqueville (1945), for instance, observed the extent to which the press played an important, normative role in American politics in the early days of the republic. The printed press was integrally involved in the American Revolution, and the press achieved an important status in the Constitution's First Amendment as a result.

A period of rapid technological change in communication began in the mid-19th century. First came the mechanization of printing (leading to the development of a democratic, popular press), then the telegraph, the telephone, and radiotelephony. These developments had striking impacts on American culture and society, impacts that only the distance of time has enabled us to fully appreciate (Carey & Quirk, 1989). Changes of recent years have seemed to move ahead at an accelerating pace, but it remains to be seen whether the social and cultural impacts are different in scale from those of telegraphy and telephony, for example.

It is our purpose here to review and analyze emerging trends in communication technology and to draw from that analysis some implications for technology education. The capacity for communication is widely thought to be one of the primary characteristics which makes human beings unique among the species, and which gives human society and human cultures their form and substance. Communication technologies thus are unique in their position in social and cultural space. Further, the role of communication in democratic processes has been recognized in the American context, both formally and informally. Thus, our review will look at communication technology in a number of social, political, legal, and cultural contexts. We will proceed from there to a consideration of how and why technology education must take particular account of developments in the media.

Communication as Public and Private

It has been customary to see communication technologies as fitting into two rather large and indistinct categories: the public and the private. Public media include the mass media of television, radio, film, the press, and (more recently) cable and satellite television. Private media include the telephone, telegraph, satellite and other data channels, those technologies used for the transmission of private messages, data, closed business information, press wire service copy, and wholesale information, services. Federal regulation has long recognized this distinction, through the division of the Communications Act of 1934 into *common carrier* (private) and *broadcasting* (public) titles. The FCC structure reflected this distinction for many years.

The distinction between the private and the public was traditionally a technologically-enforced one. The public media were those which were publicly-receivable over the public airways or rights-of-way. The other media were those that involved closed systems of transmission (usually wires).

In terms of social and cultural impact, however, this distinction has always been a misleading one. Even the purest example of a private technology—the telegraph—has been shown to have had an important influence in the public media, with press wire services and new means of transmitting and disseminating news, political intelligence, cultural material etc., evolving as a result of it. The telephone, also a *private* medium, came to play an important role in public communication in the Iranian and Philippine revolutions of the 1970s and 80s, as well as in the collapse of the Soviet Union, where fax-based messaging played an important role in news dissemination.

The collapse of these two types of communication into one another has been hastened by developments in computer technology and digitalization, where channel capacities, delivery systems, and transmission networks have been revolutionized. Communication scholars call this phenomenon the *convergence* of computer, mass media, and *narrowcast* technologies toward a future that is only dimly conceived. This future has become widely discussed under the rubrics of the Clinton Administration's Information Superhighway proposal (Gore, 1994b; Auletta, 1994), and the development of the information age.

The Functions of the Media

A review of the roles and functions of these various communication technologies and activities reveals that there is much at stake in the *information future*. Much is claimed. Information technologies can serve education, health care, democratic discourse, industrial competitiveness, and many other goals, according to various sources (Kapor, 1993; Gore, 1994b; Brody, 1993). What are the possibilities that such changes are possible? There is reason to be somewhat suspicious of halcyon claims (Carey & Quirk, 1989; Marvin, 1988; Streeter, 1986). These claims and possibilities should be seen in light of the roles and functions of the media in society as they have evolved over time. We will address specifics in the field of education in some detail later on, but first we turn to the broader arena of media and society.

Charles Wright (1986) has suggested that there are four basic socially-significant activities of mediated communication: (a) surveillance, (b) correlation, (c) socialization and (d) entertainment. Surveillance, the most straightforward, is the simple gathering and dissemination of intelligence (news and data). *Hard news* is the term devised by the canons of journalism to account for this function. Correlation, the editorial function, is the set of decisions whereby information and other content is selected, placed, emphasized, and de-emphasized. The media serve both to present ideas, data, *facts*, and images to us and to decide which ones are important and which are not. Socialization is the process whereby the social heritage of ideas, values, histories and norms is conveyed. Alongside the *pure facts* (to the extent there are such things) and the way those are arranged, the media also give us messages about what is important and what is right.

Entertainment is the last activity which is, of course, not quite on a par with these other things, but it nonetheless is an important element of what the public media do for us. Obviously, there are no clear demarcations between these various activities. Thus, some of the most important socialization takes place through entertainment programming. News can also be entertainment, as we see in current trends in broadcasting.

From their earliest days, the public media have been under tremendous social scrutiny as a result of their assumed *effects* on their audiences. Television violence has received the greatest attention in this regard, but there were studies and government hearings about the effects of film on children as long ago as the 1920s (Charters, 1933). In general, what research there is, stretching from the 1960s to the present, does hold both good and bad news. There are clearly-demonstrable negative effects of viewing of television violence. At the same time, those effects do not appear to be universal. A wide variety of social factors has been found to mediate the effects of exposure to violence in the lives of individual children, so that the outcome of most research is that negative effects dominate for some of the children, some of the time (Hoveland & Kelley, 1953).

Dissatisfaction with such *direct effects* models led subsequent research to look at other, more *indirect* effects. For instance, the role of media in politics seems to be indirect, with the influence flowing through friends and neighbors rather than directly from the media (Katz & Lazarsfeld, 1955). Research also found that the media have an important effect in setting public agendas. It is not that they tell people what to think, but that they tell people what to think about (McCombs & Shaw, 1972).

Thus the relationships between media, society and culture are complex ones. The media do not lead culture, but they do have an influence. They do not reflect only values; they have an influence on values. The media are important indicators of public values and sentiments, and obviously are involved heavily in such things as politics and government, where their role in democratic processes is hotly debated.

Processes of public communication obviously predate the emergence of communication technologies. Historians tell us that before the development of writing (itself a technology), public communication was narrated by folk practices such as storytelling (Ong, 1982; Innis, 1951). The introduction of industrial technologies into the process has substantially changed things in two important ways. First, the means of communication have shifted. Modern mediated communication rests much more on the visual sense than did previous technologies (McLuhan, 1968; Ong, 1982). Today's media are predominantly visual, and whole codes and languages of *the visual* are emerging (Messaris, 1994).

Second, the means of structuring public communications have shifted. Whereas before printing, public communication and the whole public sphere were controlled by the Church and the State, today whole new structures of communication have emerged (which we collectively call *the media*) to usurp the powers of those previously-dominant, legitimate authorities (Eisenstein, 1979). The questions of *who owns* and *who controls* the media are now rather different questions than they were in those earlier times. Now, those questions also necessarily refer to who controls access to public debate and public dialog (Bagdikian, 1989).

A Problem of Definitions

The larger social and cultural compass with which we have been charting these questions obviously implies that a broader definition of communication processes is needed. The old *instrumental* view of media as *tools only* will no longer suffice. Instead, we need a more cultural view, one that takes into account the variety of issues implied by McLuhan's (1968) observation that "... the medium is the message." James Carey (1989), for instance, has observed that we should probably abandon *transportation* metaphors for mediated communication in favor of *ritual* metaphors, where the whole social and cultural functioning of the media can be taken into account. People do use media in ritualized ways, and there is much evidence that the media are coming to play an important, almost *religious* role for them (Gerbner & Connoly, 1992; Hoover, 1994; Roof, 1993).

In the simplest terms, this *culturalist* approach implies that there must always be an isomorphism between a communication-technological practice and its social and cultural context. A review of some of the converging technologies reveals how this is the case. Electronic mail has come to be thought of as *virtual community* by some (Kapor, 1993). The home computer now is embedded deeply in daily life in many homes, and is an important point of contact between children, parents, and school (as we will discuss in more detail later). The coming of interactive video will alter the process and practices by which we entertain ourselves (Brody, 1993).

These developments also are transforming aspects of culture. The electronic networks are overcoming boundaries of *private* and *public*, *home* and *work*, etc. Even intimate spheres of family and spirituality are being affected.

What are the current trends in communication and media as we move toward the information future? Are there things we should be concerned about, in the context of this more *cultural* view of the processes and instruments of mediated communication?

In the area of surveillance, much is changing. New programming and news services in print and broadcast media are becoming more *visual*, less *linear*. News-gathering technologies have permitted stories which in a previous time might not have been *news* to become newsworthy simply because *visuals* are available. The remarkable spectacle of football star O. J. Simpson being pursued through the freeways of Los Angeles, carried live on national television, is an example of this trend. Also widely cited is the experience of the 1991 Persian Gulf War, where spectacular visual material from the battlefronts tended to obscure the reality of the war *on the ground* (Mowlana, Gerbner & Schiller, 1992).

The print media are following the lead of the electronic media in this direction, with more papers using color photos, color ink, bright graphics, etc. *USA Today* is hailed by supporters as a vanguard of a new trend in popular journalism. Its detractors deride it as *McPaper*.

The visual is also important in the area of correlation, with a new kind of quasi-journalism, *reality television*, emerging in programs such as *Cops*, *Rescue 911*, and *Inside Edition*. All of these are inheritors of a legacy of the 1970s, when many local television programs began turning to a so-called *happy talk* format, which stressed crime, sex, violence and soft-features in place of interpretive information about public issues. The key element was the discovery that such formats could become successful in terms of ratings, turning what had been a *loss leader* public service obligation (news) into a *profit center*. Changes in the ownership structures of the major broadcast networks have led them in the direction of more superficial, less weighty news, as well.

The whole definition of *news* is thus changing away from a more or less information-based logic to one that is more entertainment-oriented. There is now less news overall, more *feature* coverage, and one major genre, the documentary, has virtually disappeared from commercial television altogether.

In the area of socialization, the trends are complex and challenging. The mere amount of media exposure of the typical American child or adult means that these sources are the dominant influences in the area of social value and behavioral norms. As was noted earlier, the media have been shown to be important influences on children's behaviors, even though those influences have not been shown to be total or absolute (Palmer, 1987).

The most compelling questions about media and socialization tie the media sphere to the activities and influences of the schools and of education (an issue we will turn to in greater detail below). Most children spend more time with media than they do in classes. Further, there is a negative correlation between television viewing and academic performance, leading to charges that the declines in educational achievement by American students can be tied to their media habits (Postman, 1990). Other traditional influences, the church and the family, also pale in comparison with the media. The challenge to education is one that is particularly compelling, as we shall see.

At the same time, the new media technologies hold out the promise of establishing entirely new networks of influence and relationship through which socialization might occur (Kapor, 1993). New interactive technologies are said to have already established de-centered *virtual communities* and *virtual discourses* for heavily-involved users of the Internet, for example. Such technologies may prove successful in creating the social equivalent of community for users, but there is some question as to whether this really amounts to such a *decentering* of community, or whether such *virtual* spaces have any meaning at all (Gillespie & Robins, 1989).

In the area of entertainment, the emerging technologies hold out a great deal that is new. Already, a vast array of interactive games has been developed. A great deal of research is being devoted to the development of *virtual reality* technologies. Interactivity is being explored via networked and CD-ROM-based platforms.

The role of entertainment markets in the development of communication technology is something new to the electronic era. In earlier phases of communications-technological development, entertainment played a less significant role. Since the development of radio, entertainment has emerged as a major engine of capital, research, and development. Home video, a phenomenon of the VCR era, has come to dominate even national communications and culture policies in some countries (Cuthbert & Hoover, 1990). A further danger, expressed by some, is that the demand for entertainment services will serve as a glut on the information superhighway, making other services and uses compete for space and attention (Brody, 1993).

Entertainment applications also have come to influence American federal policy in international relations. Foreign demand for American entertainment material always has been high. This demand has led to an actual balance of trade surplus in these so-called *cultural products* over the past decade. The realization that American industrial prowess in international trade now is experienced increasingly through such products has led to a shift in U.S. policy, where culture is now recognized as an important export item, and a major subject of negotiation in the General Agreement on Tariffs and Trade (Braman, 1990). As a consequence, countries that wish to protect their domestic culture industries now face economic retaliation in the trade arena (Hoover, Venturelli, & Wagner, 1993).

Entertainment also has a structural impact on the private sphere and the home. The acquisition of entertainment technologies, and their use, now establishes conditions through which families interact with the media. Any new technological developments thus will be introduced by necessity into the home by virtue of their entertainment, rather than informational utility.

Issues in Regulation

The control of these technologies also is becoming an issue of some dispute. Much of the discourse about the convergence of communications and media technologies has stressed the presumed tendency for this new reality to de-center, to provide for new, smaller, democratic and communitarian structures to emerge (Toffler, 1990). Whereas broadcast technologies and mass-circulation newspapers seem, by their very nature, to be structured and controlled centrally, networked digital systems seem to carry the potential for decentralized control.

At the same time, the ownership and control patterns of the information society can be seen to be typified by increasing, not decreasing, centralization (Aufterheide, 1994). Such things as the proposed merger of Bell Atlantic, a major regional phone company, and

TeleCommunications, Incorporated, the largest cable company (since called off, at least for the time being) are seen to be harbingers of the future, more than is decentralization (Gillespie & Robins, 1989).

The case is simply that governments, corporations, and non-governmental organizations alike see tremendous power and influence in these emerging technologies and structures, and it is unlikely that they can or will develop further without important centralized support from these sectors. For countries such as the United States, communications and cultural products give important access to global markets in an era when international competition is becoming more intense.

This era of change continues to invoke a set of key social/ethical policy issues that will need to be addressed at some point in any new development. These policy issues have been raised from the very beginning of the emergence of discourses about new technologies in the 1970s.

The Information Poor

The first issue has to do with the *information poor*. American telephone policy traditionally has entailed an objective of *universal service*, enforced by a system of government grants and industry cross-subsidies (Mueller, 1993). The logic of this was that no sector of society should be disadvantaged in access to such important resources by geographic or social circumstances. As a result, most Americans today have access to telephone service; the question is, Will this continue in the future? If access to the means of modern communication is to become important in the future, should a threshold of access be made available to all Americans? The current proposals regarding an information superhighway promise to address this issue (Brody, 1993), but it remains to be seen how this will be done.

Information Overload

The second issue is information overload. Most surveys and anecdotal evidence indicate that the general public finds itself increasingly unable to deal with the amount of information and the level of choice now available. The idea that in the future an information superhighway into the home would bring even more information is greeted by many with alarm. This problem has two dimensions. The first is the question of resistance.

Will end-users of new technologies simply resist new services and devices? The second is the issue of complexity. That is, will these services and devices be designed in such a way that they are accessible to a general public which has a wide range of skill and knowledge? This is obviously related to the access issue, as well.

Privacy

Finally is the issue of privacy. To put it simply, the new technologies promise to massively change the means by which individuals define and maintain their own spheres of private consciousness and action. First of all, the important question of how the widespread digitalization and interconnection of information sources and data banks will affect the ability of individuals to keep a wide range of information about themselves to themselves. Also significant is the question of the functioning of the private sphere in an era where everyone is interconnected constantly in real time. The whole distinction between the *private* and the *public* thus is up for grabs. (See Stephens' chapter on Technology, Crime, & Civil Liberties for a fuller discussion of this issue, presented from a futurist's perspective.)

All of these considerations are influenced by a process whereby technological innovation is first prophesied, then proposed, then introduced. At each of these stages, more reality and less *hype* come into play. With regard to the information future, we still are largely at the stage of *prophesy*. Policy and planning are driven by visions of the future. This is necessary because the attention of the public and of public authorities must be drawn into the discourse (as it has now been through the work of Al Gore's *information superhighway* discussions) and has to be given a good reason for doing so (Streeter, 1986).

In general, the normative *visions* of new communication technologies tend to coalesce around the following set of claims. First, these new technologies will be, as has been said, more *democratic*. Initiatives for voting-by-phone, for instance, stress the use of technology for basic processes of citizenship. Second, the technologies are potentially more egalitarian. Unlike previous media, access to the resources of the information society can be made available to anyone (again, provided the necessary policy structures exist). Third, communication technologies will be more plentiful. The diversity of channels made possible by increasing bandwidths will bring a wider variety of choices into the home, it is claimed.

Fourth, the future will be more leisurely. As with many previous innovations for the home, these new technologies hold the promise for more leisure. People will be able to work from home, saving commuting time. They will be able to organize their personal lives better, saving time for leisure. They will be able to communicate more conveniently and carry out such personal tasks as banking. Finally, the claim is made that these new technologies will finally bring about McLuhan's (1968) vision of a *global village*. The easy access to speedy and plentiful communication has already brought the world closer together, it is thought.

Important questions can be raised about each of these visions of the future. All of them are at least problematic without the exercise of public will to bring them into play. It remains to be seen whether the national initiatives which will bring about the *information superhighway* and the *information future* will actually and effectively address them.

Communication Technologies in Education

As can be inferred from what we have said, the role and place of communication technologies, particularly those of the public media, present broad and profound questions at this point in their development. Among these questions are the educational implications of all this. Two kinds of questions can be seen. First, there are questions of education for practice. That is, the new demands of the new technologies imply large shifts in the demands for technical knowledge. Even the most basic job skills in the communications industries now must recognize the impact of the digital revolution. Second, there are questions of education for citizenship in the media age. The whole nature of civic and political participation is being transformed by these devices. Thus, critical educational objectives are implied by these developments. Their complexity demands a public which is informed, media literate, knowledgeable, and involved. Up to this point, the public has come into play primarily in its role as an aggregate of consumers of technologies and services. This has led directly to the situation we have noted, whereby entertainment devices and services have been determinative of policy and practice.

However, this situation must change if the true benefits of the "information society" (however contested they may be) are to be realized. This, admittedly, leaves a rather large mandate for the schools. In light of what we have said, it is worth asking the question ". . . how have and how will the schools respond?" In our view, this question must be answered on at least two levels. We first address questions of the role of communication technology in education itself, and then move on to questions of education's role in addressing the needs of the information age.

Research suggests the impact of the media in education has been rather modest. Educational institutions are conservative by nature, and new technologies are incorporated incrementally into these systems only over considerable periods of time. This is not to suggest media have been ineffective in education, but rather that the impact may be evolutionary rather than revolutionary.

As a case in point, Rockman (1987) documented the gradual acceptance of educational television over the course of the last three decades. Once hailed as a panacea for the problems in our schools, educational television had little impact in its early years. The low-cost, poorly produced "talking head" productions broadcast to schools in the 1960s got educational television off to a slow start. Gradually, these locally-produced programs were replaced by well-funded projects supported either federally or through consortia agreements. By the 1980s, a diverse array of educational programming had evolved. Today, we have channels such as the Public Broadcasting System, the Learning Channel, and the Discovery Channel which cater to viewers interested in educational programming. Programs like *Sesame Street*, *Newton's Apple*, and *3,2,1, Contact!* have created a niche for educational television in the classroom and in the home. Moreover, modestly priced videocassette recorders and the ready availability of videotaped programming on a wide range of topics have allowed teachers to make good use of video in the classroom.

We might expect the pattern for the new media we have been discussing to be roughly the same. Despite grandiose claims, computers and new media have yet to reach their potential in education. The limited impact to date may be explained by a number of factors: The ratio of students/computer is still very high; teachers have not been adequately prepared to teach with these new technologies; interactive media are very much in their infancy; and the infrastructure necessary for the so-called "information highway" stops short of most schools. If and when the universal access is established, it will almost assuredly alter the teaching/learning process. But the infrastructure will not reach out to most schools before the turn of the century. Much will need to be done before the information age results in widespread fundamental change in education.

Educational Paradigms and the Media

By and large, the locus of control in America's schools is with the teacher and the curriculum, rather than the student. Students, for the most part, are on the receiving end of the curriculum. Most of the decisions about what will be studied and how it will be assimilated are fixed. The traditional role of the teacher is to transmit information while the student acts as receiver.

As has often been the case in the past, current educational reform movements are trying to alter this traditional instructional model. Driven by cognitive research, educators once again are striving to transform the fundamental relationships among teacher, student, and curriculum. Constructivist models (Glaserfeld, 1989) employing inquiry and problem-solving strategies bear considerable resemblance to the earlier progressive education movement. Both constructivists and the progressivists recognize the student as an individual with a critical role in the teaching/learning process. In these models, the locus of control shifts to the students, who construct their understandings of the world through an active, rather than passive learning process. Students learn to formulate and pursue their own strategies for inquiry that often take them well beyond the traditional classroom.

Papert (1993) believes that powerful technologies are just now being developed that will result in "personal media capable of supporting a wide range of intellectual styles" (p. ix). He suggests these technologies will, at last, enable a shift to the student-centered/progressive/constructivist curriculum; a shift that he feels did not take place previously for want of the proper infrastructure. He theorizes that just as daVinci's airplane design could not be built until the necessary technological infrastructure (materials, tools, engines, fuels, and scientific culture) was developed, so too our schools have lacked the technologies required for fundamental change. Papert feels those tools (computers and interactive media) are now finally in place and these technologies will facilitate this paradigm shift in our educational institutions.

The Global Information Infrastructure and Education

Implicit in the infrastructure Papert (1993) alludes to is the convergence of print, broadcast, and computing technologies. The increasing overlap among these three media systems is the result of each transitioning from analog to digital formats. The fact we are now able to routinely encode, transmit, receive, and decode all media digitally provides many advantages over conventional analog formats. Among the benefits is the ability to transmit all three digitally via the same channel (optical fiber and/or the airwaves) and receive/decode all three signals with the same box. In other words, our computers are now quite capable of acting as our telephone, television, radio, and computing system—delivering voice, video, and data over the same channel. Our entertainment and work stations have become one.

The convergence of these media, coupled with the explosive expansion of information services in our society, has resulted in the current preoccupation of political and corporate America with the development of a Global Information Infrastructure (Gore, 1994a). This infrastructure would build upon the existing Internet, with the ultimate goal of providing worldwide "universal access" to information.

While an astonishing array of media capability already exists on the Internet, access is really very limited to date. Schools are an unfortunate example of this limited access. Assuming the Global Information Infrastructure (GII) concept will one day be in place, it very well may provide a vehicle for fundamental change in our educational institutions. It will facilitate remarkably easy access to vast quantities of information of all types and media formats from a remarkable throng of sources throughout the world. The GII is, therefore, inextricably linked to the future of media in education.

Since the infrastructure provides immediate global access to information, teachers and students in "connected" schools will not be restricted to the resources found in or near their classrooms. Teachers, libraries, and curriculum in these "virtual schools" will be designed increasingly to facilitate electronic access to this information. Learning webs (Illich, 1971) will evolve in which teachers will be wherever one finds them on the network. Initially, school and public libraries will provide network access points for those who do not have classroom and home connections and will catalog the vast array of data available. As the infrastructure evolves, those community access points may or may not continue to look like or be libraries. Since wireless technologies will enable access from any point on the planet (school, home, or playground), our concept of educational institutions will evolve. Schools will provide a framework for learning and a place for socialization to occur.

Brief History of the Internet in Education

Is there reason to assume the infrastructure will expand to include our schools? The brief history of the Internet has been characterized by rapid expansion and increased accessibility in education, suggesting widespread infrastructure access is a question of *when*, rather than *if.*

Global networking began in the 1970s with ARPANET, but this network was limited primarily to defense-related research. BITNET, a worldwide network established in 1981, was the first network to reach the *masses*. Because the associated costs were relatively insignificant to participating universities, it enabled academicians throughout the world to freely exchange information. It expanded network access from a small number of researchers to a significant and broad cross-section of the academic community. The development of the information infrastructure and accompanying tools reached a critical mass in the late 1980s. NSFNET followed BITNET in 1986, providing the backbone for the Internet, which became an indispensable communication tool for educators throughout the world in the late 1980s and 1990s. Information dissemination was facilitated on the Internet by the development of a series of new software tools. Listservs enabled subscribers to send easily and receive electronic mail or documents to and from all other subscribers. The first electronic journals used listservs for dissemination purposes in the late 1980s. Wide Area Information Server (WAIS), released in 1991, provided a full-text indexing and natural language query system for the Internet. Gopher networks, also established in 1991, offered a menu-driven system for accessing text and other data on the Internet. File Transfer Protocol (FTP) was developed to facilitate the transfer of files from one computer to another. Telnet client software allowed users to log onto any Internet-connected computer, assuming they had been granted access privileges by its owner. The development of World-Wide-Web software provided a means of storing and retrieving digital text, graphics, audio, and video files throughout the Internet.

By the early 1990s, many educators at all levels had taken a keen interest in the Internet. University faculty gained widespread access, though most public schools still provided relatively limited access to the Internet. Its potential had become obvious to a growing number of policymakers, bureaucrats, entrepreneurs and educational administrators. Widespread access to the Internet for teachers and students at all levels seemed to be just a matter of time.

The immediate future of the infrastructure in education may be characterized by increasing access and increasing bandwidth. The former means more schools on-line. The latter means increasing opportunities for digital audio and video (multimedia) via the Internet. Asynchronous Transmission (ATM) technologies, currently being deployed throughout the infrastructure, offer increased transmission capacities on the order of 5,000-10,000 times that capable with the current dial-up access speeds to which most schools are now limited! These transmission speeds are essential for practical widespread applications of video and audio transmission on the Internet.

Contemporary Projects in Education

There are already many projects completed or under way that provide a glimpse of the role the Internet and other new communication technologies will play in our schools. Several statewide initiatives have provided educators free access to the vast array of Internet resources. Virginia's Public Education Network (Virginia's PEN), established in 1989, has a simple menu interface that includes the Internet as a menu item. Free access for Virginia's teachers resulted in very heavy traffic on Virginia's PEN in the early 1990s. In 1994, the architecture of the network was changed to accommodate the large volume of use it received (Cothern, 1994).

KidNet was a collaborative project between the Technology Education Research Center (TERC) and the National Geographic Society. Students collected acid rain data and then sent it via the network to a central computer. The data were compiled and returned to participating schools for analysis and discussion in science class. Papert (1993) suggests activities like this provide kids with "a deeper sense of doing something important" (p. 25), a factor he believes was crucial to his own intellectual development as a child and is necessary for young students to become self-directed learners. The K-12 Network began as a pen pal project and has expanded to more than 300 sites worldwide and an excess of 25,000 users (Murray, 1993). The Global SchoolHouse Project allowed students in grades 5-8 in California, Virginia, Tennessee, and London to engage in video teleconferencing over the Internet. By 1994, the project included 20 schools in 11 states and 9 other countries (Taylor, 1994).

In 1993, The *Live from Other Worlds* project demonstrated ways in which media increasingly will be used in education. The project broadcast three forty-minute programs via PBS. It connected students in Hawaii, Virginia, and Iowa with researchers in Antarctica who were experimenting with underwater robotic systems. In addition to the live broadcast, students had on-line access to information provided by the researchers (a daily log and a research log) as well as access to databases established in conjunction with the project. Students watching the live video broadcast were able to ask questions on-line that were answered by experts. During one of the broadcasts, students in Virginia and Hawaii used the Internet to allow them to control a wheeled robotic test vehicle in a simulation set up in California. Two-way compressed (digitized) video via Internet promises to take this sort of interactive educational experience to the next level.

Homework Helper (Salvador, 1994a) initially engaged more than 35 publishers to provide a wide range of material on-line for K-12 students. Sources and material includes *Reuters*, *USA Today*, the *Los Angeles Times*, *Simon & Schuster*, the *Jerusalem Post*, *Forbes*, and the Cable News Network. In addition to gaining access to these and other resources, school subscribers ($10-$15/month) can upload/download curriculum material.

Encyclopedia Britannica is preparing an on-line version to be available initially to universities and public libraries. This is significant because Britannica, publisher of one of the most respected general reference tools on the planet, initially was reluctant to go on-line with their 44 million word, 23,000 illustration encyclopedia.

This is not to suggest that all such developments have been universally perceived as beneficial in education. Some innovative applications of media in education have been hotly debated. *Channel One* television is one such application. The controversy revolves around the issue of vendor-developed curriculum and advertising in America's classrooms. *Channel One* is a daily 12-minute made-for-school news broadcast. The vendor, Whittle Communications, provides schools with a free closed-circuit television system that includes a satellite downlink (dish) and a videocassette recorder connected to televisions in classrooms. The venture is paid for by advertisers, who are provided commercial time embedded within the *Channel One* broadcast. The controversy revolving around advertising to a captive audience has not thwarted the efforts of *Channel One* television; by 1993 it was being received in 8,000-10,000 schools in 44 states (Banks & Ledford, 1994).

Advertising in the curriculum is just one of the many issues and problems associated with new media applications in education. Television is often blamed for creating a society of "couch potatoes," who prefer passive observation to active participation. Will increasing use of media in schools compound this problem? Students' initial exposure to new media is often through entertainment. Can instructional applications of media be effective without entertainment value? Or, if these new media rely to a large extent upon entertainment value, how will this impact more traditional modes of instruction? Will access to seemingly endless sources of information improve our schools, or will it adversely complicate the work of educators and distract students from the important issues and tasks? As with all new technologies, there are positive and negative impacts to new media applications in education. New media represent opportunities, not panaceas.

Political and Economic Impediments to Infrastructure Expansion in Education

Despite obvious potential, there are a number of political and economic issues impeding further expansion of the infrastructure into the educational sector. Resources are a primary issue. The current jockeying for commercial rights to the information highway requires that a balance be struck between the interests of laissez-faire capitalism and governmental regulation in the public interest. Schools will benefit from the infrastructure, but the current funding strategies for education are not sufficient to allow them to buy in at this time.

So who *will* build/pay for it? And when completed, will our schools be able to afford the toll? What resources will be mobilized to prepare current and future educators to utilize these tools in the schools? As Vice President Gore (1993) put it, "When it comes to ensuring universal (networking) service, our schools are the most impoverished institutions in our society."

Legislation such as the National Communications Competition Information Infrastructure Act (Boucher, 1994), when signed into law, will radically alter the way in which information providers do business. These new statutes will supplant the Communications Act of 1934, the last omnibus act to regulate telecommunications in America. Whereas the earlier law served to circumscribe areas of communication activity according to technology (e.g., telephone companies could not provide cable TV and vice versa under its provisions), the new bill is intended by its sponsors to encourage open competition among all service providers. Thus, your cable television company may also provide Internet and telephone services. Voice, video, and data services will be provided by the most competitive provider.

Because of its statutory mandates, the Federal Communications Commission will attempt to provide for *universal access* here in the United States by ensuring that commercial providers subsidize telecommunication access in less profitable markets (e.g., schools), and through control of the airwaves under the public interest standard. At the same time, a more open competitive environment is expected to facilitate rapid development of the infrastructure. Information providers are forming worldwide corporate partnerships that will enable them to compete in this new environment. As an early part of this scheme, the FCC auctioned off 10 bandwidths to commercial providers in July, 1994. In the past, bandwidths were allotted by lottery. In contrast, this auction was intended to raise the capital to facilitate rapid development and delivery of new products. Bids for these bandwidths topped $110 million, about 20 times what had been projected.

Commercialization of the Internet (and thus the potential for a rapid expansion of commercial services there) has been limited in part by the National Science Foundation's *Acceptable Use Policy* (AUP). The NSF contributes approximately $20 million per year to support their research interests. From the onset, the NSFNET has been governed by their AUP, which essentially limited use of the network for research and experimental, rather than commercial uses. In 1994, the NSF began a three-year process of reconfiguring their role in the Internet to one of lesser importance. The NSF backbone will be replaced by "network access points" to which commercial "network service providers" will provide access. This will open up the Internet to a vast array of commercial opportunities and services, including those directed toward schools.

Technological Development

The evolution and maturation of these new communication technologies will facilitate solutions to many of the problems of global access to information. Though education is not the primary client for most of this research and development, schools will benefit nonetheless from these activities. Among the major innovations are the refinement of optical fiber networks, digital broadcast satellite television, wireless technologies, decreasing costs of microprocessors, and software development to support all of the above.

The development and refinement of optical fiber and networking hardware have provided the "pipe" for the new infrastructure. Twisted pair copper wire, while quite sufficient for our telephone networks, is simply incapable of efficiently carrying the vast quantity of information already bouncing around the Internet. Fiber optic cables, on the other hand, carry seemingly unlimited quantities of information, the upper limits of which are still untested. Moreover, optical fiber now is less expensive to install in new residential construction than is copper wire (Gruener, 1994), so its use is expanding rapidly.

Digital broadcast satellite television began operation in 1994. This technology broadcasts a digital signal from satellite to an 18-inch dish at a cost competitive with cable television systems. Initially providing 125 channels, the service is projected to expand to hundreds of channels very quickly. Schools stand to benefit from new educational programming offered via digital broadcast satellite television.

Wireless technologies offer promise for the last mile of network connections (Woerner, 1994). Compression algorithms are allowing wireless technologies to better adapt to the fixed bandwidth space available. Efficiencies of scale will bring costs down considerably, making wireless technologies cost-effective for local networking strategies. This is particularly promising for schools, where many connections must be made in the last mile. The government plans to make a 40 MHz band of the radio frequency spectrum available for noncommercial wireless use. The intent, according to the FCC, is to allow this part of the spectrum to be used by schools for their local wireless networks, which could provide for radio frequency digitally compressed video, for example, by the end of the decade (Salvador, 1994b).

While these new technological developments in communication are an obvious component in the new global education model, the infrastructure itself is much easier to build than are the new educational paradigms required to exploit the infrastructure. The "blue sky" educational scenarios depicted in the popular press will not occur widely in the immediate future, because the challenges in education are infinitely more complex than running cable through dirt. Providing for widespread implementation in education requires a long-term commitment at all levels of education. Teachers, students, administrators, parents, and publishers need to make fundamental alterations to their philosophy and practice. In order for these "blue sky" scenarios to unfold, all of these constituents will have to embrace media as an educational tool as never before. As Soto (1985) states rather bluntly, "The relation between the world of the media and that of education has long been one of barely disguised antagonism" (p. 188). As with virtually all other technological innovations in education, a small percentage of teachers, administrators, and schools will become early adopters. The rest will maintain strong skepticism and the status quo until the advantages of the technology become terribly obvious.

The Role of Technology Education

In the 1980s, technology education emerged as a new school subject given to the study of technological systems—specifically, communication, production, and power/transportation systems. Often confused with "educational" or "instructional" technology, technology educators teach *about* a wide range of communication, production and power/transportation technologies, while educational technologists focus on how to teach *with* instructional technologies (e.g., computers and video).

Though emerging technologies are important to all educators, technology educators, particularly communication technology teachers, have a unique opportunity with respect to media in education. Because their job focuses directly upon various technologies, technology education teachers are in a unique position to influence the decision-making processes that will occur in local school divisions as the infrastructure is developed and curricula evolve. The increasing use of media in schools provides an opportunity for technology teachers to step forward and play a prominent role—but this will only happen if they are proactive in their approach to these emerging technologies.

Communication technology teachers should certainly be among the early adopters of educational media, since there is a natural and considerable overlap between the content of communication technology and the tools generally thought of as educational technology. As early adopters, they will be in a position to work with other teachers in the school and influence local infrastructure and curriculum decisions.

Libraries are currently at the hub of media dissemination in America's schools. Their role, thus far, has been to provide access to information and teaching research strategies informally within the context of the library. School libraries and librarians undoubtedly will continue to play a central role with respect to media applications in education.

The role of technology teachers in our schools must go well beyond that of teaching students how to access information. Communication technology courses can and should provide students with a more in-depth understanding of new communication technologies as they evolve. Technology students should be engaged in activities that allow them to develop a thorough understanding of the technical building blocks of the various communication technologies. This should begin with hands-on data communication (computing) activities. Technology students should become comfortable and proficient with various computing platforms. In addition to studying the obvious communication applications of computers (e.g., electronic publication and telecommunication) technology students must understand their use in broader contexts, such as collecting data, controlling external devices, generating and manipulating graphic and audio data files, simulating "virtual" environments, modeling and forecasting. The technology education laboratory must be a place where students begin to work with and understand the incredibly diverse array of applications in communication that computers provide.

In addition to developing a level of expertise with computing systems, students in communication technology classes should be engaged in hands-on problem-solving activities with respect to four other major communication systems: (a) graphic production systems (print technologies); (b) broadcast systems (analog and digital audio/video technologies); (c) technical design systems (drafting and computer-aided design/CAD technologies); and (d) optic systems (photographic, holographic, and optical fiber technologies). The tremendous and ever-increasing overlap between these four systems and computing systems should be studied in communication technology classes.

Given the fundamental responsibility of technology teachers to teach *about* technologies, communication technology teachers must aggressively seek to acquire these new tools of communication and incorporate them in meaningful ways into the fabric of the communication technology curriculum. Technology teachers need to be the early adopters of new media in our schools. The early adopters, whether they be from technology education or from other disciplines, undoubtedly will play an important role in the use of media and new communication technologies in tomorrow's schools.

REFERENCES

Aufterheide, P. (1994). The media monopolies muscle in. *The Nation*, January 3/10, p. 1.

Auletta, K. (1994). Under the wire. *The New Yorke*r, January 17, pp. 49-53.

Bagdikian, B. (1989). The lords of the global village. *The Nation*, June 12, pp. 805-820.

Banks, D. A., & Ledford, B. R. (1994). Channel one: To see or not to see. *International Journal of Instructional Media, 21*(2), 97-107.

Boucher, R. (1994). *National communications competition and information infrastructure act.* (An Act approved by U.S. House of Representatives Telecommunications Subcommittee).

Braman, S. (1990). Trade and information policy. *Media, Culture and Society*, *12*(3), July, 361-385.

Brody, H. (1993, August/September). Information highway: The home front. *Technology Review*, *69*, pp. 31-40.

Carey, J. (1989). A cultural approach to communication. In J. Carey (Ed.), *Communication as culture* (pp. 13-36). London: Unwin-Hyman.

Carey, J., & Quirk, J. (1989). *The mythos of the electronic revolution.* In J. Carey (Ed.), *Communication as culture* (pp. 113-141). London: Unwin-Hyman.

Charters, W. W. (1933). *Motion pictures and youth: A summary.* New York: The Macmillan Company.

Cothern, H. L. (1994, February). The great PEN transition is finally here. *Virginia's PEN*, pp. 1-2.

Cuthbert, M., & Hoover, S. (1990). Video beachheads: Media and culture policy in the eastern Caribbean. Lent and Sussman (Eds.), *Transnational communications: Wiring the third world.* Newbury Park, CA: Sage.

Eisenstein, E. (1979). *The printing press as an agent of change*. New York: Cambridge.

Gillespie, A., & Robins, K. (1989). Geographical inequalities: The spatial bias of the new communication technologies. *Journal of Communication, 39*(3) Summer, pp. 7-18.

Glaserfeld, E. von. (1989). Cognition, construction of knowledge, and teaching. *Synthese, 80*, 121-140.

Gore, A. (1993, December 14). National press club presentation. Washington, DC.

Gore, A. (1994a). Address to the Academy of Television, Los Angeles, January 11.

Gore, A. (1994b). Address to the International Telecommunications Union, March 21, 1994, Buenos Aires: Argentina.

Gruener, G. (1994, September). Go on-line, young man. *Internet World, 5*(6), 48-53.

Hoover, S. M. (1994). *Religion in public discourse: The role of the media*, Center for Mass Media Research, Boulder: University of Colorado.

Hoover, S., Venturelli, S., & Wagner, D. (1993). Communication technology and policy: Lessons from the Asian case. *Asian Journal of Communication, 3*(1), 103-132 .

Hoveland, C., & Kelley, H. (1953). *Communication and Persuasion: Psychological studies of opinion change*. New Haven: Yale.

Illich, I. (1971). *Deschooling society*. New York: Harper and Row.

Innis, H. A. (1951). *The bias of communication*. Toronto: University of Toronto Press.

Kapor, M. (1993, July/August). Where is the digital highway really heading? *Wired*, pp. 3-9.

Katz, & Lazarsfeld, (1955). *Personal influence*. Glencoe, IL: The Free Press.

Marvin, C. (1988). *When old technologies were new*. New York: Oxford.

McCombs, M., & Shaw, D. (1972). The agenda-setting function of the mass media. *Public Opinion Quarterly 36*, pp. 176-184.

McLuhan, M. (1968). *Understanding media: Extensions of man*. New York: McGraw-Hill.

Messaris, P. (1994). *Visual communication.* Boulder: Westview Press.

Mowlana, H., Gerbner, G., & Schiller, H. (1992). *Triumph of the image: The media's war in the Persian Gulf.* Boulder, CO: Westview Press.

Mueller, M. (1993, July). Universal service in telephone history: A reconstruction. *Telecommunications Policy*, pp. 352-369.

Murray, A. (1993, August). K-12 Network: Global education through telecommunications. *Communications of the ACM*, *36*(8), 36-41.

Ong, W. (1982). *Orality and literacy*. New York: Methuen.

Palmer, E. (1987). *Children in the cradle of television.* Lexington, MA: Lexington Books.

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer*. New York: Basic Books. Perspective. New York: Random House.

Postman, N. (1990). *Amusing ourselves to death: Public discourse in the age of show business*. New York: Viking.

Rockman, S. (1987). Technology and assumptions: Let's take another look. In A. Bank & R. C. William (Eds.), *Information systems and school improvement: Inventing the future*. (pp. 136-142). New York: Teachers College Press.

Roof, W. C. (1993). *A generation of seeker*s. Berkeley: University of California Press.

Salvador, R. (1994a, May/June). Homework service signs up 35 publishers. *Electronic Learning*, *13*(8), 9.

Salvador, R. (1994b, April). What's new in wireless networks? *Electronic Learning 13*(7), 10.

Soto, L. R. (1985). Interaction between educational, cultural and mass communications policies. In *Reflections on the future development of education* (pp. 187-195). Paris: Unesco.

Streeter, T. (1986). Unpublished doctoral dissertation, Champaign-Urbana: University of Illinois.

Taylor, R. (1994, September). Brave new internet. *Internet World*, *5*(6), 37-42.

Toffler, A. (1990). *Powershift: Knowledge, wealth and violence at the edge of the 21st century*. New York: Bantam.

Toqueville, A. D. (1945 edition). *Democracy in America*. P. Bradley (Ed.), New York: Alfred A. Knopf.

Woerner, B. (1994, July). *Wireless communication*. Paper presented at the Ninth Congressional District Telecommunication Conference, Blacksburg, VA.

Wright, C. (1986). *Mass communication: A sociological perspective*. New York: Random House.

DISCUSSION SCENARIO

Telecommunications Dilemma

The Sun Valley Telecommunications Corporation (the successor to the Sun Valley Phone Company) is proposing a new service tariff for the Sun Valley region. North Sun Valley's residents are largely retired people living on fixed incomes from pensions and Social Security, while South Sun Valley has a more diverse and younger population and a growing high-tech commercial sector. SVTC proposes to the state public utilities commission that it offer broad-band, high-capacity telecommunication services to South Sun Valley only, retaining a *lifeline* low-capacity, narrow-band network (essentially a basic telephone system) in the North. SVTC's president is quoted as saying ". . . those people in the North are not involved in productive activities, and besides most of them lack the technological sophistication to take advantage of broad-band services anyway. For most of them, it is a struggle just to use a touch-tone phone."

Critics of SVTC point out that increasingly, health, social, and information services are available through broad-band networks. More and more doctors are offering routine office visits and screenings through videoconferencing, etc. SVTC's president responds, "that is not our problem. We are in business to make money, and those people in the North won't generate enough revenue on the new system to justify the expense of installing it."

The Public Utilities Commission has three options: 1) It can deny the application altogether, effectively leaving both parts of the area with older, narrow-band service; 2) It can require that the same service be offered throughout the SVTC service area (essentially the policy now in place in most jurisdictions in the United States); or 3) It can approve the SVTC plan. It can also recommend alterations to the plan. If you were on the Commission, what would you propose, or how would you vote?

DISCUSSION QUESTIONS

1. To what extent should the media be restricted to reflecting social and cultural values, and to what extent should the media be a force for creating and influencing social and cultural values?
2. How large of a role should the federal government play in regulating and monitoring the materials placed onto the Internet?
3. Should the government intervene and require that set percentages of television programming be educational or cultural in nature?
4. Should public tax dollars be spent on public radio and television or should these be funded privately?
5. Is surveillance an appropriate role for the media in a democratic society?
6. Should interaction with electronic media be allowed to replace more traditional media (primarily books) in the schools?
7. To what extent should the schools be teaching students how to access more information and to what extent should they instead be focusing on teaching students how to be selective in what they read and access?
8. Has entertainment- and instant access-oriented media degraded or enhanced the learning abilities of students?
9. Will communication technologies erode democratic values since they are used more by younger, computer-literate, economically privileged segments of the population?
10. To what extent should the media be allowed to be the message?
11. To what extent should the media be allowed to alter truth (enhanced and electronically-manipulated video images, sound bytes, virtual reality, etc.)?
12. To what extent is the media serving to convey information and to what extent is it serving to make our citizens superficial?

CHAPTER 4

The Military

Michael Daugherty and Robert Wicklein

Throughout the history of the United States, the military has been a prime mover for prototyping and developing new technologies. The military establishment has provided leadership in the development of computing systems, space technology, aviation, the manufacturing assembly line, communication systems, and advanced electronics to name just a few examples. At the same time, the military and military technological development have had an enormous effect on American society and culture. Few other societies in world history have been willing to invest resources toward the development and proliferation of military technology and expertise as heavily. Investment in military technology underpins the American relationship between technology and power, and enables America to protect Western interests in the international arena. However, current global social and political changes may force the military establishment to change the long-established methods of developing, procuring, and utilizing technology and military might.

> The American nation, born in one war (1775-83), defended in a second (1812-15), expanded in a third (1846-48), held together in a fourth (1861-65), given global power by a fifth (1898-1901), sixth (1917-18), and seventh (1941-45), and taught the limits of that power in an eighth (1950-53) and ninth (1965-73), has been affected deeply throughout its history by military affairs. (McEliheny, 1986, p. 35)

Through this chapter, the reader will have the opportunity to examine the distinct relationship between the military and the development and proliferation of technology. The reader will also examine the historical, social, environmental and economic impacts that the development of the military-technological infrastructure has had, and is having, on the quality of life.

Since discussions in this chapter focus on the United States military activities primarily during this century, and frequent reference is made to different conflicts, a chronology of military actions is listed here with the dates indicating the periods of U.S. involvement.

World War I 1917-18
World War II.................................1941-45
Korean War...................................1950-53
Vietnam War 1965-73
Lebanon 1982-84
Grenada invasion..........................1983
Panama invasion...........................1989-90
The Cold War (with USSR)..........1946-89
Gulf War (Iraq) 1991

The "Cold War" began just after World War II, growing out of the tension between two opposed political (dictatorship versus democracy) and economic (communistic versus capitalistic) philosophies. A number of nations, but not all, were aligned, according to this division, with either the Union of Soviet Socialist Republics (USSR) or with the United States of America (U.S.A.). Military technology was amassed on both sides with each side trying to outdo the other. The Cold War ended when the USSR stated that their economy simply could no longer maintain the military machine considered necessary.

Military and Defense Economics

Suggesting that the military has become a pervasive component of the economy and the social fabric of the United States is, at the very least, an understatement. Whether it is the huge General Dynamics plant in New London, Connecticut (with a $7 billion defense contract) or the small U.S. Air Force National Guard Training station in Peoria, Illinois, the defense industry and military-related economies have touched, and continue to touch, all facets of the American economy.

To understand the overall quantitative impact of military spending on the U.S. economy, a casual observer need only analyze the actual numbers on military payrolls. Totals as of December 31, 1991, show 1,943,937 personnel on active duty in the four branches of the U.S. military service. The National Guard and reserve components employ another 1,806,092 and civilian employees number 1,007,132 (Defense 92, 1992). Together, these three components total 4,757,161 jobs directly attributed to the military. These figures do not reflect the economic impact and jobs created by regional businesses directly related to the presence of military installations and defense-related industries.

By combining these employment statistics with the Office of Technology Assessment estimates of 3,150,000 individuals employed in defense-related industries and 1,354,000 employees who work in selected nonmanufacturing positions, defense-related occupations are responsible for over 7.4 million jobs worldwide (U.S. Congress, Report #524, 1992). Combining each segment of this economic triad (defense, industry, and defense-related) results in over 12.1 million employment positions. While the social effects and economic efficiency of employing this number of persons in military-based occupations will be discussed later in the chapter, it should be noted that the military undeniably has a huge economic impact on the United States as well as on a number of other nations around the globe.

A Mechanism for Technological Development

Throughout history, the military and technology have followed similar paths. As early as 900 A.D., Chinese rulers focused their resources on the technological advancement of military weapons. Just as today's industry counterparts are rewarded by defense research dollars, Chinese inventors, who suggested innovative weapons to the emperor, were given presents of silks and gowns for their efforts on the part of national defense (McNeil, 1982). Whether it is the use of the crossbow in 500 B.C., the development of the first atomic bomb in 1945, or a modern satellite tracking system, military technology has been, and continues to be, at the forefront of technological development and innovation. The relationship between the needs of the military and civilian sectors also have a historical link. Technologies originally developed for military defense have historically found their way into civilian life. Certain innovations have even provided the basis for entire industries. Canned food, for example, was originally used by Napoleon's armies, and more recently, computers, jet engines, communications satellites, and jeeps were initially developed for military purposes (Berkowitz, 1993).

Military Creating Industries

The military has a long history of shaping, if not leading, domestic policy and influencing domestic industries. Many common consumer and industrial products, such as the microwave oven and radar, were first developed for military purposes or were initiated by the military establishment. In fact, the American industrial revolution was fueled, in part, by the military establishment. When Eli Whitney received a contract from the U.S. government in 1798 for 10,000 muskets, he instituted the use of jigs and fixtures in making interchangeable parts (Sprague de Camp, 1961, pp. 31-32). (The concept of interchangeable parts was apparently first used to make muskets by Frenchman Le Blanc in the early 1780s, a fact that Thomas Jefferson noted in a letter to Congress in 1785. The French, however, did not apply this technique to other manufacture [Blow, 1960, p. 33].) In 1815, the U.S. military Ordinance Department initiated the Policy of Uniformity, and in 1824, at the Harpers Ferry Armory in Virginia, John H. Hall began to manufacture small batches of breech-loading rifles with interchangeable parts as well (McEliheny, 1986). These efforts toward uniformity and standardization were necessary precursors of mass production and the modern assembly line. Soon after these innovations, domestic and foreign buyers began acquiring access and the means to replicate the new American technology of uniform production. Even the Pratt & Whitney Corporation traces its origins to the Connecticut-Valley arms industry (McEliheny, 1986).

Early in the American Industrial Revolution, factories that were originally designed to make weapons for the military were converted and used to produce consumer products. McEliheny (1986) stated that,

> The Sharps Rifle Factory, built at Hartford, Connecticut, during the 1850s, was later purchased and used by the Weed Sewing Machine Company. After another decade, Alfred Pope began to manufacture the Columbia bicycle in the same factory, using the same basic processes and machining techniques. (p. 35)

Technology that originated in the military arms factories was adapted by the civilian population to manufacture technically related items. Scaled down versions of early military machinery was even used for the manufacture of watches in mid-nineteenth century America. The transfer of technology from the military to civilian manufacturers was quite rapid for the 19th century; occurring within the span of three decades between 1850 and 1880. During this same period, skilled individuals took technical expertise with them as they moved from industry to industry. This transfer of technology and the movement of skilled people is similar to what is happening today in the Silicon Valley (McEliheny, 1986). With the onset of the Cold War after World War II, this transfer of technology slowed and the movement of technology from the military to consumer applications became less frequent. This issue will be discussed in more detail later in the chapter.

Domestic Expansion

The military also played an early role in the westward expansion and in the development of the technological infrastructure throughout the United States. Some of the earliest railroads, canals, and roads in the United States were developed by the U.S. Army Corps of Engineers. The U.S. Congress passed the General Survey Act in 1824 which led to much of this development. Upon request, the law authorized the Chief of the U.S. Army Engineers to assign junior officers to assist private corporations in building roads, canals or railroads (McEliheny, 1986). McEliheny stated that: "The U.S. military deserves as much credit for initiating the U.S. Industrial Revolution as does Francis Cabot Lowell or Eli Whitney or Robert Fulton" (p. 38). There are scores of examples where the government or the military establishment entered into the promotion of industry. But that entry usually lasted only during the developmental stages. After a technology entered the marketplace and became commercialized, the government or military influence usually declined.

As one might expect, this early promotion of westward movement and industrial development served more than one purpose for the military establishment. By encouraging citizens to move westward throughout the United States, the military could promote the expansion of territorial boundaries and, in fact, justify the expansion of the military.

Contemporary Technological Development

The U.S. military has a long history of involvement in the development of technology and technological systems. By maintaining substantial federal research and development support, the military retains a leadership position in the development of technology. The military often has access to technology that the common person envisions only being available in theory. Some of the most technologically advanced computer simulation systems are currently being utilized at the Trident Submarine Training Facilities. Highly complex computer systems provide realistic simulations for submarine crews, not only in combat situations, but in ship control as well. Today's Trident submarine crews in training can conduct missile or torpedo launches in the classroom, utilizing the same equipment and computer systems that would be used in the actual submarine. After a training exercise, the simulation software provides crews and trainer evaluators with an opportunity to visually critique problem areas and actually assign additional training scenarios to reinforce learning. Similar technical trainers and computer software packages are used by military pilots for realistic air combat, flight control, and weapons performance training.

The U.S. Navy and the Human Interface Technology Laboratory at the University of Washington are now developing technology to move military training to another level, *virtual reality*. This may be one early (and even rare) example of a commonly available, contemporary consumer technology being adapted and used for military purposes. Expected to be fully functional in late 1995 or early 1996, the virtual reality simulation will train Navy personnel in a multitude of damage control scenarios, utilizing the latest in virtual reality equipment and technology (Stephens, 1994). The system will first be implemented to train crews on Arleig Burke-Class destroyers using training programs developed by the Sense 8 Corporation. Because the Arleig Burke-Class destroyers are the first warships to be designed on computer-aided-drafting (CAD) systems, they provide large and extensive databases of information about the ship (Greenfield, 1994). By converting the CAD data into a three-dimensional (3-D) virtual reality training program, realistic war-time team reactions and interactions can be assessed and analyzed without damaging equipment or compromising crew safety. Using virtual reality goggles and gloves, the trainees are provided with incoming damage and tactical information based on a Battle Damage Estimator database that will input appropriate damage that may be expected by certain enemy weapons. Use of the new simulation systems will allow for accelerated training, instant evaluation, and realistic simulation that will be of great value when the trainee is placed into actual combat situations aboard ship.

In another example of the military's advancing existing consumer technology for military purposes (the LOJACK automobile locating systems), the U.S. military has begun fitting vehicles, including tanks and helicopters, and troops with a radio device that will send locations and movements to orbiting satellites. The satellite then relays the information to surveillance planes and ground command centers. As the information is reviewed and updated, the on-board computers plot the position on a *battlefield* grid. The locations indicated on the grid will then be sent instantly to other military units via radio (Komarow, 1994). Jim Quinlivan, Vice-President of the Rand Corporation and an Army consultant states "that along with the new technology will come a new mindset and new military tactics" (Komarow, 1994, p. 5). Quinlivan compares the implementation of this new technology to the addition of helicopters by the Army over 40 years ago. If the initial testing program is a success, an initial $1 billion will be spent between 1993 and 1998 to upgrade existing equipment and incorporate the new technology (Komarow, 1994). Undoubtedly, computers and associated technologies are going to play an ever-increasing role in military matters.

Alan D. Campen, the former Director of Command and Control Policy in the U.S. Defense Department, stated that the Gulf War, "was a war where an ounce of silicon in a computer may have had more effect than a ton of uranium" (as cited in Toffler & Toffler, 1993, p. 69). Campen's statement underscores the military's increased reliance on computer technology. By the end of the Gulf War there were over 3,000 computers being used to coordinate and maintain military operations for the war effort (as cited in Toffler et al., 1993). The technology used in this war represented a significant change from earlier wars. During World War II, urgent radio and wireless transmissions took hours to reach Allied Commanders in or near the theater of operations. Critical battle information transmitted via computers during the Gulf War reached commanders almost instantaneously. Just as the Gulf War marked the military's entry into the information age, emerging computer technology will help shape the future of military operations.

However, not all modern technological developments by the military are considered advancements by the general society and many have been criticized by human rights groups. In 1995, when the U.S. Army began production of the Laser Countermeasure System (which fires a beam powerful enough to blind a person 1,000 yards away) the Human Rights Watch, a private citizens group, criticized the Pentagon and called for a ban on all laser weapons (Blinding Weapons Decried, 1995). The Army acknowledged the hazards associated with the weapon but insisted that the weapon (and two others currently in development) was not intended to be used against an enemy's eyes. The two other laser weapons in development included the Dazer and Stingray weapons. The Army insisted that the weapons were designed to disable electro-optical systems. The Human Rights Watch and the International Committee of the Red Cross have pressed the U.S. government to embrace a Swedish proposal to ban the use of blinding weapons in the same way that chemical and biological weapons have also been banned. Meanwhile, President Clinton has indicated that he supports the continued development of the technologies. He stated that, ". . . [a ban] would divert attention from the more immediate humanitarian problem of antipersonnel land mines" (Blinding Weapons Decried, 1995, p. 8). However, Clinton has pushed for a ban on antipersonnel land mines at the 1995 Vienna Conference.

Numerous other technologies are undergoing development, testing, and implementation within the U.S. military establishment. These technologies have the capacity of radically reshaping the nature and the capabilities of the military as well as the potential for sparking debate and concern among the citizenry. In the future, military commanders may have technology available that will enable them to see a battle unfold and evolve on computer screens (Komarow, 1994).

Technology is rapidly changing the face of military confrontation. Admiral David E. Jeremiah (1993), the Clinton Administration's Vice Chairman of the Joint Chiefs of Staff, stated that, "Future [conflicts] may increasingly resemble a game of electronic cat and mouse between the enemy's *hiders* and U.S. *finders*" (p. 5). Admiral Jeremiah further asserted that "given end-to-end integrated command, control, communication, computer and intelligence systems, commanders will be able to know, decide and act faster than the enemy at every turn" (p. 5). The Clinton

Administration's Army Chief of Staff, General Gordon R. Sullivan, U.S. Army, reinforced Admiral Jeremiah's comment by stating:

> We are digitizing the battlefield right now. We are in the process of upgrading intelligence, maneuver, fire support, sustainment and command and control platforms with advanced technologies that can gather, sort, and distribute information among themselves. These technological assertions and upgrades will allow our task forces to observe, decide, and act faster and more precisely than before. (Sullivan & Dubik, 1993, p. 58)

Upon reflection about the new developments in military technology, the 1969 Star Trek television episode depicting civilizations conducting warfare by vast computer systems with minimal human input, comes to mind. Do these images of computer modeling represent a future reality for military tactics? According to futurists Alvin and Heidi Toffler, they do. The Tofflers believe that "the day may well come when more soldiers carry computers rather than carry guns" (Toffler et al., 1993, p. 6).

The Final Frontier

What does the future hold for military technological development? The development of space-based military technology is the most likely future for military research and development efforts (Toffler et al., 1993). Most of the current research efforts in the military (Global Positioning System, surveillance satellites, etc.) involve technologies designed to use space and satellite technologies to extract a strategic military advantage. Like computer technology, the Gulf War may have marked a dramatic change in the way space and satellite technology will be used in future conflicts. The Gulf War was "the first instance where combat forces were largely deployed, sustained, commanded, and controlled through satellite communications" (Campen as cited in Toffler et al., 1993, p. 98). One of the space-based technologies used extensively during the war was the Global Positioning Satellite System (GPS). Because of the lack of natural recognizable features in the battle zone, the terrain was extremely difficult to navigate. To assist personnel in traversing the desert terrain, the U.S. military equipped a number of military aircraft with GPS receivers. Moreover, they issued handheld GPS receivers to ground troops. These GPS devices provided the users with instant latitude and longitude data (Chumley, 1992). The GPS is another example of technology suitable for civilian as well as military application. Given satellite availability, hopelessly lost civilian drivers operating a GPS equipped vehicle will be able to pinpoint their locations. GPS receivers have already been installed and are being used in many rental cars in Florida and California, and is becoming available in some other countries as well. This technology will continue to be useful in recovering stolen vehicles until car thieves learn to disarm the GPS mechanisms. The system is expected to be available as an option in new American automobiles by 1998.

In the past, space-based systems were primarily used for strategic applications. They have recently become an integral part of military intelligence, tactical planning, and communications. Because today's U.S. satellites are the *eyes* and *ears* of the military and have proven valuable in a real war scenario, all facets of space technology will have military significance in the future.

Technological Development and Human Conflict

Technological Solutions

The increased use of advanced technology in the military may increasingly lead to an American public that has a tremendous amount of confidence in the capabilities of technology, particularly military technology (Markert, 1993). This confidence may not be matched with an equal measure of technological understanding, and therefore may lead to blind faith in the ability of technology (and the military) to solve all kinds of problems. The military, in times of war, often uses new weaponry or inventions that have unforeseen long- and short-term consequences. Scott (1992) suggested that this unyielding trust in technology may occur because technological innovation proceeds more rapidly than the cultural or structural adjustments to them (see reference to cultural lag in Chapter 1), and because the effects of combat on participants are imperfectly understood.

During the Cold War, huge weapons development industries came into existence in the Soviet Union and in the United States. Militaries from both of these countries utilized the technologies available to develop weapons systems capable of maintaining a military threat. Citizens of both countries seemed to support the further development of these systems, even though they had little understanding of what was being developed.

The over-reliance on technology and the military establishment to solve technical problems may be a result of our own success in implementing new technologies in the public sector. Television news networks have become very adept at using former military technologies to transmit news from almost any location on the earth, and beyond. Meanwhile, society has become accustomed to receiving up-to-the-minute reports from almost any location.

Technological creations are developed to solve problems; however, these creations, whether originated by the military system or by civilian industry, always come with unforeseen side effects. It is exactly those unforeseen side effects that the public (and, in fact, the developers of the technologies) seems to understand the least. The development and dismantling of the nuclear arsenals in the United States and the former Soviet Union provides one vivid example. In what has to be one of the strangest conclusions to the Cold War, Lawrence Livermore Laboratories of California, a company that specialized in making nuclear weapons for the United States, has been contracted to help the Ukraine and Russia dismantle many of their nuclear weapons developed during the Cold War. However, unlike the nuclear weapons produced in the United States, the weapons built for the former Soviet Union were not produced to be dismantled. Whether the company will actually be able to dismantle the volatile weapons is still in question.

Solving Human Conflicts

Over the ages, technological (arms) development in the military has incorporated advances in human knowledge. The original legitimate purpose of arms development was to exploit an advantage in order to survive. Throughout history, weapons have provided a multiplication of a person's physical strength, making it possible for that person to expand and extend life both in space and time. Early arms helped humankind not only satisfy hunger and fend off wild animals as well as hostile members of their own species, but also to plunder and kill beyond what was necessary to secure their existence (Lohs, 1980).

When initially introduced, most modern weapons are hailed and promoted as defensive systems. However, these initial intentions almost always collapse after the enemy has developed a similar technological advantage. When World War I broke out, many military leaders around the globe wanted to draft the Holt (Caterpillar) tractor to haul siege guns. Holt engineers working with the British Royal Army adapted the Holt tractor to a metal shrouded machine that could shrug off machine-gun fire, break through barbed wire, and cross trenches. This was the first use of the tank; however, all participants in the conflict were using some version of the tank before the war's end (White, 1993). Similarly, most of the scientists in the United States who worked on the atom bomb during World War II did so with the intentions of averting the drive for power by Hitler and his allies. Many prominent scientists, like Niels Bohr and others, believed that the atom bomb would make another war impossible for all time. Such a belief may appear naive to scientists today, but this view, held by so many scientists after WWII, represented the contemporary scientist's belief that the weapon would only be used to secure survival (Lohs, 1980). One would have thought that by the 21st century, nations would have learned to live peacefully with each other, and to negotiate differences in a civilized and diplomatic manner. However, this still is not the case. In Chapter 1, Wiens and Wiens refer to the concept that the "technology makes the user," meaning, in this context, that if a country has military resources it will sooner tend to consider military solutions to its problems. If this is true, arming the world as the arms exporters are currently doing, will not lead to world peace, but likely to more aggression.

Weapons of Mass Destruction

Most modern weapons of mass destruction evolved from scientific and technological research that, in many cases, was intended for far different applications. The danger of misusing new scientific findings and technological potential for military purposes was realized as early as the second half of the 19th century when the chemical industry was established and extended into the military arena (Lohs, 1980).

One of the earliest weapons of mass destruction was first unveiled on April 22, 1915, when German soldiers released chlorine gas on Allied positions near Ypres, France, poisoning and killing about 5,000 men in a matter of minutes and seriously disabling thousands more (Lohs, 1980). The total casualties caused by chemical warfare agents during World War I are estimated at 1,300,000; this quantifies, in a terrifying way, as one of the earliest examples of technology being applied in arenas for which it was not originally intended (Lohs, 1980).

The U.S. military Chemical/Biological Defense program was originally developed after World War I with the objectives of enabling U.S. forces to survive, fight and win in chemically and biologically contaminated environments (Barker, 1991). The U.S. military, and militaries around the globe, have maintained and have continued to develop chemical and biological weapons throughout much of the 20th century. President George Bush, in his chemical weapons initiative of May 13, 1991, reversed the long-standing U.S. policy of maintaining a small reserve of chemical and biological weapons with a new, aggressive effort to obtain a signed multilateral agreement. This multinational initiative set forth the process and initiated treaties between NATO and the Warsaw Pact which banned the development, production, and use of these weapons (Barker, 1991).

Technological advancement and development by the military have historically been undertaken for the purpose of extracting a tactical advantage over the enemy while moving *friendly* soldiers further from danger. This strategic use of technological knowledge is increasingly producing a military machine in which technology may play a larger role than soldiers.

Impersonal Warfare

During the Gulf War, dramatic government selected video images made it clear to citizens around the globe that hundreds of bombers dropping thousands of bombs (or even tens of bombers dropping scores of bombs) are no longer needed to destroy a single target. Now, one aircraft, often delivering only one weapon, can destroy one target (Mann, 1993). Warfare had moved into the technological age. Bombing had become so precise that weapon systems had the capability of routinely identifying not just a building or a room, but the corner of the room that would bring everything down—even the ventilation shaft that would put the bomb inside the shelter. The U.S. military's technological capability was dramatically shown on television screens as viewers saw the accuracy of *smart munitions* and target acquisition systems (Livingstone, 1991). Precision-guided munitions (PGMs) now made it possible to *mass* against a target with only a handful of airplanes (Mann, 1993). Similarly, Global Positioning Satellite systems technology allowed soldiers fighting in the Gulf War to pinpoint enemy positions while stealth fighters penetrated enemy airspace undetected. "Technology is often heralded as having won the Gulf War. While not [completely] true, that perception is the prevailing self-sustaining myth" (Starry, 1993, p. 12). These new technologies had essentially taken many of the soldiers out of the battlefield and replaced the face-to-face nature of warfare with a blip on a computer screen. Because the television reports and footage shown were screened by the government, and information to the press was equally restricted, the people who watched the nightly news reports had reason to wonder (which few did) whether they were receiving an accurate accounting of technology performance.

Following the war, the Congressional Research Service issued a report that suggested that the high-tech weaponry performed far below the military's glowing assessments issued during the conflict (Gulf War weapons overrated, 1995). Pierre Sprey, a Special Assistant to the Assistant Secretary of Defense for Systems Analysis during the Johnson and Nixon Administrations, suggested that the citizens of the United States were poorly served by doctored statistics and hand-selected video clips of isolated successes that were feed to the media during the Gulf War in order to influence postwar budget decisions (Gulf War weapons overrated, 1995).

With good reason, much has been said and written about the technology used by the military during the Gulf War. The new military technologies first used in the conflict clearly shortened the conflict and most likely saved many U.S. lives. However, this same conflict may have ushered in a frightening new era in military conflict. This new era is one where technology makes it possible to fight a battle without ever seeing the battle or the enemy forces. Pentagon officials predict that, within the near future, the military will begin phasing out current methods of waging war, replacing them with futuristic techniques that would have been inconceivable even at the start of the Gulf War conflict.

The military's increasing ability to use computer links, communication systems, satellites and sensors to boost the range and accuracy of conventional weapons such as bombs and missiles means that U.S. troops increasingly will fight from longer distances, not actually moving into a battle zone until after most of the weapons in the area have been destroyed. Andrew W. Marshall, Director of the Defense Department's Office of Net Assessment, suggested that new forms of military tactics will be based on improved technology and may include some of the following methods:

1. Using precision-guided missiles to replace face-to-face combat.
2. Using space-based, intelligence-gathering satellites to track enemies, direct firepower and assess damage.
3. Replacing tanks, manned bombers, and aircraft carriers with super-smart missiles and high-speed land vehicles.
4. Launching massive invasions by using technology to direct land, sea and air forces simultaneously (cited in Toffler et al., 1993).

This means that impersonal warfare and advanced technological weaponry will increasingly be the model for future conflicts and the United States and its competitors will be vying to maintain what Marshall calls *information dominance*.

These new technologies and military strategies may also usher in an era where the horrors of war are only seen from a distance. Technology is changing the face of the military more rapidly than it has changed during any comparable time period since the inception of the U.S. military establishment.

The American Military Buildup

During the United States' first major military decade in the 1780s, Senator William Maclay of Pennsylvania cried out, "Give Knox his army and he will soon have a war on hand" (Morgello, 1969, p. 74). Henry Knox, Secretary of War under President George Washington, did not get the sixfold increase in manpower he wanted, but in 1790 he did persuade Congress to increase his force from 886 officers and men to 1,273. More recently, President Eisenhower warned the American people that the building of a huge military-industrial complex or acquiring unwarranted global influence (whether sought or unsought) would place the United States in a tenuous position (Morgello, 1969).

From 1961 until 1980, world military expenditures rose (in constant prices) by nearly 50% to reach a total of nearly $1 million a minute by 1980. The Third World share of this total had increased from about 3% in 1961 to about 15% in 1980. These figures suggested that the entire planet was well on its way to being fully militarized (Barnaby, 1980). After increasing every year from 1960 until 1989, global military expenditures dropped an estimated 6% in 1990. Preliminary tabulations from 1991 and 1992 show another drop of comparable magnitude (Brown, 1993). Although 6% may not seem like much, it amounts to $56 billion, a sum that exceeds expenditures on reforestation, soil conservation and family planning in the Third World (Brown, 1993). Figure 1 illustrates the recent (1991) drop in the worldwide number of offensive nuclear weapons. This drop represents the first year, since nuclear weapons were introduced, that did not end with an increased number of nuclear weapons available to the militaries of the world.

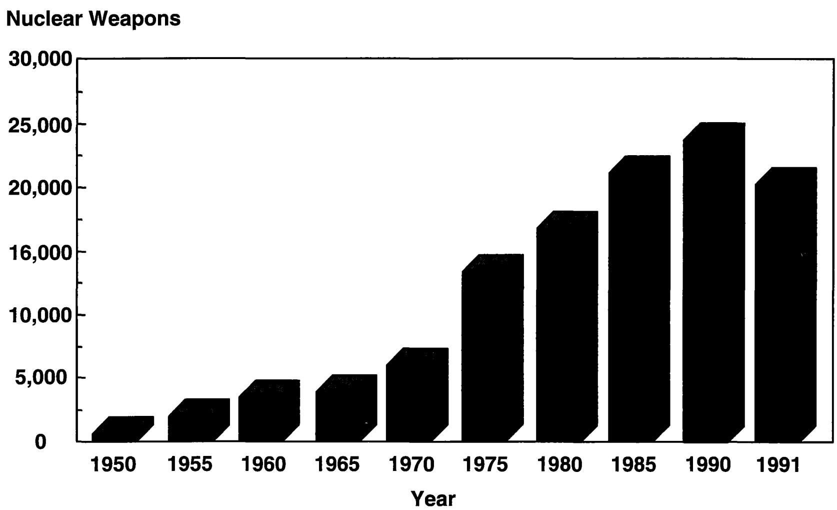


Figure 1. *Worldwide number of strategic offensive nuclear weapons (Brown, 1993).*

At the conclusion of World War II, only a few industrialized countries produced military weapons. By 1980, as many as 50 countries (about half of them in the Third World) were producing aircraft, missiles, armored vehicles and naval ships. At this time, world military expenditures were about double the gross domestic product of the whole of Africa, about equal to that of Latin America and about three-quarters of that of Asia, excluding Japan (Barnaby, 1980). By the early 1990s, more than 20 countries had confirmed or suspected chemical weapons programs and at least 10 had confirmed or suspected biological weapons programs (Barker, 1991). With the close of the Cold War between the former Soviet Union and the United States, the superpowers have become more reluctant or, in the case of Russia, less able to supply selected satellite countries with weaponry. This reluctance, or inability, to supply selected Second and Third World countries with weaponry, has led many to initiate the development of military industrial manufacturing capabilities (Klare, 1990).

However, this short-lived reluctance to provide military weaponry to Second and Third World countries may be coming to a close. On the November 26, 1994 edition of *Sixty Minutes*, a CBS News program, Ed Bradley reported that since the fall of the Soviet Union, the United States has become the world's major producer and marketer of military weaponry. In 1994 alone, United States military manufacturers made 72% of all U.S. arms sales to Third World countries—amounting to about $22 billion in sales (Bradley, 1994). U.S. military manufacturers marketing their products abroad is not a new venture; however, federal government funding and tax support for marketing military weaponry abroad is something new. Early in 1993, the Clinton Administration initiated an aggressive new policy aimed at assisting military manufacturers in the sale of weaponry abroad. Ed Bradley suggested that the U.S. government spent approximately $1 billion promoting the sale of military products abroad in 1993 and 1994, $400,000 at the 1994 Paris Military Show alone. The federal government has assisted these manufacturers by supplying soldiers, pilots, aircraft, and other military personnel and services. A number of foreign powers have even accused the U.S. Central Intelligence Agency (CIA) of conducting covert corporate and governmental espionage for American military manufacturers (Bradley, 1994).

With the development of new military weapons suppliers and the changing roles of the superpower nations, global military spending may again be climbing to another all-time high, surpassing $400,000 billion

(Klare, 1990). This apex figure, set in 1990, represented significantly more than governments spent on education (with 20% of the world's population being illiterate) and over 50% more than was spent on health care. Klare (1990) implied that the amount of money spent by developing countries was escalating when he stated that:

> Between 1981 and 1988, developing countries spent $345.6 billion (in 1988 dollars) to acquire over 37,000 surface-to-air missiles, 20,000 artillery pieces, 11,000 tanks and self-propelled howitzers, 3,100 supersonic fighter planes, and 540 warships and submarines. (p. 44)

Klare (1990) further suggested that the world powers have traditionally been responsible for the development of many weapons. He stated that:

> until 1982, the Soviet Union and the United States accounted for two-thirds of the world's weapon sales. From 1975 to 1982, six nations—the United States, the Soviet Union, Great Britain, France, West Germany, and Italy—sold 84 percent of all munitions ordered by Third World Countries. (p. 46)

However, most recently, nations like China, Brazil, Holland, Poland, Spain, Sweden and a host of others are cashing in on the world weapons business. Figure 2 illustrates the growing number of nations who are developing arms industries.

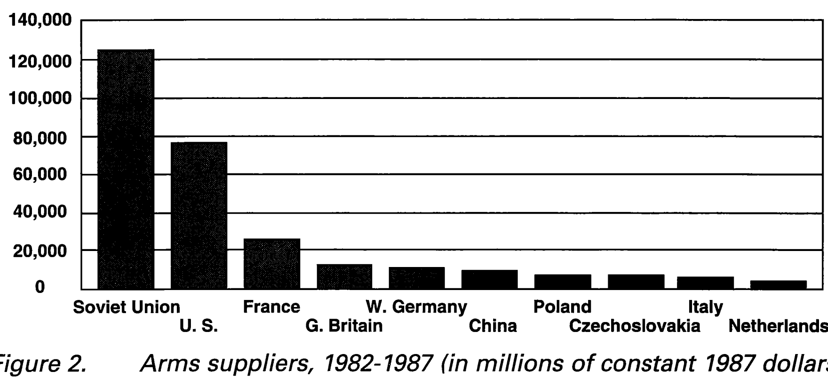
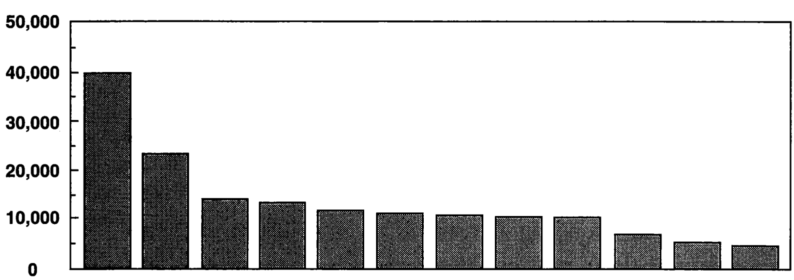


Figure 2. Arms suppliers, 1982-1987 (in millions of constant 1987 dollars) (Klare, 1990).

The global arms picture is likely to widen even more in the coming decades as still others seek to carve out a niche. India, Indonesia, Pakistan, Singapore, Taiwan, and Turkey have all announced plans to become major arms exporters (Klare, 1990). The increased competition among these suppliers will likely result in fewer manufacturers who are willing to cut off sales to nations or conflicting groups charged with human-rights violations and terrorism. Although recent global developments have led many Second and Third World countries to make at least some weapons, most nations still rely on the international market for a significant share of their military requirements. "According to the U.S. Arms Control and Disarmament Agency, some 107 Third World countries each imported at least $1 million worth of arms between 1983 and 1987" (Klare, 1990, p. 48). Figure 3 illustrates the growing number of arms importer nations.

No one measure can eliminate the violence now overwhelming the international community or curb the escalating spread of arms and military technological development throughout the world. However, if the world community can adopt a comprehensive system of international mediation, crisis control, and peacekeeping, the risk of nations using military force and conflict escalation might be lowered.



Iraq	Saudi Arabia	Syria	India	Libya	Iran	Cuba	Egypt	Vietnam	Angola	Israel	Ethiopia
39,718	23,207	14,263	13,411	11,995	11,233	10,999	10,801	10,754	7,502	5,646	5,256

Figure 3. Major Third World arms importers, 1982-1987 (in millions of constant 1987 dollars) (Klare, 1990).

Economic Realities of Military Buildup

After the conclusion of World War II, the Cold War buildup between the United States and the former Soviet Union progressed for almost 50 years through the development of an enormous number of conventional and technological weapons systems. The national dedication toward continued research and development of the weaponry and technologies necessary to continue the Cold War extracted huge costs on the United States, the Soviet Union, and their allies. These costs may be calculated along a number of lines: economic, environmental, social, etc.

The claim of *victory* in the Cold War (in the early 1990s) overlooks the enormous costs incurred by the United States. When World War II ended, America's economic power stood supreme; it accounted for nearly half the world's total production. After waging Cold War for nearly 50 years, and spending trillions on alliances, nuclear weapons, foreign aid, and military interventions, the American share of the world's gross national product had shrunk to about one-fourth (Clifford, 1992). The Cold War may not be entirely at fault in this matter, but it was certainly a major contributing factor. The defense budget, which stood at $13.5 billion in 1949, expanded to $300 billion by 1988. The United States' first trade deficit since the 1880s occurred in 1971, and increasing oil imports produced a stunning $148 billion deficit in 1985. From 1980 to 1988, the United States went from being the world's largest creditor to the world's largest debtor. The 1992 federal debt stood at $4 trillion with $300 billion in interest paid annually (Clifford, 1992).

Massive military spending during the Cold War eroded America's infrastructure by drawing off capital from other categories essential to the national welfare. The inadvertent spoils of Cold War victory included urban decay, falling savings, sagging agriculture, declining manufacturing, environmental degradation, and an economic underclass in which 35 million Americans live below the poverty level (Clifford, 1992). In the words of Russia's leading *Americanologist*, Georgi Arbatov, "both countries neglected their real problems, inside the country, and now have to pay for it. We have to pay more, you maybe less" (Clifford, 1992, p. 11).

At the conclusion of the Cold War, both the United States, Russia and their allies were left with aging arsenals and deep environmental scars, while the public sector in most industrialized countries around the globe had been developing new laws and generating a growing environmental consciousness. Meanwhile, military powers had, until recently, been ignoring the environmental consequences of military buildup. In the United States alone, the military's 871 domestic installations produce more tons of toxic waste each year than the top five U.S. chemical companies combined (Turque & McCormick, 1990). The environmental damage created by the Eastern Block and the former Soviet Union is calculated to be even more intense. The U.S. Department of Defense indicated that there are 8,000 military sites in the United States that may require some form of environmental restoration, a task that could take 20 years and $20 billion to complete (Turque & McCormick, 1990).

There is little doubt that the massive military buildup during the Cold War extracted, and continues to extract, a huge toll on all countries involved. In the future, historians may link numerous technological breakthroughs to the Cold War era; however, these same historians may also be forced to attribute the creation of a growing number of economic, environmental and social ills to this period of time.

The Military-Industrial Complex

In 1969, Morgello reported that the United States military-industrial complex was the nation's largest single activity. It employed one out of every ten working Americans. Although significant downsizing has occurred since 1969, the military remains stable as the nation's single largest employer (Sobke, 1992). The military is not only the nation's largest employer, but also its largest land owner. The Department of Defense's landholdings cover 25 million acres of America, an area the size of the state of Kentucky. The U.S. Army Corps of Engineers manages another 12 million acres of land through its Civil Works Programs. Tanks, troops, artillery, and aircraft share lands with a rich variety of wildlife. Installations include wetlands, forests, coastline, prairies and other ecosystems. These lands include cultural assets, as well as important historical and archaeological sites (Sobke, 1992). The military undoubtedly has had a pervasive economic, environmental, and social effect upon the United States and the world not only through military actions, but also through the development and proliferation of a massive military-industrial complex. The term *military-industrial complex* was coined by President Dwight Eisenhower to describe the private/public relationship between the corporate world and the military infrastructure. Although President Eisenhower was one of the earliest political figures to openly express concern over the military-industrial complex, strong relationships between the military and industry have enjoyed a long history in the United States and continue to do so.

In one of the earliest private contracts to build large-scale military equipment, the federal government contracted with James Buchanan Eads of St. Louis, Missouri to construct seven technologically-advanced gunboats for the Union Navy during the American Civil War. Eads developed one of the largest work forces (4,000) the United States had ever seen to complete the project (Gaden, 1994).

Private corporations have been vying for military contracts ever since. In fact, many corporations, such as McDonnell-Douglas, Hughes Aircraft, General Dynamics, Northrop, Lockheed, etc., owe their very survival to the production of military equipment and products. Likewise, many cities and communities in the United States have developed and flourished around private industries that specialize in making products for the U.S. military-industrial complex. The military-industrial complex expanded dramatically after World War II because the military economy, established in the United States during the war, had not been dismantled. Nor had the Soviet Union dismantled its military-based economy. In fact, during the years between the end of World War II and the fall of the USSR, the size of the military establishment had increased so considerably that it is not unreasonable to regard the American and Soviet societies as having been virtually militarized (Bawell, 1993).

Between 1960 and 1980, the world's armed forces increased by about one-third, to some 26 million persons (Barnaby, 1980). A high proportion of the world's scientists work only on military activities. Of the physicists and engineering scientists in research and development, for example, the majority are in military research and development (Sobke, 1992). Many of the technologies developed for military use are developed using the best and brightest scientists and engineers. A large portion of the world's basic research occurs in the United States, Canada, Japan, and the European Community. This research is usually conducted through some form of collaboration between government, industry, and academia with most of this research conducted for military or industrial purposes. However, industrialized countries which have not traditionally invested heavily in military research (i.e., Japan, and parts of the European

Community) are currently investing more heavily in industrial research to commercialize basic research findings. This places the United States, which still invests a disproportionate amount of tax dollars in military research and development, at an economic disadvantage (Snow, 1991).

Research and Development

Transfers of technological advances from the defense-related research laboratories to civilian sectors in the United States have led to the development of a number of vital consumer technologies. For example, nuclear weapons laboratories have been primary initiators of high speed computing, as well as being one of the first users of superconductors and associated hardware (Defense Conversion Commission, 1992). Additionally, computer system coding, utilized to provide nuclear explosion modeling has been adapted for use in automotive industry crash testing experiments. Similarly, Lawrence Livermore Laboratory's experiments and research in laser technology for the military have been instrumental in developing civilian uses for the laser. However, these transfers of technology from the military to the civilian sector represent a small percentage of the total number of technologies developed for the military and a small return on federal government research and development funds.

Members of the industrial community and the general public have recently increased pressure on the U.S. military establishment to make a more deliberate effort to transfer technologies developed for the military to private enterprises. The United States government's research and development efforts have historically been a predominant source of technological development in American society (Defense Conversion, 1992). Until recently, commercial applications of technology developed for the military were considered to be bonuses.

> It was understood that war—or in the case of the Cold War, conflict just short of war—often accelerated the rate at which technology evolved and that private industry could benefit. Yet there was little deliberate effort to introduce defense technology into the commercial arena. (Berkowitz, 1993, p. 74)

Numerous changes have taken place in the way the U.S. military and defense industries are perceived by the American public. Major adjustments to the *old line* policies of research and development, procurement, and utilization of defense-related technologies are becoming bureaucratic history. New technological advances are being discovered daily. These technological advances are helping add pressure on the U.S. military establishment to continue to be not only at the forefront of the development of new technologies, but also to contribute to the dual-use concept of technology sharing with commercial industry.

When compared to other industrialized nations, the U.S. defense community has been notoriously ineffective and inefficient in transferring technology, developed through military research and development funding, to the private sector. Military-funded research and development has not traditionally produced a large return on the investment dollar. In contrast, countries such as Japan and Germany have historically devoted "a much greater percentage of their government-funded research and development to industrial development, energy, and other fields that are more likely to yield commercial products and increase the standard of living" (Berkowitz, 1993, p. 74). Japan and Germany outpace U.S. companies in developing new products because the United States spends a disproportionate amount of research dollars on military research that have not been allowed to be used in the private sector.

Nearly two-thirds of taxpayer-funded research and development in the United States was spent on military programs in 1989. The defense portion of taxpayer supported research and development money far outdistances the government allocation in other research and development areas (see Figure 4). In 1992, the U.S. government spent over $68 billion on research and development (out of a national total of $157 billion). From these research and development monies, $41.5 billion was dedicated to defense-related research and development, with health concerns running a distant second (Defense Conversion Commission, 1992). Of the total U.S. government research and development budget for defense-related objectives, 45% was subcontracted through private research organizations. With the Cold War at an end, taxpayers are becoming increasingly anxious about the manner in which their taxes are spent.

The U.S. government research and development umbrella encompasses several laboratories either owned or funded by the federal government. These research facilities range from NASA's Jet Propulsion Laboratory and Nuclear Weapons Labs to small offices with minimal staffing. With the current cutbacks in weapons research and defense spending, it is

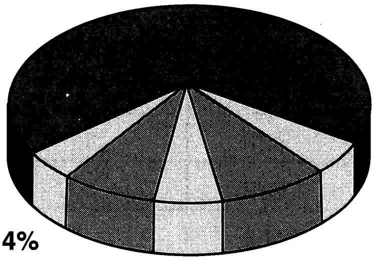


Figure 4. Federal research and development funding, 1992 (Defense Conversion Commission, 1992).

becoming more apparent that a concentrated effort must be made to redirect the wealth of research and development experience and facilities to meet basic civilian needs.

The Stevenson-Wydler act of 1980 established technology transfer as a part of U.S. policy and directed government laboratories to establish offices of research and technology applications to serve as a link between the government and the private sector (Berkowitz, 1993, p. 75). As a result of this, and other acts, certain fields grew rapidly, most notably the biotechnology and computer software industries. "Unfortunately, among all U.S. governmental departments and agencies with significant research and development programs, the Department of Defense has been the least effective in transferring this research and development to the private sector" (Berkowitz, 1993, p. 76). The U.S. Department of Defense is much less effective at transferring technological discoveries to the private sector than other governmental agencies. This is largely due to the different methods used to carry out research in the military in relation to the methods used to carry out research in other governmental agencies (see Figure 5).

Most technology developed and funded by the Department of Defense is not carried out in laboratories as stipulated in the legislative acts; therefore leaders in the military establishment have considered much of their research to be excluded from the federal acts. A second reason why the Department of Defense has been less than successful in establishing technology transfer is due to the fact that a large part of the research is carried

United States Agency of Department	R&D Budget ($ Millions)	Number of Active Technology Transfers	Ratio of R&D to Transfer
Commerce	580	115	5:1
Agriculture	1,328	177	8:1
EPA	496	31	16:1
Veterans Affairs	230	8	29:1
NASA	7,706	244	32:1
Transportation	446	9	50:1
Interior	583	11	53:1
Health and Human Services	10,218	144	71:1
Energy	6,514	43	151:1
Defense	40,043	193	207:1

Figure 5. Technology transfer (Berkowitz, 1993).

out under black or *special access required* programs. "Not only is access to the data produced in these programs tightly controlled, but sometimes the very existence of the program is not made public" (Berkowitz, 1993, p. 76). However, the single largest reason for the lack of technology transfer from military research and development to the consumer market is the low priority placed on technology transfer by leaders in the military.

Recent changes in the global military environment are beginning to provide the impetus for changing the prevailing attitudes in the military establishment. New cooperative arrangements between civilian industry and federal research and development agencies and laboratories have been forming since the close of the Cold War. New initiatives in this arena not only provide for joint use of new technologies, but ensure that the military utilizes and actively seeks existing technology and equipment from industry. In response to this mounting public pressure, President Clinton and Vice President Gore stated the administration's basic goals in their report, *Technology for America's Economic Growth, A New*

Direction to Build Economic Strength (1992), and emphasized the continued need for government investments in science research (Clinton & Gore, 1993). The goals outlined in this report are to provide stable funding for university research, national laboratories, space and science exploration, and environmental research. The same themes were reiterated by the Office of Technology Assessment in their report, *Defense Conversion, Redirecting R&D* (U.S. Congress, 1992).

President Clinton's Council of Advisors in Science and Technology (PCAST, 1992) has also addressed the problem of "the government's inability to develop and procure high-technology systems efficiently" (p. 8). During strategic meetings of this council in 1992, four challenges were developed to enable the United States to meet the science and technological threats to American industry and national security. These challenges included the following changes:

1. Keep defense R&D relevant and high quality in the face of reduced production.
2. Manufacture military parts and supplies in civilian commercial plants/factories.
3. Where military and commercial production and industry can be integrated, it should be possible to benefit from synergy in certain high-tech areas.
4. Defense Department must de-emphasize unique designs and systems that are of an esoteric nature. Future designs need to be manufactured in commercial plants with current commercial processes (PCAST, 1992, p. 8).

In 1993, the share of the civilian total for research and development was roughly 41%. The goal for the civilian share of federal research and development for 1998 is 50% with over a $10 billion increase in civilian research and spending (Clinton & Gore, 1993). This Clinton Administration initiative, if implemented by Congress, would slowly shift the federal research and development emphasis to the private sector while, at the same time, increasing overall federal research and development support. There is substantial public support, both in Congress and within the Clinton Administration, for cooperative research and development partnerships between the U.S. government and industry, including cost-shared agreements between companies, or consortia of companies, and government laboratories (Defense Conversion Commission, 1992). Initiatives like this exemplify the changing nature of the military establishment in the United States. As the military research and development and industrial base decreases during the defense drawdown, the federal government has begun to react to wide spread public pressure to ensure a prosperous future for the United States by initiating an effective transition from a defense priority to a private sector research and development priority.

Another positive aspect of the meshing of civilian and defense research and development has been the partial removal of the tight security associated with military or national security-tagged technology and research. The classification of many of the military's technology banks has reduced its use in the civilian sector to minimal levels. With the increased emphasis on the economic state of the country, the previously untouchable technologies developed for military purposes will be used to provide social and economic ammunition for the fight against critical health, science, and environmental issues (Aftergood, 1992).

Governmental Control

In 1989, the cost of protecting classified information in industry alone reached an astonishing $13.8 billion. The U.S. government classified 7,107,017 documents in 1992, an average of more than 19,000 documents per day. More importantly, at a time when economic security is far more at risk than military security, secrecy has prevented huge sectors of the nation's technology base from being applied to the commercial marketplace, thus hampering this country's economic competitiveness. Secrecy has also hindered scientific progress on issues critical to the world's health, such as global warming (Aftergood, 1992). Secrecy through classification is commonly abused by the executive branch of government as a mechanism for avoiding congressional or public oversight. Senator Daniel P. Moynihan, a former member of the Senate Intelligence Committee, recently stated, "The American people would be baffled if they knew the true size and extent of the intelligence budget. Boggled" (Aftergood, 1992, p. 81).

The budget for protecting military secrets is commonly estimated to be about $30 billion per year; however, this number must be estimated because the actual number is itself classified. A prime example of the overzealous nature of U.S. government secrecy can be found (if you have a security clearance) in the 1991 Central Intelligence Agency report on how the agency might achieve greater openness; upon completion, the report was classified. Although the Defense Department must present its annual budget to Congress and ask for an appropriation, money for classified work is handled separately, in an appendix which is seen only by certain members of the Armed Services Committees and Defense Appropriations Subcommittees. Numerous program failures, cost overruns, and instances of fraud have been attributed to this hidden or *black* budget. Excessive secrecy was implicated by congressional investigators in the collapse of the A-12 naval attack aircraft program, which cost taxpayers several billions of dollars. The A-12 program, initiated in the 1980s, was canceled in 1991 by Defense Secretary Richard Cheney after he discovered that he was being misinformed about it. Often the American public is the only group that is kept in the dark about such appropriations. In April 1992, while the Air Force maintained absolute silence about a classified space launch, details of the launch were announced by Tass radio in Moscow two days in advance. Tass identified the launch date and location, launch vehicle, and purported mission. All of the information was broadcast in English (Aftergood, 1992).

In science and technology, the need for openness is vitally important. Without free and open communication, the cross-fertilization of ideas that is essential for progress is inhibited and the peer-review process is crippled. Military secrecy, a throwback to the days of the Cold War, has not kept up with changes in the global environment. In the 1990s, excessive government secrecy seems to be actually slowing the flow of technological innovation. A number of emerging technologies developed in *black* programs that have commercial potential have been stifled before they have been given a chance at commercial success. For example, infrared sensors that do not require cryogenic cooling could be used to vastly improve the sensitivity of environmental monitoring systems; electrostatic fields that condition airflow around aircraft could dramatically reduce fuel costs for commercial aviation; and advances in materials science could be used to improve aircraft control and propulsion are all missed opportunities representing a *negative spinoff* phenomenon (Aftergood, 1992).

A defense contractor who develops a new technology within a black program can apply for a U.S. patent. But under the Invention Secrecy Act of 1951, the U.S. military can impose a *secrecy order* on the application and withhold the patent if it believes that patent approval could have a *detrimental* effect on national security. In 1991, a total of 5,893 secrecy orders were in effect, up from about 3,500 in 1980 (Aftergood, 1992). These interventions are often self-defeating, rendering some of the most talented engineers in the nation technologically and economically frozen since their products can never be sold, or even used, unless a defense agency decides it wants to acquire the technology for its own classified needs.

End of an Era

In the afterglow of the victory of the Gulf War, President Bush suggested that the United States had *won* the Cold War by a lopsided score and now international relations could begin anew; historians, however, have been hesitant to make such judgments. "Exactly what the seismic events of 1989-1991 portend for the United States and the world is uncertain" (Clifford, 1992, p. 26).

> It is not certain that the United States won the Cold War. Washington did outlast Moscow. The leaders in the Kremlin quit first. Its work force demoralized by low wages, absenteeism, and a corrupt party bureaucracy, the never robust Soviet economy became overburdened by the nuclear arms race and the ten-year war in Afghanistan. Hoping to slash military expenditures, which amounted to one-fourth of the state budget, Gorbachev also cut assistance to third world clients, reduced military forces in eastern Europe, and pursued arms control agreements with the United States. It was Gorbachev and the east Europeans themselves, not the Americans, who rolled back the iron curtain and ended the Cold War. (Clifford, 1992, p. 26)

Foreign policy in the post-Cold War era will not be easy. It will be necessary for the United States to forget the exuberant proclamations of millennialism that accompanied the end of the Cold War. However, the world's only remaining military and economic superpower can still wield influence for good or ill in an international system it can no longer control. The United States will certainly retain a role in writing the rules for a new world order in which the East-West contest is no longer a zero-sum game. But that role will be significantly different than roles played in the past. "One must hope that the new game will be about world cooperation, not mastery, and that Washington will be on the winning team" (Clifford, 1992, p. 30).

In the early 1990s, the American foreign-policy community discovered that the world is riddled with ethnic, nationalist, and separatist conflicts. Experts in the State Department proclaimed that the world was now more dangerous than it ever was during the Cold War. The foreign policy community usually describes these wars as products of the post-Cold War era. "They [ethnic, nationalist, and separatist conflicts] are nothing of the sort. Ethnic, nationalist and separatist conflicts have been occurring with grim reality for millennia" (Schwarz, 1995, p. 58). Schwarz suggested that military announcements about the new dangers in the world are uttered and met with as much relief as concern, for this new phenomenon supposedly means that expert advice, and Cold War bureaucracies, remain indispensable despite the end of the Cold War.

In his book, *Out Of The Cold: New Thinking for American Foreign and Defense Policy in the 21st Century,* Robert McNamara (1989) suggested that the former advisors of the Cold War should agree on a joint *Code of Conduct* under which they would:

1. Promise to pursue political interests through diplomacy and not through military force or the threat of force.
2. Agree to reduce substantially their military forces and balance them in defensive postures.
3. Pledge not to become involved in regional conflicts.
4. Agree to utilize international organizations such as the United Nations to help solve conflicts of interest among nations.

Such a Code of Conflict, if it had been applied in the past, would have eliminated unilateral interventions by both superpowers in such places as Vietnam and Afghanistan. It might well have affected the American decision to intervene militarily in Panama and Kuwait (Hopkins, 1990).

Military and Defense Drawdown

With the restructuring of the Soviet Union, the Cold War effectively came to an end and so too did the justification for a complex military machine. The Gulf War redefined the U.S. military doctrine and mission in much the same manner as it was redefined after the Korean and

Vietnam conflicts. The prevailing picture of nuclear warheads raining down on American cities and the *Doomsday Machine* of Stanley Kubrick's satirical motion picture *Dr. Strangelove*, showing the world on the precipice of mass destruction, was altered.

Since the conclusion of the Gulf War, Americans have begun to experience the restructuring and drawdown of the military and cuts in defense spending. In relation to the overall size of the national economy, the projected cutbacks in defense spending should not create a long-term national impact. If accurate, the projected drawdown and defense cutbacks will accelerate a reduced share of the gross national product designated to the military. These changes will undoubtedly have some short-term impact on defense workers, communities and local economies.

> It is in the defense-dependent communities that reductions in defense spending can hurt most. Without detailed analysis at the local level, it is impossible to say just how many American communities are highly defense-dependent, but a rough estimate (based on the value of prime defense contracts per capita and the presence of the military bases scheduled for closure) is 160 of the Nation's 3,137 counties. (U.S. Congress, Report #524, 1992, p. 3)

By contrast, the 1990 report, *Converting to a Peaceful Economy*, suggested that the military economy has provided an artificial or mythical economic gauge (Renner, 1990). This report indicates that in 1981, over $1 billion was dedicated to guided missile production, creating a base of over 9,000 jobs; in the production of military aircraft, a yield of over 14,000 jobs would occur. By comparison, the same defense dollars applied to a local city transit program could generate over 21,500 transit related jobs and 63,000 positions for educational services. The report references Employment Research Associate figures and estimates that a $40 billion conversion program could yield as many as 650,000 jobs (Renner, 1992). Using these figures, and logic, it could be surmised that the economic impact of the drawdown might, in the long run, be a catalyst to other industrial and government programs. Some in the military establishment argue that military monies are, in fact, spent on military installation schools, recreation centers, and public facilities; however, these dollars could undoubtedly be spent more economically in the public sector (Berkowitz, 1993).

In December of 1992, the Defense Conversion Commission filed its report *Adjusting to the Drawdown.* Through special hearings and meetings, the commission addressed the numerous questions of how current and future defense spending reductions would affect the citizens of the United States. The DCC had several historical precedents to reference, including the drawdowns following the Vietnam and Korean Wars as well as World War II. The present reduction has, for the most part, been ongoing since 1989 and has provided gradual economic shifts and adjustments to the drawdown. Fortunately, the drawdown impact will be felt the most in only a few concentrated geographic and industrial areas. The commission goes on to suggest that although the problem is national in scope, recommendations and solutions must be targeted to the hardest hit regions and industries (Defense Conversion Commission, 1992).

One industrial site that is likely to be devastated by defense spending reductions is the Bath Iron Works Company in Sagadahoc County, Maine. Bath Iron Works receives over 11 times more funds per capita for prime defense contracts than the national average. Similarly, General Dynamics Electric Boat Submarine Division in New London, Connecticut, receives over 18 times the national average (U.S. Congress, Report # 552, 1992). As defense budgets continue to shrink, the short-term economic impact on these communities will be extremely significant. However, it might be argued that these industries and the people who worked and lived in the communities surrounding these industries were living (and profiting) at the expense of the taxpayer for two generations, and while they may have fulfilled a vital service to the United States, their services are no longer required. Therefore, to encourage overall economic growth, it is time for these industries, and the people who worked in them, to enter into industry and occupations that produce *real* revenue and GNP for the country.

Although almost everyone in the United States agrees that in light of global events in the early 1990s, the United States' defense spending must be decreased, many members of Congress are hesitant to sacrifice or hurt their own districts for the benefit of all, and most politicians have not been willing to put aside the needs of their constituents to spread the burden and prosperity over all economic boundaries (Defense Conversion Commission, 1992).

The reduction of defense spending in the United States will also undoubtedly affect not only specific economic areas, but social issues as well. The U.S. military has increasingly become a source of employment opportunities for minorities and inner-city youth. "The armed forces have become the most color blind institution in the United States." Perhaps no other *industry* has provided more opportunities for minorities to advance into high level positions than the U.S. military, and the defense downsizing is likely to affect these groups more directly than any other single group of Americans (U.S. Congress, Report # 552, 1992). However, with the increased emphasis on technologically advanced weapon systems, the military establishment had already been systematically reducing the number of positions available for individuals who lack advanced education, and many inner-city youths who have traditionally entered into military service lack advanced educational training. With the continued military drawdown, many minority and disadvantaged citizens may increasingly find fewer government-sponsored opportunities. Schwartz (1995) indicated that, although the U.S. military forces are experiencing reductions, an average of 200,000 young people continue to enlist in the services each year. Schwartz continued by stating that "Ninety-eight percent of those who enlist have a high school diploma, and most come from middle-class suburban backgrounds" (p. 69).

America the Superpower

Many questions about the role of the United States as a superpower and world peacekeeper remain unanswered in the mid-1990s. Paul Kennedy (1993) suggested that the United States was in a transition phase with respect to its role as a *global police force*. When the global and nuclear threat of the Soviet Union eased after the conclusion of the Cold War, it was initially a foregone conclusion that the definitive reasoning for a U.S. military presence throughout the world was in question. The United States entered a period of military self-restraint where the lack of visible threats and fear of casualties discouraged any use of American forces abroad. Military leaders however, insisted that instead of one *superpower* threat to the world (i.e., Soviet Union), the United States now faced increasing international pressure to become involved in erupting regional conflicts, each having its own potential geo-political impact (Snow, 1991; Sobke, 1992; Mann, 1993). They insisted that instead of a relatively stable Soviet nuclear threat, the U.S. military and political establishment would increasingly be called upon to intervene in global conflicts involving religious and ethnic disputes as well as human rights issues. This line of thought was based on the fact that although a major change in the worldwide military configuration had occurred, the worldwide nuclear threat from newly independent and nonaligned states had not been eliminated. This *threat* was interpreted by many in the military as meaning that rather than a unified nuclear capability from the former Soviet Union and the United States, the world might now face numerous threats from unstable and independent former Soviet states, each with nuclear capability. Paul Kennedy (1993) stated that "if any of the former Soviet States revert to hard-line political control and attempt to revive the policies of the Soviet Union, they could pose global as well as regional threats" (p. 23).

With the collapse of the former Soviet Union, enforcement and verification of treaties like the START II bilateral treaty and others between the superpowers became much more difficult (Defense 92, 1992). Military leaders in the United States suggested that this break-up might cause an increased number of threats to the United States. The threat model reflects the perceived shift from a single-threat scenario to a broad spectrum of potential threats. In Jeremiah's (1993) study, it was suggested that by the year 2025, the world's population will approach 10 billion people—nearly double the current population. Competition for natural resources such as gas, oil, and clean water will be fierce. As much as one quarter of the earth's population will be malnourished and in need of economic support and assistance. Without global commitment and cooperation by all governments, many Second and Third World countries might resort to force and nuclear capabilities (Jeremiah, 1993).

These global changes have resulted in the United Nations increasingly looking upon the United States as the only remaining superpower that has the resources to project and maintain a global presence. Without the support and military machine of the United States, any ultimatums imposed by the United Nations might be unenforceable. Paul Kennedy (1993) suggested that several Second and Third World countries were emboldened by the perceived lack of threat of superpower retaliation after the Cold War concluded. Post-Cold War tension also increased systematically by the threat of smaller (former Soviet Block countries) which had retained

1983	1993	2013
Superpower confrontation	Nationalism	Environment
Regional Wars	Regional Wars	Nuclear Proliferation
Terrorism	Civil Unrest	Ethnic/Religious Conflict
Nuclear Exchange	Economic Competition	

Figure 6. U. S. threat prediction (Kennedy, C., 1993).

nuclear weapons capabilities. Paul Kennedy (1993) goes on to suggest that the United States must continue to hold a significant military position and responsibility worldwide. He (1993), writes:

> In general, the leading power favors international stability, to preserve the system in which it [the U.S.] enjoys great influence and wealth; usually it has inherited a vast legacy of obligations and treaties, promissory notes to distant allies, and undertakings to keep open the world's seaways. But executing a special leadership role includes the danger of becoming the world's policeman, combating threats to "law and order" whenever they arise, and finding evermore "frontiers of insecurity" across the globe that require protection. (p. 27)

Since the conclusion of the Gulf War, the United States has become increasingly unwilling to become involved in international conflict, as witnessed by the strong opposition to an American military presence in Somalia, Bosnia, Haiti and Rwanda. In an international climate, where countries have little faith in the U.S. military resolve, many Second and Third World countries may become overly confident in their own military prowess.

Geo-political Changes and Demilitarization

The changes that occurred around the world during the first two years of the 1990s were truly phenomenal. The world watched the dissolution of the Warsaw Pact, the reunification of Germany, the independence of the Baltic republics, and the disintegration of the Soviet Union (Baca, 1992). The pace of change and competition over technology have become issues in international relations, especially as more traditional forms of competition (such as military power and industrial might) recede as effective means for exercising national influence and as nations seek scientific and technological advantage in order to pursue national objectives and guarantee security (Snow, 1991).

Military technology has reached the point where further weapons developments (except possibly those with only defensive characteristics) are totally unnecessary. These geo-political changes around the globe have caused the U.S. military to focus on issues unheard of only a short few years ago. One of those issues is the demilitarization of former military strongholds. In one remarkable logistic achievement, the U.S. Army removed, without incident, the entire U.S. stockpile of chemical weapons from Europe. In June 1991, the United States and Germany collaborated to move approximately 100,000 rounds of chemical munitions to a German port for shipment to the U.S. disposal site in the Pacific. The 100,000 rounds of munitions had been stored since 1968 at a U.S. Army site near the small town of Clausen, Germany. The munitions included 155-millimeter (6-inch) howitzer projectiles and 8-inch artillery rounds, each containing one of two types of lethal, fast-acting, liquid nerve agents (Fowler, 1991).

Geo-political changes and American demilitarization have forever changed the role of a superpower. A superpower in the future will have to serve as a peacemaker, a negotiator, a policeman, and (as the following case illustrates) a salvage and clean-up team. In the wake of the four-day ground war against Iraq, the U.S. Army mounted the largest military civil reconstruction operation since World War II in an effort to restore the shattered country of Kuwait (McDonnell, 1993). The amount of structural damage was less than anticipated, but the entire country was without water, electricity, sanitation and other basic infrastructure. The schools in Kuwait had been closed for nearly a year, since the Iraqi invasion, and their reopening was an important indicator of a return to normalcy. The schools had been used as troop medical clinics, command and control headquarters, supply points, and billets, while the gymnasiums were used for vehicle maintenance. The schools had been badly damaged by extensive Iraqi looting, arson and vandalism (McDonnell, 1993). Roads within Kuwait City were littered with destroyed military vehicles, abandoned cars, mines and bomb craters. Iraqi occupation troops had also erected numerous barriers, fortification bunkers and guard houses at intersections and overpasses in Kuwait City that had to be removed (McDonnell, 1993). The removal of chemical weapons from Europe and the rebuilding of Kuwait illustrate future roles that may be undertaken by the U.S. military. In the future, the U.S. military may increasingly play nonhostile roles that assist rather than attack nations.

Influencing the Social Agenda

Since the conclusion of the Vietnam War, and certainly since the conclusion of the Gulf War, the social and economic perceptions of the U.S. military have continued to shift radically. This realignment of social perceptions, with respect to the military, has most recently begun to affect the military and the role the military plays in the U.S. social agenda. Early in the 1990s, public support for international interventions by the U.S. military began to diminish, as it had during and after the Vietnam War. Public sentiment moved the military's need to respond to a perceived threat to a secondary position, a position somewhere below social problems like drugs, crime, and health reform. Without perceived internal threats to Americans, many citizens (in the early 1990s) began to believe that the military machine lacked a defined mission. Charles Kennedy suggested that the military's purpose should be to ensure that, in wartime, the economic and social elements of peacetime cannot be neglected and, by the same token, in peacetime the need for an effective military and defense cannot be neglected (C. Kennedy, 1993).

The American military, with the absence of a superpower threat, has begun to play an increasing role in social conflicts and the social agenda.

In early 1991, President Clinton called upon the U.S. military establishment to take a more active role in domestic problems—most notably, crime in America. By late 1994, the Pentagon and the Justice Department were beginning to determine which military technologies might be best used to fight the war on crime. The 1994 Crime Bill provided over $15 billion toward the war on crime, with a significant portion devoted toward drafting military technologies for use in the national *war* on crime. By using the latest military technology and equipment and adapting it to civilian police force requirements, significant progress and technological advances could be attained (Barry & Morganthau, 1994). The new global environment is rapidly creating a need to develop new military tools that can be used to keep the peace or fight future conflicts without killing people.

The changing role of the military and the search for new tools used to fulfill this role spawned the first systematic effort to develop nonlethal weaponry in U.S. military history. In 1994, Defense Undersecretary John Deutch authorized a team of Pentagon officials to explore the feasibility of nonlethal weapons (Barry & Morganthau, 1994). Nonlethal weapons (NLW's) have a long history in warfare. The ancient Greeks used smoke to conceal troop movements around 425 B.C. (Barry & Morganthau, 1994). Some modern NLWs, like the proposed riot gun that shoots tiny beanbags, could be used to quell social unrest or riots without permanently harming people. During the recent Gulf War the U.S. military, for the first time, used an NLW. The U.S. Navy launched cruise missiles that showered electrical generating plants around Baghdad, Iraq, with millions of tiny carbon filaments. Air Force Colonel John Warden, Commandant of the Air Force Command at Staff College at Maxwell Air Force Base, in Montgomery, Alabama, stated, "We wanted to defeat Iraq, not destroy it" (Barry & Morganthau, 1994, p. 24).

The list of exotic weapons currently under development by the U.S. military is large and growing. Some of the weapons include: lasers, microwaves, sound waves, strobe lights, electromagnetic pulses, microbes, chemicals, and computer viruses that can effectively cripple an entire society; supercaustics that eat through metal, rubber or plastic; supersticky foam that traps victims; or, avalanches of soap bubbles that restrict sight, hearing and movement (Barry & Morganthau, 1994).

Summary

While military leadership, preparation, and dedication often come from within, technology must be sought, developed, and acquired from without, since the military does not make its own weapons but contracts with industries. Government research and development dollars spent directly on nonmilitary technology development will, undoubtedly, provide more commercializable products and, hence, will contribute more to U. S. international competitiveness than relying on spinoffs from military R&D. But our military advantage must not be compromised in this process. Undoubtedly, the many technological advances brought about by the U.S. military-industrial complex have affected every citizen of the United States as well as many citizens of the global community (Livingstone, 1991). Opportunities abound to do much better with less money, materials, or manpower in the future.

Clearly the role of the military in a post-Cold War environment has changed. The future role of the military will involve increased social, environmental, and economic activities. The military will have to be prepared to pursue initiatives that enhance the quality of life for Americans and people from around the world. In the future, the military may measure its success not only by winning the battles, but also by winning the peace!

The discussions outlined in this chapter prompts the following question, What is the future role of the military? The U.S. government and the citizens of countries around the globe must make decisions about the purpose of the military and its function within the framework of society. Although the defense of the country and its vital interests is a given, with the absence of a viable military threat, the U.S. military must begin to focus on domestic issues, expanding commercial research and development bases, and establishing a role as a global peacekeeper. Undoubtedly, future military and defense cutbacks will impact the military establishment; however, by refocusing the mission of the military establishment, these impacts can be minimized. The U.S. military of the 21st century will only vaguely resemble that of its predecessor. The military of the future will be more socially responsible, environmentally conscious, and more capable of flexing and adapting to the changing needs of American and global citizens.

REFERENCES

Aftergood, S. (1992). The perils of government secrecy. *Issues in Science and Technology, 8*(4), 81-88.

Baca, T. E. (1992, July/August). DOD's environmental agenda for the 1990s. *Defense*, pp. 2-12.

Barker, R. B. (1991, May/June). The future of the DOD chemical/biological defense program. *Defense*, 24-28.

Barnaby, F. (1980). *Ethical dilemmas in weapon development.* Paper presented at the Stockholm International Peace Research Institute, Stockholm, Sweden.

Barry, J., & Morganthau, T. (1994, February 7). Soon, 'Phasers on Stun.' *Newsweek,* pp. 24-26.

Bawell, W. A. (1993, July/August). Policy implications of new technology. *Professional Bulletin of United States Army Logistics*, pp. 4, 6-8.

Berkowitz, B. D. (1993). Can defense research revive U.S. industry? *Issues in Science and Technology*, 73-81.

Blinding weapons decried. (1995, May 22). *The Pantagraph*, pp. 1, 8.

Blow, M. (1960). *Men of science and invention.* New York: Harper & Row.

Brown, L. R. (1993). Vital signs. *Buzzworm: The Environmental Journal, 5*(1), 42.

Chumley, R. A. (1992). Guarding the high frontier. *Airman, 36*(3), 20-29.

Clifford, J. G. (1992). History and the end of the Cold War: A whole new ball game. *OAH Magazine of History, 7*(2), 26-31.

Clinton, W. J., & Gore, A. (1993). *Technology for America's economic growth: A new direction to build economic strength* (Publication No. 1993-347-397/80142). Washington, DC: U.S. Government Printing Office.

Defense 92, (1992). *Defense 92 Almanac.* (DOD Publication No. ISSN 0737-1217). Washington, DC: U.S. Government Printing Office.

Defense Conversion Commission (1992). *Adjusting to the drawdown.* Washington, DC: U.S. Government Printing Office. (no report or publication number listed).

Fowler, D. (1991, March-April). Removing chemical weapons from Europe. *Army Logistician: Professional Bulletin of United States Logistics*, pp. 36-39.

Gaden, E. L. (1994). Eads and the Navy of the Mississippi. *Invention & Technology, 9*(4), 24-31.

Greenfield, R. P. (1994). Toward a virtual Navy. *Newmedia, 4*(4), 33.

Gulf War weapons overrated. (1991, April 23). *The Pantagraph*, pp. 1, 8.

Hopkins, F. S. (1990). Putting an end to the Cold War. *The Futurist, 24*(2), 40, 46.

Jeremiah, D. E. (1993). What's ahead for the armed forces. *Defense 93, 1*(1), 3-5.

Kennedy, C. (1993). The dimensions of threat. *Looking to the future, TRADOC's 20th Anniversary Seminar on Warfare*, US Army Training and Doctrine Command, Fort Monroe, VA., pp. 29-35.

Kennedy, P. (1993). *Preparing for the twenty-first century.* New York: Random House.

Klare, M. T. (1990). Who's arming who? The arms trade in the 1990's. *Technology Review, 93*(4), pp. 45.

Komarow, S. (1994, April 4) Army adding byte to the battle. *USA Today*, p. 5.

Livingstone, S. (1991, July/August). Technology: The logistician's quest. *Professional Bulletin of United States Army Logistics*, pp. 4, 12-13.

Lohs, K. (1980). *The ethical dilemma of arms development.* Paper presented at the Stockholm International Peace Research Institute, Stockholm, Sweden.

Mann, L. C. E. (1993). One target, one bomb: Is the principle of mass dead? *Military Review, 73*(9), 33-41.

Markert, L. R. (1993). *Contemporary technology: innovations, issues, and perspectives.* South Holland, IL: Goodheart-Willcox.

McDonnell, J. A. (1993). Rebuilding Kuwait. *Military Review*, *73*(7), 51-61.

McEliheny, V. (1986). Swords into plowshares. *American Heritage of Invention and Technology*, *1*(3), 34-40.

McNamara, R. S. (1989). *Out of the cold: New thinking for American foreign and defense policy in the 21st century*. New York: Simon and Schuster.

McNeil, W. H. (1982). *The Pursuit of Power*. Chicago: University of Chicago Press.

Morgello, C. (1969, June 9). The Military-Industrial Complex. *Newsweek*, pp. 74-87.

Presidents Council of Advisors on Science and Technology. (1992). *Science, technology, and national security*. Washington, DC: Office of Science and Technology.

Renner, M. (1990). Converting to a peaceful economy. *State of the World 1990*, pp. 154-162.

Schwarz, B. (1995). The diversity myth: America's leading export. *The Atlantic Monthly, 275*(3), 57-69.

Scott, W. J. (1992). PTSD and agent orange: Implications for a society of veterans' issues. *Armed Forces & Society*, *18*(4), 592-612.

Snow, D. M. (1991). National security: A preliminary assessment. *Armed Forces & Society*, *17*(2), 243-258.

Sobke, J. F. (1992, July/August). DOD diversifies conversation strategies. *Defense*, pp. 13-19.

Sprague de Camp, L. (1993). *Heros of American invention*. New York: Barnes & Noble Books.

Starry, D. A. (1993). TRADOC at twenty. *Looking to the future, TRADOC's 20th Anniversary Seminar on Future Warfare*, U.S. Army Training and Doctrine Command, Fort Monroe, VA., pp. 9-17.

Stephens, K. (1994). Sailing the silicon sea. *All Hands*, *924*(1), 36.

Sullivan, G., & Dubik, J. (1993). War in the information age. *Military Review*, *4*(1), 46-61.

Toffler, A., & Toffler, H. (1993). *War and anti-war.* New York: Little, Brown and Company.

Turque, B., & McCormick, J. (1990, August 6). The military's toxic legacy. *Newsweek*, pp. 20-23.

U.S. Congress, Office of Technology Assessment, (1992). *After the cold war* (Report No. OTA-ITE-524). Washington, DC: U.S. Government Printing Office.

U.S. Congress, Office of Technology Assessment, (1992). *Defense conversion* (Report No. OTA-ITE-552). Washington, DC: U.S. Government Printing Office.

White, N. (1993). From tractor to tank. *Invention & Technology, 9*(2), 58-63.

DISCUSSION SCENARIO

Nuclear Terrorism

The year is 2003 A.D. Three years after the civil war in the Banji Republic two major factions are continuing an internal struggle for power and the country has essentially disintegrated into a society of anarchy. However, the struggle has also crossed international borders and has evolved into a war of terrorism. One faction, the Bishad Fundamentalist Front (BFF) believes that the U.S. military establishment has been secretly supporting the opposing faction, the Democratic Reform Party (DRP), and there seems to be support for this assertion. Subsequently, the BFF has declared a war of terrorism on the United States. A number of recent bombings and acts of terrorism near U.S. military establishments in Europe have been linked to the BFF.

You are the incoming Commander of the U.S. Joint Chiefs of Staff, the highest ranking military officer in the United States. The director of the CIA and the President of the United States have called you to a cabinet meeting to discuss a communiqué received from the leaders of the BFF. The leaders of the BFF claim to have purchased about 3 pounds of plutonium from one of the *cash-strapped* former Soviet Republics. The BFF claims to have constructed a nuclear weapon from this plutonium. The communiqué states, "The weapon is now complete, is inside the United States and could be relocated within the city limits of Washington D.C. on short notice. The weapon will be delivered and detonated within the next 24 hours if the BFF does not receive $450 million." The communiqué goes on to give instructions for delivering this money to overseas bank accounts.

This type of international blackmail has increased dramatically since the incident in 1994 in which, then President Clinton, essentially paid the North Korean government to stop developing a nuclear capability. Thus far, the CIA has been unable to locate the weapon, but have collected strong evidence to substantiate the fact that plutonium was purchased and the weapon may indeed exist.

As Commander of the Joint Chiefs of Staff, you must make several decisions:

1. What actions can the military take to prevent a catastrophe from occurring?
2. If the U.S. government were to decide to pay the terrorists, how could you be assured that the weapon would be dismantled or turned over to the U.S. military establishment?
3. Should the public be notified? If so, how could you prevent wide-spread panic?
4. If payment were to be made, how could you be assured that it would not be used to develop more weapons and make the BFF an even stronger terrorist organization?
5. Do you have any alternatives? If so, what are they?
6. What actions can you take to stop the illegal sale and delivery of weapons-grade plutonium on the international black market?
7. If you decide to make payment, what precedent might this set for the future?

Sao Poma

You and four members of your immediate family recently moved to the United States to join family members who had legally emigrated to the United States some five years ago. Your native country, the small South American country of Sao Poma, has been experiencing upheaval for a number of years—and leaving may have been a matter of survival. Sao Poma is one of the smallest republics on the South American Continent and has long been under the military umbrella of the United States military. For more than a century, Sao Poma had been a peaceful, quiet, agrarian-based republic. Sao Poma is neighbored by Donitu, a long-standing rival country. The countries were, during Portuguese rule, one country. Since independence in 1879, Sao Poma and Donitu have prospered at modest rates, but both countries have continued to dispute territorial boundaries. However, peace remained during the period in which the United States military provided assistance to Sao Poma. Donitu has continued to amass huge military stockpiles and military might under several dictatorships.

The current upheaval in Sao Poma has been caused by a number of factors, including: (1) recent political changes in the United States have called for the U.S. military to become a national defense force-abandoning all international commitments, (2) huge petroleum deposits were recently discovered near the border between Sao Poma and Donitu, (3) Donitu nationals have begun laying claim to most of the Sao Poma region containing the large petroleum deposits, (4) General Raol, the latest in a long series of military dictators in Donitu, seems to have been emboldened by the U.S. military departure from Sao Poma and has begun amassing troops near the disputed border, (5) A Donitu spiritual leader has written a book in which he claims that Donitu natives have superior racial heritage over the "mongrel" Sao Poma peoples, and (6) General Raol has begun to tie any and all Donitu problems to the parasitic effects of the inferior Sao Poma natives.

Needless to say, the Sao Poma Republic is in a state of turmoil. Many citizens have begun to espouse that they are Donitu by heritage and hate crimes against traditional leaders in Sao Poma have become rampant. Government police forces have begun to try to form some type of military defense force, but have not been very successful. The Sao Poma Republic has signed a peace treaty with General Raol of Donitu, in which most of the contested region was ceded to Donitu (this included most of your relatives' land). Most citizens of Sao Poma recognize that it is just a matter of time before General Raol asks for more. There is some evidence to suggest that many of the Sao Poma citizens that lived on the ceded lands have been imprisoned in forced labor camps. You fear for your relatives, your native country, and the citizens of Sao Poma.

You have been called to testify before the U.S. Congress next week. You realize that during your testimony you will have the chance to speak before millions of Americans and the only governmental body in the world who has the capacity to stop General Raol and save the citizens of Sao Poma.

Questions:

1. How will you prepare?
2. What will you say?
3. How will you convince Congress and the American people to change their minds about international military assistance?
4. What other actions can you take to save your native land?
5. Do you think this scenario could become a reality in the not-too-distant future?

Can a Pig Start a War?

This is a true story. Can you guess how it concluded?

During the development of the Oregon Treaty of 1846, the strait between Vancouver Island and the mainland was selected as the boundary between British and American territories. But after more accurate maps were developed it was discovered that there were two straits, and San Juan Island was between them. Great Britain and the United States both claimed the island and quickly sent settlers to take up residence. When America tried to tax some produce grown by British farmer John Griffin, the farmer refused to pay. Griffin insisted that he was not an American subject, and therefore, was not required to pay taxes to America. In 1859, one of Griffin's pigs wandered away and began rooting around in the potato patch of an American farmer named Lyman Cutlar, who promptly shot it. Griffin went to the local British magistrate and demanded a payment of $100 for the pig. Cutlar refused to pay, insisting that he was not subject to British law. Tempers began to flare between American and British citizens of the island.

Americans petitioned their government for protection. Soon, Captain George Pickett—who later led the famous charge at Gettysburg—arrived with troops. Britain sent warships to rout the Americans. A stalemate ensued when both sides waited for the other to fire the first shot. Finally, General Winfield Scott was dispatched from Washington, DC, to propose that the standoff be institutionalized: each country would station 100 men on San Juan Island until an accord could be reached. The British accepted the accord. This accord stood for 12 years until German Emperor Wilhelm I was called in as a neutral arbitrator.

Questions:

1. What items should have been considered by Emperor Wilhelm I to come to a plausible decision in this case?
2. Taking all known factors into consideration, how would you have decided this case?

3. What decision could have been enacted that would have satisfied the most people?

4. What are the stakes for Wilhelm I in this case?

Note: German Emperor Wilhelm I ruled in favor of America in 1872. All British citizens were allowed to remain on the island, but were subject to American taxation. The island was ruled to be a territory of the United States and became a property of the State of Washington.

DISCUSSION QUESTIONS

1. In the 21st century, the U.S. military could become much more socially conscious. This would include setting up field hospitals in inner-cities, providing disaster relief efforts, etc. The defense and conflict-resolving capabilities of the military should be diminished. Do you agree or disagree? Explain.

2. The future role of the military could, in essence, become that of an international police force. In that role, the military could enforce global law and support worldwide democracy. Do you see any problems with this position?

3. The future role of the military should be substantially diminished. The future military should only be equipped and administered to defend the borders of the United States. Respond to this question, either by supporting or arguing against it.

4. Do you believe that the military/industrial infrastructure of the United States should be abolished? We could purchase any defensive weapons we need from other nations. Explain your position.

5. Take position a. or b. and develop the argument to defend it. Use documentation from the chapter to support your position as well as thoughtfully reasoned arguments.

(a) The U.S. military/industrial infrastructure should receive continued support from taxpayers. This infrastructure employs huge numbers of citizens and the United States needs to be in direct command of the development of the latest weapons of destruction.

(b) The military/industrial infrastructure in the United States creates no wealth (it simply spends tax dollars) and should be eliminated. All federal monies spent on the development of military hardware should be diverted to social programs and education.

6. Will the increased use of technology, and more specifically, computer technology lead to future battles where soldiers never see the enemy or the devastating effects of military weaponry? If so, will this lead to an increase or decrease in the likelihood of military conflict?

7. Should space-based military technologies be developed further? What does the development of space-based military technologies mean for the future of humankind? How can the development of these technological capabilities be used to increase the quality of life for the average Earth inhabitant?

8. When citizens of the future look back at the late 20th century, what contemporary technological developments will they most likely view as short-sighted and ill-conceived?

9. Should soldiers have access to technology that shelters them from seeing the horrors of war?

10. What can the world community do to reduce the risks posed by the uncontrolled international arms trade? One method of curbing the escalating global arms trade might be for the world powers to again supply arms to Second and Third World nations, thus discouraging them from developing their own manufacturing capabilities. Should we?

11. How would the United States and the world differ if massive amounts of money had not been spent on arms development during the Cold War? If the Cold War had not occurred, would worldwide technological development be at its current level? How will future historians judge the effects of technological development during the 50-year Cold War? While the U.S. claims to have "won" the Cold War, what types of sacrifices did it take?

12. If you had the authority to make changes in the way technology and technological information are classified or shared, how would you balance the need for military security and the need for commercialization of new technological developments?

13. Should the United States retain the position of *global policeman*? If so, who should have the authority to decide when police action should be taken? If not, how should the United States react to international conflicts of an ethnic or religious nature?

14. The United States military establishment is clearly developing the technological devices and mechanisms that will enable them to become more involved in domestic unrest and social issues. Does this worry you? Should the military play an active role in domestic and social policy?

15. During the Gulf War (Kuwait), the U.S. government totally controlled the press so that the American people saw what the government wanted them to see. This was in fact a result of the role the free press had played in causing dissension during the Vietnam War. What are the positive and negative arguments for a "free press" during wartime?

16. The U.S. has stepped up its sale of arms to Second and Third World Countries. Will the world be safer if all countries are heavily armed?

CHAPTER 5

Technology Comes to the Country: The Marketing of Rural America

Daryl Hobbs

We are consumers all, whether we live in the city or the country. This is to say that the urban and rural landscapes...are not two places but one. They created each other, they transformed each other's environment and economies, and they now depend on each other for their very survival. To see them separately is to misunderstand where they came from and where they might go in the future...We all live in the city. We all live in the country."

(Cronon, 1991, p. 385)

The difference between rural and urban America today is less than the difference between rural America 50 years ago and rural America today. Rural and urban Americans watch the same television programs, are bombarded by the same advertising, consume the same products (usually purchased from shopping malls), send their children to remarkably similar schools, and depend on sophisticated multidisciplinary clinics for health care. Rural producers, whether farmers, factory workers, employees of a ski lodge or telecommuters, may reside in a rural location but are no less participants in a capitalist, global economy than the stockbroker or the secretary in an advertising agency of the metropolis. They each produce for distant markets and are subject to the exigencies of the market. Casualties of change, in the form of the poor, are found in rural and urban localities with the principal difference between them being whether they live in high or low density settlements. Why they are poor does not differ with their location; indeed the rural poor can become the urban poor, and frequently do, with an overnight trip by car.

Technology is prominent among the many complex forces that have redefined rural and urban America and has contributed to their convergence over the past century and a half. But technology is as much a product of social, economic, and political change as a cause of those changes. Broadly defined, technology is applied knowledge, which can be manifested in many different forms: machines, chemicals, techniques, forms of organization, etc. A 1995 school or medical clinic is as much a form of technology as the techniques that are employed there as well as the devices and equipment that are utilized in the practice of those techniques.

All cultures, whether *primitive* or *advanced*, have and employ technology. What has distinguished the *advanced* cultures over the past 150 years has been the pace of development of new technologies, their role in evolving complex systems of production, distribution, and marketing as well as the rate at which new technologies have replaced or supplemented the old. Thus, to understand the role technology has played in transforming rural America requires understanding the economic and cultural environment that has provided incentives for substituting new technologies for old and inspired continuous investments in developing new technologies.

Capital and Technology Come to the Country

Our premise is that the engine of rural-urban convergences has been a capitalist economy (first local, then regional, national, and most recently, international) with the products of capitalism, in the form of technology, being one of the most visible and powerful forces. Technology is a form of capital. Understanding investments in technology, who makes them and for what purpose involves understanding the logic of capital. Technology is not an independent, autonomous impersonal force. It produces consequences as a result of incentives to produce it, sell it, buy it, and use it. Technology, without an incentive to use it, holds forth little probability of contributing to increased production, consumption and related social change. Technology also thrives in an environment of expectation of technology—an expectation that was to become a part of the rural American ethos a century and a half ago. Evidence of the inability of technology alone, in the absence of incentives, to modify production, consumption, or life-styles, can be found in the relative ineffectiveness of technology transfer as a strategy for increasing agricultural production in underdeveloped countries.

Thus, to understand the role of technology in transforming rural (and urban) America involves also an appreciation of the political-economic context which, through a set of incentives, transformed land, and the products of land, into commodities to be bought and sold in the marketplace. Without this exchange of commodities, the rural market for technology, and the change in production and consumption that accompanied it, would not have occurred. Rural America, as it became devoted to producing for a market, also became a market. Rural Americans became willing partners in a set of exchanges that were to transform their social and economic existence and link their destiny with the metropolis.

The American Railroad

To fully appreciate the role of capital in the form of technology in transforming rural America requires going back to mid-19th century and tracing evolution of the system that, with some modifications, has been largely responsible for most of the trends that have affected rural America ever since. Cronon (1991) assigns a significant role to the *iron horse* (railroads) in what was to become an inextricable linkage of rural and urban America into two sides of the same market-driven coin. But it would be a mistake to accord too much significance to the mechanical technology of the railroad alone in producing this market linkage. The railroad was not just a mechanical technology, it was as much or more an innovation in organization. Utilizing the railroad meant devising a previously unknown and inexperienced set of innovations in coordination and management of transport into a pool of capital designed to make more capital (Cronon, 1991).

To be sure, the railroad was a mechanical technology, but its consequences were as much, or more, attributable to its being combined with a set of organizational technologies that contributed to the railroad becoming a system for connecting producers and consumers into markets. As the railroad system evolved, not even time was left untouched, since it was the need for coordination of railroad *time* that led to the adoption of time zones in the U.S. But it was the technological by-products of the railroad, as much as the system of transportation itself, which were to convert farmers into producers for the market. Concurrent with railroads was development of telegraph lines which typically ran adjacent to rail lines. It was the combined development of transportation and communication systems that inspired development of the Chicago Board of Trade which was a complex system for trading, not just grain and other commodities, but futures in commodities not yet produced. It was these systems of trade for connecting producers and consumers that were establishing a common bond between the interests of consumers and producers—rural and urban. These systems freed consumers and producers alike from the constraints of local markets and goods. But they exacted a price. As these systems developed, capital became more centralized and concentrated in the cities and rural areas began a long-term trend of giving up autonomy in exchange for the markets and being a market (Gartrell 1983).

The system of market linkages, which in abbreviated form, was called the railroad, literally transformed the ecosystem of the Midwest and Great Plains. It was, for example, the railroad that connected the market for buffalo hides with the buffalo of the Great Plains and thus sealed their fate. Those buffalo which did not contribute their hides to the warmth of distant consumers, fed the workers building the railroads. But as the buffalo were banished from the Great Plains they were replaced by cattle, aided and abetted by a new technology, barbed wire, brought to the farms and ranches by the railroads on their return trips from hauling grain and other commodities to the central markets. With cattle confined by barbed wire, the sod of the native prairie was turned and, in its place, appeared fields of corn, wheat, and other crops that were to be marketed directly or through the cattle. The railroads played an essential role in linking the cattle with the distant markets of the east with a stop in Chicago for slaughter and processing. But again, the logic of capital inspired another piece of technology to refine the linkage of markets—the refrigerated rail car which literally *iced* Chicago's claim as the meat packing center of the nation. As a result, capital was further concentrated, the market for Midwestern cattle was expanded, and the future of small butcher shops in the east was placed in jeopardy (Cronon, 1991).

But the growing commercialization of agriculture in the Midwest and Great Plains was producing a two-way street. Inspired by the prospect of markets, and therefore profits, new agricultural production technologies began to appear. One of particular fame was the mechanical reaper developed by Cyrus McCormick in the 1840s. In its initial phase, production was small and sales were largely confined to farms along the rivers and waterways (Cronon, 1991). Again it was the railroad system that contributed to expanding the market for an urban-produced technology and began a process, which has only gained momentum over the years, of farmers substituting capital in the form of technology for labor.

But for a potential demand for a technology to materialize as an actual demand, consumers must have a means of paying for it; a problem for the cash poor farmers of the Midwest in the mid-19th century. Thus, yet another technological piece of the growing system of markets and production—credit—was devised and placed into service. With it, farmers, whose paychecks were few and far between, became customers for expensive technologies and the railroads were more heavily loaded both on their trip to the market and their return. The railroads were one part of the system but banks, and the technology of credit, played an important role in providing railroads with loads to carry.

It would be a mistake, however, to place all the credit or blame for the transformations that were occurring at the doorstep of capital and its handmaiden—technology. Along the way, capital was acquiring a new partner, government, whose actions greatly encouraged, supported and protected the investments of capital. It is a partnership that continues today; indeed common interests of capital and government are so prevalent that a branch of social science theory and analysis carries the label, *political economy.*

Government Support of Agriculture

It is possible to be quite specific about actions of U.S. government which contributed directly to the systems which were to transform rural America. Much of the capital which constructed the railroads was made available by government through awarding railroad companies large land grants that not only provided the rights of way for railroads but were also available for sale or exploitation to generate capital.

In the period of settlement of the Midwest and West, land grants became the modus operandi of public policy that was to have great effect on agriculture and therefore rural America. In 1862, both the Morrill Act, establishing a land grant college in each state, and the Homestead Act were enacted. In each case, government exchanged title to land for initiatives thought to be in the public interest. The land grant college act, with its subsequent addition of research and extension funds, firmly endorsed utilization of scientific knowledge and technology to increase agricultural production. That support has been unwavering and, indeed in the budget cutting context of 1995, the Congress is continuing to place a priority on allocating public funds for agricultural research.

The Homestead Act, which provided 160 acres of land gratis to farmers who would settle on and farm it for a minimum of five years, played a major role, not only by expanding production and markets but also in the conversion of land to a commodity—an important factor supporting the system of credit that had developed. Farmers were able to mortgage their land as security for loans.

Along the way government contributed many additional initiatives which were to strongly reinforce the markets utilized by rural consumers and producers. For example, rural free delivery (RFD) was authorized and funded early in the 20th century largely to support and reinforce yet another piece of the broadening system of markets, the mail order catalog business of Sears and Roebuck and Montgomery Ward. Daniel Boorstin (1973), the historian, credits the mail order catalogs with drawing rural Americans into national *consumption communities*—a foothold that has only grown stronger over the years. Thus, the system of technologies embedded in the market was extending into the homes as well as the fields of farmers.

Although government has long facilitated the use of technology and acted in many ways to protect markets, an additional era of legislation stands out because it further transformed agriculture. That was the New Deal period of the 1930s. New Deal legislation brought government directly into agriculture by a combination of supply management and direct subsidies to producers. Not only did New Deal legislation serve to help protect farm income, it also stabilized markets for grain companies, food processors and other segments of what has come to be known as agribusiness. Further, by linking price supports directly to individual commodities, the door was opened for general farmers to become specialized commodity producers. That trend continues today and is gaining momentum—raising the specter of another transformation in agriculture just around the corner.

Another decisive role of government in rural utilization of technology has been direct investment in infrastructure. Following extensive capitalization of railroad construction, government direct investment in highways and bridges, rural electrification, hospitals, vocational schools, etc., has insured the utilization of technologies and thus the return on private investment in technology. We shall return later to a discussion of more recent effects of private transportation on rural areas.

Thus by the end of the 19th century the main elements of the system that has shaped the rural America of the 20th century were in place. Although technologies of the 20th century have changed dramatically, accommodation to them has generally followed the logic of capital, and the integration of rural and urban begun in the previous century, has only intensified. However, before assessing the impact of 20th century technologies on rural America we digress briefly to explore how rural has been conceptualized in the past and how structural change has invalidated those conceptions.

Sociological Treatment of Rural and Urban

Nineteenth century European sociology, which contributed greatly to the emergence of American sociology, was substantially devoted to analyzing the social consequences of technical change. From the late 17th century forward, technical progress and the evolution of capitalism has been continuous, consistent, cumulative and irreversible (Caplow, 1990). By mid-19th century the social impact of these technical changes had become too significant to ignore. The object of early sociologist's attention became the modern industrial city and the institutions that melded together there. Many of the classics produced during that time used rural, not as an integral part of the emerging capitalist system, but as a counterpoint to the urban and industrial. To Marx, Weber, Durkheim, Toennies, and others, the magic of urban industrialization was conceptualized in large measure by contrasting it with its presumed social and organizational antonym—rural. Weber contrasted the secular rationality of the city with the tradition of the countryside; Toennies chronicled the transformation of society from Gemeinschaft (community) to Gesellschaft (corporation). Marx analyzed the consequences of capitalism coming to fruition in the industrial city. He viewed the countryside as a regressive backwater in relation to the progressive forces of urban capitalism.

These conceptualizations were carried forth into 20th century American sociology and contributed to the persistence of social analyses focusing on rural and urban differences. But even as these analyses were being conducted, rural America was being swept into the orbit of industrial capitalism. Largely because of the European classics of the 19th century, generations of American sociologists were being sensitized to look for rural/urban differences even as those differences were diminishing.

Our perspective, therefore, takes exception to dichotomizing rural and urban as different worlds easily distinguished by different customs, norms, life-styles, etc. Rather our view is that rural America has become an integral part of a capitalist system of change, technologies, and markets that have transformed rural and urban in tandem. Rural and urban continue to be viewed separately for some purposes; to be sure, rural America continues to be the domain of distinctive features such as low population density, an abundance of small towns, and agriculture as well as other natural resource industries. However, as Cronon (1991) describes, "we all live in the city; we all live in the country" (p. 385).

Rural Contribution of People to the Growth and Change of Urban

As important as rural America's role as supplier of food, raw material, and consumer markets for urban goods became, the role of rural America in responding to the burgeoning urban market for labor was at least as significant. It was the process of substitution of capital in the form of labor-saving technology for labor, begun in the latter part of the 19th century, that triggered massive migration from rural to urban—a trend that has continued throughout most of the 20th century. Indeed most rural counties in the Midwest reached their 20th century peak in population in 1900. Population has declined consistently since then.

The effect of this migration was a transfer of great quantities of human capital from rural to urban since many of the rural-urban migrants brought with them a basic education, along with pertinent skills and work habits acquired on the farm. As the migration continued throughout the 20th century, the rural migrants were more often college graduates who found the best market for their abilities where the productive capital was concentrated—the cities. The effect was a brain drain for rural America. In the mid-1990s, the proportion of college graduates in metropolitan areas far exceeds the proportion in rural areas, not because rural areas are failing to invest as heavily in education, they are, but because the economic division of labor between rural and urban areas has produced few rural opportunities for college graduates (Economic Research Service, 1992).

The Growth of Suburbs—A Rural-Urban Compromise

Partially because of improved transportation, partly because of urban growth, and partially because of values accompanying rural migrants to the cities, a new social phenomenon—suburbs—began to emerge at the edge of cities by mid-20th century. Because improved transportation made it possible, and urban growth made it necessary, people were able to accommodate a preference for living in separated houses with some space (likely a value brought with them from the country) with the economic necessity to be in proximity to where the largest and most specialized labor markets were found. The reflection of rural values embodied in the suburbs can be found in the rural names attached to many of the new suburban housing developments. This distinctively American development, which buffered the city from the countryside, has been so significant that by late 20th century most Americans are no longer either rural or urban—they are suburban. But not only do the most people reside in the suburbs, the suburban residents generally enjoy higher income and are more highly educated. Correspondingly, they have gained in political power and influence causing rural *and* urban interests to take a back seat in the policy arena.

Like so many other social changes, the role of suburbia in redefining rural and urban has been a consequence of many related technologies; but no one technology , or even a few, can be singled out. Suburbs were made possible, or even necessary, by a complex set of interrelated technologies, many of which were in place long before suburbs began to appear. Most directly responsible was the combination of forces that contributed to increasing real wages, which expanded the size of the middle class able to afford a house in the suburbs and a car to commute with.

The exceptional rate of suburban growth, beginning after World War II, was a major contributor to official redefinition of rural and urban. As cities sprawled into the countryside, growth was more rapid outside of cities and a large and growing part of the population, economically dependent on the city, was no longer contained within its boundaries. This contributed to the U.S. Census Bureau's redefining counties as being either metropolitan or nonmetropolitan. Metropolitan counties were those that included a city of 50,000 or greater and/or those counties adjacent to a large city and having a highly urbanized population economically dependent on the central city. Counties not meeting that definition were placed in a residual category called nonmetropolitan which, for national policy and program purposes, has become equated with rural. Because of continued horizontal expansion of metro areas, after each decennial population census, additional counties have been reclassified from nonmetro to metro. Consequently, rural population and places have been shrinking over the past several decades by the stroke of a Census Bureau pen.

In 1992, 836 U.S. counties were classified as metropolitan with a population of 203.3 million (79% of U.S. total) while 2,303 counties were nonmetropolitan with a combined population of 51.8 million (21%) (U.S. Department of Commerce, 1994).

But the continued sprawl of metro areas has not stopped at the county line; it has continued on into the countryside, leading the U.S. Department of Agriculture to adopt another classification of rural (nonmetro) counties bearing the label *nonmetro adjacent* (those counties adjacent to a metro county). In 1992, there were 1,001 such nonmetro counties (out of 2,303) having a total population of 28.7 million. That means that the remaining 1,302 *real* rural counties have a combined population of 23.2 million—just over 9% of U.S. total. The nonmetro adjacent classification was adopted because generally, counties within commuting range of metro areas have experienced much more significant population growth in recent decades than the remainder of nonmetro counties. But there are some exceptions as will be discussed later.

Perceptions of Rural

Although official definitions exist and many conceptual tools have been devised to differentiate rural and urban, those terms have become largely abstractions. Rural is, even in late 20th century America, at the same time real and concrete and an abstraction. It is, to an important degree, a creation of mind and, accordingly is, depending on the observer, bestowed with different attributes, including a liberal quantity of mystique (Willits et al., 1990). Rural is simultaneously there to be experienced first-hand and locked in the past. People's views of rural vary with their experience with rural. A recent survey, conducted for the National Rural Electric Cooperative Association (1992), reveals that most Americans regard rural places and communities as more generously endowed with values, virtues, strong families and a viable community spirit. Indeed, based on those impressions, most Americans report they would, if given a choice, prefer to live in a rural area or small town than in a city or suburb.

Stages of Change in 20th Century Rural America

These varying impressions of rural and urban are understandable since, as Allen and Dillman (1994) contend, America, including rural America, has gone through two very different eras during the 20th century and is entering a third. It is relevant, in terms of impressions of rural, that many Americans have experienced all three. The first era, covering approximately the first quarter of the 20th century, they label as the era of community control exemplified by city neighborhoods and rural communities served by local institutions (see Figure 1). It was an era when mobility was limited and people's needs were mostly satisfied in their neighborhood, or in the case of rural people, in the nearest small town. It was during this era, which extended back into the 19th century, that the small towns and neighborhoods were not only important for their provision of services; they became equated with cooperation and self-help embodied in the idea of community. In the community control era, people tended to know a great deal about where they lived but not much of the world beyond. There is little doubt that the origins of a rural *mystique* can be traced to this era of community control.

The second, which they refer to as the mass society era, began in the 1920s, reached a peak in the 1960s, and has been declining since. It is exemplified by diminishing relevance of communities, as communities lost their exclusive claims on their residents now more affected by the

Dominant Characteristics	Community Control	Mass Society	Information Age
Occupation	Agriculture & manufacturing	Manufacturing services	Services & information
Markets for local products	Local & regional	National	Worldwide
Product orientation	Handcraft, limited market	Mass production	Individual, targeted design market
Most valued production resource	Land	Plant & equipment	Symbolic analyst worker
Form of work organization	Small independent businesses	Large vertically integrated assembly line production	Temporary networked affiliations
Ecology of important relationships	Community, locality, focused	National, organizationally focused	Anywhere, network focused and individually controlled

Figure 1. Dominant characteristics of the three eras of social and economic organization in U.S. Ssociety

mass production, mass media, and mass merchandising of a new era. Life-styles, consumption, and markets now extended well beyond locality. The emergence and ascent to dominance of the mass society was greatly facilitated by new mass communication and transportation technologies. The mass society also ushered in standardized institutions for health, education, government, etc. The era of the mass society greatly extended the process, begun in the 19th century, of rural-urban convergence.

Allen and Dillman contend that mass society is now losing hegemony and is being supplanted by a global-information era. If different forms of surface transportation had great effect on the era of community control (rails and horses) and the mass society era (private automobiles and highways), the global-information era is more defined by information and communication technologies.

Different production, consumption and organizational technologies have typified each era. Although profound change, both rural and urban, has accompanied each era, the logic of capital has remained largely a constant through each.

Agriculture: From Frontier to Food System

Agriculture has traditionally been a distinctive and defining feature of rural. But in the social history of the U.S., agriculture was imbued with values beyond the provision of food, fiber, and raw materials for the urban-industrial sector. It was viewed as a primary occupation that, in the minds of many, was the beginning of all wealth.

Farmers entered the 20h century as the dominant American occupation, but we will depart the century with the number of farmers having become a minority of a rural minority. At the dawn of the 20th century, more than half of the U.S. population was classified as rural and more than half the rural population resided on farms. More than half of all rural workers were farmers. As we close the century, there are only 2 million farmers out of a total work force of 125 million and less than 10 percent of the rural (nonmetro) population is directly involved with farming. But even those data are a distortion, because about 80 percent of those classified by the Agricultural Census as farmers are actually part-time farmers, primarily dependent on off-farm employment or retirement for their income. These part-time *farmers* reside on farms and engage in small-scale production, largely as a life-style choice.

Subtracting the 80 percent of part-time farmers leaves about 400,000 full-time farmers (0.3 percent of the work force) who account for more than 70 percent of current U.S. agricultural production. Yet, the output of this dramatically diminished number of farmers far exceeds that of the millions who tilled the soil at the turn of the century. The reason is simply an extension of a trend begun in the 19th century—the substitution of capital for labor on a scale unlikely envisioned by agrarian analysts at the turn of the century. The capital has taken the form of a myriad of technologies from mechanization, to the hybridization of seeds, chemical fertilizers, herbicides, pesticides, and, more recently, biotechnologies that are transforming the yields and the very characteristics of the products produced. Public investments, through the research and extension services of land grant universities, have played a major role in developing these technologies and encouraging their utilization.

Yet another organizational technology has accompanied this transformation. The remaining farms have become specialized commodity producers. Contemporary full-time farmers raise corn or soybeans or cattle or hogs or poultry but not all of the above. Relegated to the era of community control are the general farms that produced a wide variety of products, some for home consumption and some for sale on the market. Today's commercial farm production is exclusively destined for the market, whether domestic or international. Most of today's specialized commodity producers obtain their food from the same source as urban consumers—the supermarket.

The logic of capital has been the dominant force in agricultural production and, as the logic of capital dictates, there have been winners and losers. Probably the clearest winners have been urban consumers who, in the U.S., spend a lower percentage of their income on food than any other country in the world. Considering, also, agriculture's contribution to the national balance of trade, it is not therefore surprising that nonagricultural Congressional members have continued to vote for farm programs despite the small number of farmers. However, it is clear that there is some political support for agriculture, not only as an essential and highly productive sector of the economy, but also based on preserving the *family farm* as an American institution.

The clearest losers have been those farmers whose preference would have been to continue to farm, but who were unable to attract the capital necessary to compete with the larger commercial producers. They were displaced, sometimes in sufficiently large numbers to attract national media attention as was the case during the farm depression of the early 1980s. Also coming out on the short end have been rural communities who came into existence to serve the needs of farmers but who found their economic base dwindling along with the number of farmers. Some have been able to find another economic niche, often in the form of a factory relocated from an urban area, but many have not. Most rural communities have been struggling for the past three decades in search of ways to diversify their economies.

But agriculture is not just another sector of the economy and many of these changes have become controversial, both on the farm and off. A part of the controversy stems from a perceived disappearance of *family farms*. Most recently controversy has focused on the emergence, across rural America, of industrially sized hog, poultry, cattle feeding, fruit and vegetable farms, which follow the logic of capital and incorporate all the latest technology of production and marketing. These industrial farms are typically vertically integrated from production, through processing, distribution, and retailing. They are not simply farms; they embody what some have begun to call the food system. While such enterprises have become impressively productive, they are perceived by many, especially rural residents in the regions where these industrial farms are located, as a threat to fundamental agrarian values. From Thomas Jefferson's explication of agrarianism as fundamental to democracy forward, the family farm has, in the U.S., been widely perceived, not just in terms of production of commodities for the market, but as a way of life exemplifying many fundamental American values (see Figure #2).

From this perspective, there has, for some time, been an uneasy coexistence between agriculture and technology. Perhaps in no sector has technology contributed to more impressive increases in production and labor efficiency; but at the same time there has been widespread discomfort with the consequences as the number of family farms diminished.

Agricultural technology has also been drawn into other controversies, more widespread among consumers. There have been a number of high-profile cases in recent years involving chemical residues in food that have stimulated public concern about food safety. Environmentalists have also questioned the environmental impact of high-tech chemical farming and livestock concentrations on water quality, wild life, etc. Consequently, Congressional debate on the 1995 farm bill includes substantial attention to food safety and environmental quality. Agriculture is no longer the exclusive concern of farmers and rural residents.

Lest one is left with the impression that the trend toward more technology is increasingly harmful to the environment, attention is drawn to the practice of low-till and no-till farming that has gained support in recent years. These processes reduce the loss of topsoil to water and wind erosion, although, negatively, they may require more herbicide application. Another more recent technological development that promises to actually reduce the amount of fertilizer and chemicals to be applied to a field is the Global Positioning Satellite System (GPS). In this technology, the farmer lays out his field in a grid and takes soil samples throughout the field. These data are fed into a computer. When fertilizing the field, the applicator responds to signals to apply more, less, or different mixes based on the location in the field as indicated by the GPS.

While these examples provide technological solutions, research is also being done on the natural perennial polyculture ecosystems to determine what combinations of plants will provide natural protection to eliminate

Rural Values

Leon C. Neher

Embodied in rural life are many values that are basic to our society, e.g., values of hard work, persistence, and responsibility. Hard work was necessary on the farm. We had to get up and go milk the cows whether we felt like it or not. Otherwise, they would become ill and/or quit producing milk. When the crops were ready for harvest, we would work around the clock, if necessary, for we knew excessive rain or a hail storm could wipe out a crop (a whole year's work and income) in minutes. "Early to bed, early to rise, makes a person healthy, wealthy and wise" was just the way it was! Neighbors who slept in, or spent too much time at the pool hall, never had much.

Persistence was another value we learned. A tornado destroyed our barn. Another was built. Ten years later a sow, while building her birthing nest, rooted straw too close to an electric lamp and the new barn burned to the ground. There was no insurance but neighbors came and helped us build another. They never turned in a bill for their labor. That barn still stands today, 40 years later.

That same persistence enters the fabric of your personal life, wherever you go or whatever you do. It is a rural value that is a part of the whole culture.

Responsibility has been another value nurtured in the hinterlands. When it's *your* land, you're not going to eat if *you* do not plow, plant, and harvest in a timely manner. Children are given responsibility early. You learn quickly. If a youth fails to shut the barn door, the cows may get out into a neighbor's corn field just about the time you wish to hop in your car for a date or a ball game. Your neighbor is irate and your date waits. You make *sure* the door is shut the next time.

There is one more value I will mention—respect. Without respect and reverence for the earth and all its inhabitants, where will we be? The earth is like a fertile, nourishing mother who has given to us, around the clock, for centuries. But if we rape her, out of either anger or lust, we rob not only ourselves but future generations.

Figure 2. Rural Values

the use of herbicides and pesticides as well as the need to cultivate the soil every year. The Land Institute at Salina, Kansas, is one organization that is committed to studying alternative agriculture.

Rural Institutions and Services—Coping with Space

Along with farming, another distinctive feature of rural areas is low population density. Because each farm job takes so much space, rural areas are simply less densely populated than urban. The U.S., like most nations, has a relatively small number of cities, but a far greater number of small towns and villages (94% of U.S. incorporated towns and cities had a 1992 population of less than 25,000; 50% had a population of less than 1,000) (U.S. Department of Commerce, 1994).

Most of today's rural towns and villages owe their existence to 19th century transportation technology. As settlement and transformation of the area beyond the thirteen original colonies began in earnest, towns were needed to serve the recurring needs of the settler-farmers; slow transportation dictated that there would be many of them and that each would have a captive market. Settlers typically went without those goods and services not available in the nearest small town (until the mail order catalogs appeared to expand their consumption options). The limits of transportation technology imposed similar constraints on institutions and the schools, churches, governments, legal, health, and other services took forms adapted to those constraints. Most of the schools were of the one room variety, churches were frequently served by *circuit rider* preachers and health care was in the hands of a sole general practitioner who, regardless of name or credentials, was known simply as *doc*.

Concentration of these institutions and services in the many towns and villages insured that interaction among residents of the locality would be frequent and generally limited to those residing in the village and the surrounding trade area. Consequently not only were the towns and villages the nearly exclusive supplier of needed goods and services but, as a result, these *communities* also became the principal basis of social organization in 19th century rural America. Each community established and reinforced its own *little tradition* (Gallaher, 1980). They were the defining attribute of the era of community control (Allen and Dillman, 1995). People in each of these communities knew a great deal about each other and where they lived, but not much about the world beyond. Problems tended to be local problems and were often solved by local initiative and collaboration. This community foundation of rural America became a part of its mystique; a perspective which still dominates the perceptions about rural held by many Americans, rural and urban alike (Willits et al., 1990).

But if these rural communities were a product of slow and limited transportation technology they, and the economic, social and institutional role they play, were to be radically changed in concert with improvements in transportation and communication technology. Those technologies were not solely responsible for the changes; but they made possible the extension of urban models of retail, health and education and other services to the countryside.

By 1920, dependable roads and private cars, along with radios and telephones, were becoming commonplace and those technologies were instrumental in redefining the meaning and significance of space. They further cemented the integration of city and country begun by the plethora of changes instigated by the railroads. Concurrently organizational technologies in the form of Fordist principles of assembly line mass production and dominance of specialization, centralization, and standardization, were triggering a transformation of the U.S. from the era of community control to the era of the mass society. The transformation was comprehensive and schools, health care, merchandising, media, and politics began adapting the principles of mass production and the presumed efficiency that accompanied them. Urban schools and health care became the domain of specialists rather than generalists and, accordingly, were reorganized into larger, more standardized and bureaucratic complexes. The nation accepted them as the standard for good education, health care, and government.

In the name of improvement and equity, these became the models for rural areas as well. Improvements in transportation and communication technology made it possible to export and implement these models to rural areas. In the time it used to take to travel to the nearest small town or neighborhood school, it was now possible to travel many times further. Accordingly, one room country schools, taught by generalists, were presumed to be inferior and, with the facilitation of school buses, they were replaced with consolidated schools, large enough to make it economically feasible to replace the education generalists with specialists. Thus, a uniquely rural form of education (the one room school) was replaced with the standardized urban form. The consequences were dramatic: in 1930 there were 128,000 U.S. school districts; by 1992 there were 14,500 (U.S. Department of Commerce, 1994). Public schooling in the U.S., rural and urban alike, became a *one best system* (Tyack, 1974); an improbable occurrence without efficient and pervasive transportation to support it.

Exactly the same thing happened with health care; as small town family doctors retired, the small towns simply lost a doctor. The doctors who replaced them were specialists and, because they were, concentration in centralized locations became a necessary condition for providing comprehensive health care. For rural areas, this meant that health care was now more distant, adding the cost of travel to the cost of health care for farmers and village residents. It can be legitimately claimed that an important part of public investment in rural health care was in roads; improving roads to make it possible for farmers and village residents to travel to regional trade centers for health care.

The logic of capital and the technologies that supported it had no less effect on retail trade, farm suppliers, markets, etc. They, too, became increasingly concentrated, with regional shopping malls replacing country stores in the small towns. As will be addressed in the next section, employment also became more concentrated in these larger regional centers as the rural economy began to diversify. The labor markets for these centers typically extended far into the countryside with commuting to work becoming a part of the rural way of life in the late 20th century. Because of these changes, local rural economies became regional economies. Throughout these transitions the logic of capital in the form of economies of scale and efficiency prevailed.

Although technological and economic change caused most 1900 farms to be lost to consolidation, most of the rural towns born in the 19th century remain in existence as we close the 20th century (Johansen & Fuguitt, 1990). But most have lost their economic and institutional basis for existence and, along with those losses, much of their autonomy (Gartrell, 1983). Vacant buildings on main street and empty schools offer silent testimony to the time when they were important and necessary to their residents. But despite the loss of function and autonomy many of these *communities* have chosen to resist becoming ghost towns. In part, because of their own efforts; in part, because of recent social and economic transitions in the society; and in part, because of state and federal policies and initiatives, some of these towns have found ways to extend their viability into the next century.

Economic Diversification of the Countryside

Rural America is no longer heading in the same direction it was a generation ago. Beginning in the late 1940s many of the consistent, continuous, and irreversible trends having affected rural and urban America for 100 years began to change directions. Notable among these was a pattern of industrial decentralization; first from the cities to the countryside within the U.S., and, more recently, to other countries—a pattern which continues today. In retrospect, the movement of standardized mass production factories from urban to rural areas in the U.S. appears now to have been a first step away from the mass society and toward a global-information era. Interestingly, one of the first industries to decentralize was meat packing which was so much responsible for Chicago's 19th century emergence as a metropolis for its role in transforming the agricultural raw materials of the Midwest and Great Plains into consumer goods for eastern markets. By the end of the 1950s, the meat packing industry had deserted Chicago, Kansas City, Omaha, and other central markets for modern processing plants in the countryside. A contributing factor was that, by the late 1950s, highways had begun to carry much of the freight that had been the exclusive domain of railroads. Whereas railroads had been a centralizing transportation technology; trucks were less so. Following the logic of capital, it was not incidental that wage rates in the countryside were also substantially lower than in the metropolis.

Other mass production, mature product industries such as textiles, shoes, wood products, and electronics soon followed suit, and during the 1960s and 1970s there was a major industrial relocation from the cities to the countryside. Most affected were the South and the Midwest. The driving force was a combination of low wage, unorganized labor in rural areas, facilitated by public investments in highways, industrial parks and other necessary support infrastructure. The urban-to-rural industrial relocation was so significant that, by the late 1970s, manufacturing employment had become the leading source of rural income and more than one-fourth of all nonmetro counties were classified by the U.S. Department of Agriculture as *manufacturing dependent* (Hady & Ross, 1990). However, this rural employment boom of the 1960s and 1970s has slowed, as a number of industries, who relocated for cheaper wages in that era, have again relocated for even cheaper wages in Asia and South

America. Reflecting this trend, the 621 nonmetro counties classified as manufacturing dependent in 1979 had shrunk to 577 by 1986 and to 506 by 1991 (Economic Research Service, 1995). Comparatively, the number of nonmetro counties classified as farming dependent decreased from 716 in 1979 to 556 by 1991.

The expansion of jobs in rural areas accompanying industrial relocation had a secondary effect on both agriculture and rural communities. With the availability of jobs nearby, a significant number of small and struggling farmers, especially in the South, chose to take off-farm employment and thus became some of the *part-time* farmers so prevalent in contemporary agriculture. Also significant was that workers for the factories came, not only from the communities where the factories located, but also from the many other small towns within commuting range. Industrialization added further impetus to the regionalization of rural economies and labor markets.

But industrial relocation was not alone in diversifying the rural economy. In addition to industrialization and metropolitan sprawl discussed earlier, rural America has become an increasingly popular destination for retirement and recreation. The nation's growing number of retired people began to respond to the attractiveness of the lower cost of living, quality of life and environmental amenities of rural areas beginning about 1970. The Hady and Ross report (1990) classified 515 nonmetro counties as retirement counties in 1979 because they had an immigration of retirement age population of at least 15 percent during the 1970s. Those counties are mostly concentrated in the mid-South, Southwest, and Upper Great Lakes areas. The trend continues; during the 1980s, the population of nonmetro retirement counties increased by 16 percent compared with less than a 4 percent increase for all nonmetro counties (Johnson, 1993).

Also adding to the diversification of rural economies has been the further development of rural recreation and tourism sites. During the 1980s, the 497 nonmetro counties placed in that category by Johnson (1993) followed only the retirement counties in rate of population growth (11%). Diversification of the rural economy is also reflected by 358 nonmetro counties being classified as *specialized government* because of the location of a military base, state university, prison, or other major government installation (Hady & Ross, 1990).

The combination of these diversifying factors contributed to the 1970s being the only decade in the 20th century in which more people moved from urban to rural areas. Since jobs moved to where people were, the rate of rural to urban migration also slowed. After a mixed pattern of rural population change in the 1980s, analysts now conclude that the 1990s are producing another general rural population increase (O'Malley, 1994). That expectation is based on a set of social and economic considerations reflective of a transition from the mass society to a global-information era.

Where to from Here: A Global Economy and Information Technology

The economic diversification of rural America has made it a nearly futile exercise to attempt to typify rural. It is no longer true that, as farming goes, so goes rural America. The logic of capital and the technologies farming has spawned in the late 20th century have produced uneven effects. As we are about to enter the 21st century, rural America is now home to the extremes of the nation's wealth and poverty—from the enclaves of affluence found in Colorado ski resorts to pockets of the most severe poverty on Native American reservations and in the rural South. It is now home to a disproportionate number of the nation's elderly whose interests are likely to be quite different from those of remaining farmers. Some rural communities, after experiencing the jubilation of a new factory restoring their economic viability, have experienced the depression of seeing that factory close in favor of a foreign location.

Because rural America has become so economically, socially, and culturally diverse, it is more difficult to assess what impact present and future technologies are likely to have and who will be the winners and losers. In the 19th century, when rural America was more homogeneous and when most rural residents were either farmers, or directly dependent on farming, it was relatively easier to assess the impact of technology. If the technology affected farming and the markets for farm products, it would have a pervasive influence on rural America. Thus, as we described at the beginning of this chapter, the complex system of capital and markets that emerged in conjunction with the railroads, transformed rural America and did so rather uniformly.

The social and economic foundation of rural America was built on the production of goods, but as we are experiencing the transition to a global economy, the comparative advantage is shifting to the production of information and services. In the global division of labor, the mass production of goods, the economic foundation of mid-20th century America ,has shifted to places having an abundant supply of inexpensive labor. The technologies most closely linked with these transitions are information and communication technologies, which include among their capabilities a capacity to transcend space quickly and inexpensively. That is potentially significant for rural, because, as we have noted, the cost and means of overcoming space have greatly affected the role of rural localities and the location and distribution of rural services.

Some rural localities may benefit economically because, with the emergence of global markets, linked with telecommunications technologies, new capital investments no longer need to be concentrated in larger population centers and markets. Accordingly, quality of life is becoming a consideration in making decisions about where new investments in information and service producing enterprises are located. The substantial movement of retired people to rural locations over the past two decades provides evidence in support of quality of life attractions to rural areas. There are clear indications that some new capital investments are being made in nonmetro areas for those reasons. The existence of the headquarters of North America's largest retailer in a relatively isolated northwest Arkansas rural community is but one example of how telecommunications technologies make it possible to manage and control a large economic network from a small population center.

Those technologies are also having a substantial effect on goods production. The automobile industry has decentralized with production of component parts through a system of dispersed sourcing; a consequence has been a number of new auto assembly plants located in small communities in Kentucky, Tennessee, South Carolina, and Alabama. While these and many other examples offer some hope for rural communities anxious to enhance their economic base, the direct effect of these new kinds of investments is generally confined to a relatively small region. The question for the future of rural America generally is which rural regions and how many will be most likely to attract such investments. It is uncertain whether the economy of all of rural America will be enhanced or just part of rural America. The logic of capital will most likely continue to produce winners and losers.

Information technologies make it possible to rethink the premises underlying the provision of services in rural areas. Space, in the past, has been a limiting rural condition; as surface transportation became more rapid and dependable rural services were consolidated and centralized. The cost of travel was, therefore, added to the cost of shopping, getting an education, or receiving health care. That was the response of the mass society era. However, since it is much cheaper to transport information than people, new technologies make it possible to reassess existing models of education, school, etc. Telemedicine is making it possible for rural people to access specialized health care without leaving their home locality; interactive television systems are making it possible for students in small rural schools to have access to specialized educational services. Continuing education offerings are increasingly available to rural professionals through distant learning technologies. Simply put, information technologies can facilitate decentralization of services rather than force their continued consolidation. These possibilities open the door to reconsidering how, where, and in what kind of structure education can best occur. All of these developments are occurring in rural America but not uniformly. Some states and communities are far ahead of others in exploiting the potential of these technologies. Once again, there are winners and losers.

As implications of a global-information era unfold they are being accompanied by a shift in perspective on rural America. As the mass society gained hegemony, rural communities lost autonomy and became more dependent on decisions made beyond the community and their control. Most features of life, from policy to education, became more centralized. However, recently that perspective is shifting and rural development is being considered more in terms of community empowerment than centralized policies and programs—that, after decades of public policies and economic actions emphasizing consolidation. Thus, the challenge for rural America will be simultaneously to overcome part of the past while attempting to adapt to the new. As suggested by Rubin (1996), "Ironically the problems facing each era are often the result of the previous era's solutions" (p. 175).

REFERENCES

Allen, J. C., & Dillman, D. A. (1994). *Against all odds: Rural community in the information age*. Boulder, CO: Westview Press.

Boorstin, D. J. (1973). *The Americans: The democratic experience*. New York: Random House.

Caplow, T. (1991). *American social trends*. San Diego, CA: Harcourt Brace Jovanovich, Inc.

Cronon, W. (1991). *Nature's metropolis: Chicago and the great west.* New York, NY: W. W. Norton and Company.

Economic Research Service. (1992, Spring). *Rural conditions and trends, 3*(1), Washington, DC: U.S. Department of Agriculture.

Economic Research Service. (1995, February). *Understanding rural America*. Agricultural Information Bulletin. No. 710. Washington, DC: U.S. Department of Agriculture.

Gallaher, A. Jr. (1980). Dependence on external authority and the decline of community. In A. Gallaher Jr., & H. Padfield (Eds.), *The dying community* (pp. 85-108). Albuquerque, N.M.: University of New Mexico Press.

Gartrell, J. W. (1983). Agricultural technology and agrarian community organization. In G. Summers (Ed.), *Technology and social change in rural areas* (pp. 149-162). Boulder, CO: Westview Press.

Hady, T. F. & Ross, P. J. (May, 1990). *An update: The diverse social and economic structure of nonmetropolitan America*. Staff Report No. AGES 9036. Washington, DC: Economic Research Service, U.D. Department of Agriculture.

Hock, D. W. (1995). The chaordic organization: Out of control and into order. *World Business Academy Perspectives*, *9*(1), 5-18.

Johansen, H. E. & Fuguitt, G. (1990, February). The changing rural village. *Rural Development Perspectives*, *6*(2), 2-6.

Johnson, K. M. (1993). Demographic change in nonmetropolitan America, 1980-1990. *Rural Sociology*, *58*(3), 347-365.

McGranahan, D. A. (1983). Changes in the social and spatial structure of the rural community. In G. Summers (Ed.), *Technology and social change in rural areas* (pp. 163-178). Boulder, CO: Westview Press.

National Rural Electric Cooperative Association. (June, 1992). *Public attitudes toward rural America and rural electric cooperatives.* Washington, DC.

Nehr, L. C. (1995). *Rural values*, unpublished manuscript.

O'Malley, S. The rural rebound. *American Demographics. 16*(5). 1994 pp. 24-29.

Rubin, B. A. (1996). *Shifts in the social contract.* Thousand Oaks, CA: Pine Forge Press.

Tyack, D. B. (1974). *The one best system: A history of American urban education.* Cambridge, MA: Harvard University Press.

U.S. Department of Commerce. (1994). *Statistical abstract of the United States 1994.* Bureau of the Census. Washington, DC: U.S. Government Printing Office.

Willits, F. K., R. C. Bealer, & V. L. (Winter, 1990). Timbers. Popular images of "rurality": Data from a Pennsylvania survey. *Rural Sociology*, *55*, 559-578.

DISCUSSION SCENARIO

Small Town Banker

You are a banker in a small Midwestern town. You have just completed your degree in agribusiness from the Land Grant University in your state so you are well acquainted with business and farming practices. Ever since you were in high school, you have looked forward to completing your degree and being able to return to your home community to work with farmers as they manage and operate their farms.

Classes and other experiences at the university have sensitized you to a number of issues that you hadn't really thought too much about before. Some of these have to do with the environmental hazards associated with irrigation, pesticides and herbicides, as well as the potential health risks associated with the use of hormones in livestock. You have also become more informed about which practices are efficient use of protein and which are expensive to the food chain (e.g., raising and processing grain to fatten cattle for people rather than humans eating grain directly).

Since obtaining your job at the bank, you have declined a loan to a farmer wanting to install an irrigation system. In a recent speech to the Chamber of Commerce, you suggested that farmers in the area should be seriously exploring alternatives to raising tobacco and that they should seriously consider reducing their dependence on fertilizers and other chemicals.

Now you're getting the sense that something's wrong. People still speak to you and they're polite when they see you in public, but there's a coolness in the air. Some of your regular customers have been observed going in and out of another bank in town. Although nobody is telling you so directly, you're getting the sense that a lot of the information that you learned at the university isn't playing well here back home. What should you do?

DISCUSSION QUESTIONS

1. To what extent should farmers be allowed to use pesticides and herbicides to increase the productivity of their operations?
2. Should the federal government establish regulations designed specifically to protect and maintain the small family farm?
3. Should restrictions be placed on the development of large corporate farms, especially when they are being developed and/or financed by foreign investors?
4. Have the changes in technology that have made the farmer more independent and the operation more efficient (larger equipment, no- or low-till farming, etc.) improved the quality of life in rural America or has farming become a lonely and isolated existence?
5. Should large scale irrigation from underground aquifers (such as the Midwestern Ogallala aquifer) be allowed?
6. Should the use of bio-technology to develop such things as hybrid crops, hormones to enhance milk production and rate of beef production, be regulated by the federal government?
7. Should farmers continue to receive federal subsidies for such things as tobacco production, low food chain efficiency practices, and payments for leaving land unplanted?
8. To what extent are values such as self-sufficiency, community, honesty, reliability, ingenuity, hard work, stability, responsibility, and tenacity functions of rural culture? What is there about "rural living" that facilitates the development of these values? Is there something about city life that erodes (or at least impedes the development of) these values?
9. In what ways is the quality of life better in rural areas than in urban areas?
10. In what ways is the quality of life better in urban areas than in rural areas?
11. In what way is a price support subsidy paid to a farmer really subsidizing everyone?
12. What is meant by the opening quote: "We all live in the city. We all live in the country" (Cronon, 1991, p. 385).

CHAPTER 6

Urban America

Britta Fischer

With 86% of the population of the United States living in metropolitan regions (Gottdiener, 1994) and the remaining 14% living lives touched daily by the urban media of TV, radio and newspapers, to write about *Urban America* is, in a way, to write about America as a whole. Still, cities are identifiable entities with particular problems, assets, institutions and behaviors.

Cities engage the observer and the resident positively or negatively. We tend to hold strong opinions about them. As sociologists we face the dilemma of being part of the object which we try to describe and analyze (i.e., society). My perceptions of urban conditions have been formed by many years of study and teaching about urban issues and by having grown up in German villages and small towns as well as in the port city of Hamburg. In the United States, I have, since my high school days, lived in a suburban section of Philadelphia; in Manhattan near Harlem at Barnard College; on the edge of the ghetto in St. Louis during graduate school at Washington University; in inner-city neighborhoods of Washington, DC, just months after the riots of 1968; across from a large housing project in Boston at a time of white flight and school desegregation; and in Lynn, MA, an old, declining industrial town north of Boston, where my children go to public school. I know Chicago very well, as I do Sao Paulo, Brazil, the city destined to be the second largest in the world by the year 2000. I consider myself privileged to have experienced the life-styles of working-class people and the well-to-do, of black and white, of Asian and Caribbean immigrants. Wherever I go, I am an inveterate people and cityscape watcher, be it in Beijing, Paris, Oslo, or Rio de Janeiro. Being a white woman in a black neighborhood, an immigrant among the native-born or a woman in a largely male world often has placed me at the periphery, but I have never been disengaged. Sometimes urban living brought with it stress and danger. One learns caution, but the sense of vibrancy and fascination associated with city life has never left me, even as I tend my garden, which is frequented by raccoons, opossums, crickets, voles, bluejays and snakes, for such wildlife is also part of the urban landscape.

Key Concepts, Definitions and History

Since this chapter is written by a sociologist but will be read by people from many other disciplines, I shall attempt to use as little jargon as possible. However, a few definitions will be helpful in providing a common understanding.

City: A relatively dense settlement of a heterogeneous population of 50,000 or more, whose economic pursuits are primarily nonagricultural.

Urbanization: the establishment of cities, "the process of people moving to cities" (Palen, 1992, p. 9), and the concentration of population in terms of numbers and density.

Urbanism: Culture, behaviors and values peculiar to urban populations.

Suburbs: Communities surrounding cities which serve as places of residence for many adults employed in the city. There are also suburbs with industries of their own. Suburbs vary by the economic status, education and ethnicity of their inhabitants. They tend to be socially more homogeneous than cities.

Metropolitan Statistical Area (MSA): "Composed of at least one large city of 50,000 along with its county and all surrounding counties linked economically with it" (Gottdiener, 1994, p. 8). According to the 1990 census there are 254 MSAs. This unit is also often called a metropolitan area. Based on this measure the United States is 75% urbanized.

Standard Metropolitan Consolidated Area (SMCA): Consists of several Metropolitan Statistical Areas "such as Los Angeles County/Riverside/San Bernardino" or "the New York/New Jersey/Connecticut complex" (Gottdiener 1994, p. 8). The SMCA is equivalent to the concept of *metropolitan region* employed by Gottdiener. Based on this measure the United States is 86% urbanized.

Downtown: The commercial center of a city.

Inner city: Residential areas, usually inhabited by poor, ethnic populations, adjacent to downtown.

Ghetto: Originally a restricted area assigned by the Pope to Italian Jews in the mid-sixteenth century during the Counter Reformation (Stille, 1991). Until this century *ghetto* referred to the Jewish quarter of European and American cities. In the mid-twentieth century this term has shifted to designate predominantly black, economically deprived urban neighborhoods in the United States.

As we approach the end of the century we have good reason to take stock of Urban America, in the last few decades there have been some remarkable developments that cast into question many of the commonly accepted notions about cities to which we almost subconsciously subscribe.

> Today the city has exploded. There is no focus or *downtown*, as there was in the past. People live and work in widely separated realms. Most of the population is urban, so most live in or near some city. But progressively fewer people each year live within the large central cities that were the population foci of the past. Instead we now call home the expanding regions of urbanization that are associated with a mix of cities, towns, suburbs, and ex urban areas. This new form of settlement space is called the *multinucleated metropolitan region*, and it is the first really new way people have organized their living and working arrangements in 10,000 years. In contrast to the characteristics of the bounded city the new form of space can be typified by two features: it extends over a large region and it contains many separate centers, each with its own abilities to draw workers, shoppers and residents. (Gottdiener, 1994, p. 5)

This new configuration of urban areas may indeed be news to the non-specialist, for most of us operate with somewhat antiquated, dichotomous notions of urban/rural or urban/suburban which constitute our common-sense understanding. Cities and suburbs are now seen more commonly as part of the metropolitan fabric, two sides of the same coin rather than as two different worlds. There is a need for rethinking some of the time-honored categories used to approach everyday life. Concepts such as suburb, inner city, and ghetto have not lost their meaning, but they have taken on considerably different dimensions. We would do better to see them as interdependent parts, closely connected into the global economy, rather than as distinct and separate entities.

Recently, there have been important economic shifts in the United States from older Northern industrial cities, like Pittsburgh, Cleveland and Detroit due to deindustrialization to *new* southern and western cities like Houston, Dallas, Phoenix, Los Angeles, Denver and Seattle. Although Cleveland and Pittsburgh have been revitalized, other cities like Detroit have not fared so well. The human cost has been high as the technological basis of the global economy moves from manufacturing to information systems and transforms urban areas in the process.

The discussion will begin with a brief historical sketch of American cities, after which we will examine the culture of urban America. This will not only entail a portrait of changing values but also an introduction to some of the most enduring sociological interpretations of these changes. Then we will look more closely at the interface of technology with urban culture, singling out transportation, skyscrapers, housing, communication and infrastructure (especially water supplies and waste disposal for special attention). Finally, some major issues of concern and some reflections about future directions for urban America will be explored.

History of U.S. Cities

We have already touched upon some of the most recent history of U.S. urbanization. Now we shall briefly consider some earlier stages. North Americans have been relative latecomers to the global urban scene. From the beginning of British colonization in the early 17th century, the founding of towns proceeded quickly, despite the fact that the majority of the population was, at the time, engaged in agricultural pursuits. After driving out the original inhabitants of the region, the English settlers often designed their cities according to a religious or secular utopian visions. In many cases, convenient transportation paths and landscape patterns were destroyed in favor of a rectangular geometrical design, or gridiron, on the land.

In the absence of enemies with equivalent firepower, American cities grew largely without the constraints of fortified walls, as had been the case in Europe. The latest ideas of Baroque city planning could be applied, though the absence of resident royalty affected the form this took. Neither ornate palaces nor gilded cathedrals marked colonial cities.

With the advent of independence, and with the emergence of the Republic at the end of the eighteenth century, neoclassicism suited the democracy that was consciously modeled on Greece and Rome. This explains the many public buildings in the shape of Greek temples, and monuments in the form of Roman arches of triumph. Yet we should not forget that the most enduring aspect of Baroque architecture is to be found in the domes of statehouses from Sacramento, California to Providence, Rhode Island as well as in the Capitol in Washington, DC itself.

In accordance with their colonial status, American cities had been primarily located on the shore of the Atlantic, functioning as commercial links with the mother country. Prohibited from developing any industry that might compete with England, propertied colonists had good reason to support the movement for independence. The Industrial Revolution, already under way in England, rapidly entered the United States in the early nineteenth century and resulted in the founding of many new cities without diminishing the importance of the old established commercial centers.

The overall pattern was a westward push which was aided by canal and railroad construction projects. The invention of the telegraph enhanced communication and with it came the expansion of markets. Individual entrepreneurs were often directly involved with the growth of new cities as they pursued land speculation and visionary commercial schemes. Cases in point are Cleveland in the 1790s and Milwaukee in the 1830s, both cities on the Great Lakes. Beginning as centers for the transport of grain, flour, and produce to other parts of the country, these cities were, by the end of the nineteenth century, manufacturing heavy machinery from iron and steel. Cleveland also became the headquarters of Rockefeller's Standard Oil Company (Orum, 1995).

Along the Erie Canal (a man-made waterway connecting the Atlantic with the Great Lakes built between 1817 and 1825), Buffalo, Syracuse, Rochester, Utica, and Rome emerged as thriving centers of trade, transport and later manufacturing (Klebanow, Jonas and Leonard, 1977). The Ohio River performed a similar role. Beginning at Pittsburgh and emptying into the Mississippi, its banks became the location for Cincinnati, Ohio and Louisville, Kentucky. These cities would not have attained their significance had it not been for Robert Fulton's steamboat. Though the *New Orleans* (the steamship to make the first trip in 1811) had been built in Pittsburgh, Cincinnati's fortune was ultimately made in steamboat construction with its iron foundries, forges and machine shops (Klebanow, Jonas and Leonard, 1977). The successful cities of the nineteenth century were diversified industrial cities, producing, in addition to a vast array of metal goods, meat, beer and liquor, furniture, shoes, paper, etc.

In the same period, Southern cities, with the exception of New Orleans at the mouth of the Mississippi, did not flourish. So thoroughly was the South dominated by the plantation system, that its cities were neither places of substantial investment nor centers of innovation in pre-Civil War times. Even their trade was primarily conducted in New York City. After the Civil War, full-fledged industrialization accelerated the growth of cities by drawing foreign immigrants and migrants from rural areas into the urban way of life by the millions. Still, the South continued to lag behind. By 1920, New Orleans was the only Southern city of more than 200,000 inhabitants, while the West already had five: Los Angeles, San Francisco, Seattle, Portland and Denver (Klebanow, Jonas and Leonard, 1977). The spread of electric power and the invention of the internal combustion engine at the end of the nineteenth century set the stage for industry's ability to settle just about anywhere, independent from natural resources. Meanwhile the mechanization of agriculture in the Midwest contributed to rural-to-urban migration.

Several of the developments characterizing cities during the heyday of industrial manufacturing (from the turn of the century through the 1960s) will be discussed in subsequent sections. Suffice it to say here that by the 1970s many of the older industrial cities like Newark, Detroit, Pittsburgh, Cleveland, and Milwaukee were in serious decline, while Atlanta, Houston, Dallas, Phoenix and especially Los Angeles, had grown prodigiously.

The City and the Fabric of Society

Urban Growth and Changing Values

Let us illustrate the interface of urban growth and cultural values by examining the greatest of Midwestern cities—Chicago. Like Milwaukee and Cleveland, Chicago experienced a great land boom after the opening of the Erie Canal. This was followed (in the mid-nineteenth century) by entrepreneurs such as Cyrus McCormick, maker of agricultural machinery, the Armours and the Swifts, who forged large businesses with stockyards and meat packing houses. A swampy terrain proved to be no deterrent. By 1893, the Columbian Exhibition demonstrated that Chicago had arrived as a world-class city. When St. Louis became the site of the World's Fair and the Olympics in 1904, its preeminent place as the rail link to the West had already been ceded to Chicago.

Such economic growth brought with it unheard-of social transformations. Theodore Dreiser's *Sister Carrie* and Upton Sinclair's *The Jungle* still provide invaluable insights into the flavor of the times. Among social scientists, some regretted the passing of rural society; others hailed the march of progress, and still others viewed this turn of events as neither morally bad nor good but simply as the inevitable course of history.

The growth of Chicago was, and has been, the object of much study. Sociologists at the University of Chicago, deserve considerable credit for conducting pioneering work in this area. As these first sociologists a century ago tried to grasp the significance of the proliferation of urban occupations and life-styles, they spoke of disorganization, deviation from the norm, pathology, and maladjustment. In fact, in a subsequent analysis Mills (1943) noted that the first sociologists had remarkably similar backgrounds. Most of them came from small towns or rural areas. They judged what they saw in Chicago from the vantage points of social reformers who stubbornly retained romanticized notions of the normality of rural life, and for whom urban problems were examples of the *abnormal* or the *deviant.* In fact, as contemporary sociologists, city planners, theologians, etc., attempt to impose suburban or middle class values on either rural or inner-city situations, some of the same tensions and biases emerge.

Although the United States embarked on capitalist industrialization relatively unencumbered by the aristocratic traditions that valued land ownership and downplayed commerce and manual labor, we have nonetheless carried a strong bias into the modern urbanized era reflecting a mythologized rural ideal (Marx, 1964; Warner, 1962). This is particularly manifest in our attachment to the concept of the single-family home, complete with lawn and white picket fence. There is a long tradition in American society that idealizes and romanticizes rural stability as the ideal for which to strive. Perhaps beginning with Thomas Jefferson, (whose wealth, we must not forget, was derived from his plantations that were worked by slaves) and continuing to the present, suspicion of the city with its alleged attendant evils are widespread. This is especially true within the middle-class suburban and small-town populations.

Conversely, and perhaps just as persistent, has been the opposing view, of the city as the embodiment of all that is modern, progressive, stimulating and innovative as an escape from the endless toil of rural life and the narrow confines of village traditions. Cities represent opportunities for almost limitless freedom, and the ability to develop one's personality to the fullest.

Faced with these extreme alternatives, another generation of sociologists at the University of Chicago set out in the 1920s and 30s to conduct a comprehensive series of empirical investigations of urban life, to document its diversity and complexity (Faris, 1970). Of the roughly 200 Masters and Ph.D. theses produced over the fifteen-year period from 1920-1935, many became classics in the field. Consider such titles as *The Gang: A Study of 1,313 Gangs in Chicago* by Frederic M. Thrasher (1927); *The Negro Family in Chicago* by E. Franklin Frazier (1920) or such titles as *The Delinquency of Girls* (Buchan, 1922), *The Hobo* (Anderson, 1923), *A Study of Isolation among Chicago Shelterhouse Men* (Weinberg, 1939), *Social Policy of Chicago Churches* (Reep, 1911), even *The Garbage Problem of Chicago* (Frink, 1902). Most of these subjects continue to be of relevance today.

The primary result of these investigations was a growing appreciation and understanding of the behavior of urban residents as seen in the context of social and cultural conditions of urban life. Since then, critics have noted that the Chicago sociologists may have undersold the critical importance of political and economic structures. Still, we owe much to their determined efforts in mapping out and interpreting the historic social landscape of one of American's major metropolitan areas.

At the turn of the century, a German sociologist, Georg Simmel (1962), also reflected on how the urban experience affects people's behavior. In his famous essay *The Metropolis and Mental Life* he demonstrated how urbanization and the economy have been closely linked together, and that this association gives rise to traits such as calculation, anonymity, and matter-of-factness. Because coordination of a multiplicity of activities into a complex whole is needed in the city, punctuality and exactness become important virtues; impatience may also increase as a consequence. At the same time, the urban dweller is bombarded with such a variety of emotional and sensory experiences that in order to retain sanity, she or he may be forced to tune many of them out. In turn, this gives rise to a reserved or blasé attitude, that says in today's parlance, "Nothing can phase me!"

Much of the humor in the early version of the TV show *Candid Camera* revolved around the internalized rule of keeping one's cool in the face of outrageous situations. The hidden camera would show a knight in shining armor or a lion on a leash emerging from a New York subway stair onto the sidewalk. Incredibly, bypassers barely seemed to notice. The tragic case of Kitty Genovese, murdered in the 1960s in full view of thirty people in a New York apartment complex who made no effort to contact the police (let alone intervening on her behalf) becomes somewhat more comprehensible with the help of Simmel's insights. Social isolation in anonymous units of habitation in an urban setting reduces the sense of community and may lead to abrogation of a sense of responsibility for one's fellow humans. Indifference, however, is not the urbanite's invention. It occurs as much in the capitalist firm as in the bureaucratic institution. For that matter, in American rural society, built in large part on slavery, and later sharecropping, tenant farming, day labor, and today migrant farm work, compassion was and is often lacking.

People who are strangers to one another must, of necessity, work out different norms of social conduct than people who know each other intimately and who meet on a daily basis. The impersonality of city dwellers is, therefore, both a defense mechanism and a means of insuring efficiency. What some may consider superficiality of urban social relations appears in a rather different light if we consider the following quote, "The cosmopolitan did not lose the capacity for knowing others personally. But he gained the capacity to know others only categorically" (Lofland, 1973, p. 177). In the modern world, to *know others categorically*, is to have a clear sense of role expectations for oneself and others. While it is true that this level of *knowing* is impersonal, it is also true that such knowledge is an important part of emotional and physical survival in the city.

To counterweigh some of these forces of alienation, city dwellers have evolved a number of mechanisms designed to promote intimacy. Ethnic neighborhoods, where the social life revolves around family visits and religious rituals, are one response. Another method is found in the close-knit friendships many urban professionals develop and maintain. Members of these groups sometimes do not live in close proximity to each other. They may be dispersed over an entire metropolitan region; yet many of these young professionals lead a more active social life with each other at the workplace, after hours, by telephone and e-mail than do their small-town or rural counterparts.

Cultural Diversity

Many public events, such as walks to raise funds for charity, gay pride marches, ethnic as well as citywide festivals, international fairs, and clean-up campaigns of public spaces, attest to the vitality and solidarity of community life on a larger scale in urban culture. There are also numerous instances and studies of multi-ethnic efforts to save a neighborhood's resources (Susser, 1982; Gans, 1962).

One of the reasons suburban people seek out cities as places to spend their leisure time is precisely this presence of cultural diversity. The Chinatowns of San Francisco and New York are legendary tourist attractions. Bostonians consider the still largely Italian North End to be an important cultural asset. Ethiopian, Thai, Korean, Brazilian and Vietnamese restaurants are relatively recent arrivals to our already multi-ethnic culinary landscape. To flourish as they do, they require both a concentration of members of these various nationalities as well as a cosmopolitan clientele from other backgrounds.

However, our society defines only some ethnic groups as exotic and picturesque, while (often through racism), others are branded as dangerous and to be avoided. As a society, we have ambivalent attitudes about the great variety of cultural styles in our midst. We frequently pay lip service to the value of diversity while, at the same time, maintaining our distance. A telling example is the frequent practice within suburban communities of voting down proposals for low-income housing which would bring racial and ethnic minorities into their communities.

Diversity is effectively counteracted in the area of consumption by the proliferation of shopping malls, one resembling another like so many peas in a pod, regardless of whether they are located in Macon, Georgia or Oakland, California or suburban St. Louis. A given mall may contain over one hundred stores; yet the prevalence of chain stores leaves an imprint of uniformity. Even unique malls like Faneuil Hall Market Place in Boston now are increasingly dotted with chain stores, because these companies are capable of paying the high rents. A very heartening exception to the tendency to homogenization is the vibrancy of commercial and artistic life combined with community spirit in a variety of neighborhoods of San Francisco (such as the Castro, Noe Valley, and Richmond neighborhoods). Here, many specialty bakeries, used bookstores, flower shops, small restaurants, and art galleries compete with each other and, in the process, provide an aesthetic and social experience rarely found in other cities. Is it a cause or effect that these neighborhoods also happen to be the ones in which gay men and lesbians feel most comfortable, take pride in their homes, and actively contribute to an atmosphere of acceptance of many diverse life-styles?

Crime

A consideration of cities invariably brings up the problem of crime. Here we will deal with perceptions, incidence, effects of crime, and explanations. City life is perceived by many as crime-ridden and dangerous. Suburbanites and other nonresidents of a big city tend to be especially fearful. Thus they do their best to avoid city driving, taking public transportation, or walking in the city. Horror stories abound, and the nightly news contributes to the vivid imagery, giving rise to notions of random violence that could strike at any time. Roche (1994) notes that "in 1993, crime news on the three major networks doubled, but real crime remained the same" (p. 22). Women and the elderly feel particularly vulnerable and fearful. However counter-intuitive it may seem, it cannot be emphasized enough that the primary victims of urban crime are young men in poor neighborhoods engaged in disputes over drugs (Gottdiener, 1994).

Urban crime comes in many different forms: violent crimes such as homicide, rape, assault, and robbery; and property crime such as break-ins, embezzlement, or car theft. Although overall crime rates have gone up, the incidence of crime differs substantially by section of a city, race, ethnicity, age group, and gender. It is also worth pondering what types of crime attract the most attention. Crime is now increasing faster in the suburbs than in the cities, albeit from a smaller base (Palen, 1992). White collar crime such as stock market fraud or bank scandals, involving literally billions of dollars and committed by wealthy gentlemen, does not receive the same coverage in the media or in the justice system as crimes committed by young minority offenders (Gottdiener, 1994). For that matter, so little progress is being made in apprehending *big-time* drug dealers in this country that one has to wonder whether it is ineptness or unwillingness of the responsible agencies that accounts for this condition.

Besides generating fear and stress, the effects of urban crime are numerous: loss and disruption of many lives, costs to individuals and families, and cost to society in terms of medical expenses, added security measures, and lack of economic investment in poor areas (Gottdiener, 1994). Furthermore, lack of investment in the ghetto is as much a *cause* as it is a *consequence* of crime.

Crime rates, in particular homicides, are substantially higher in big cities of the United States than in other comparable industrial countries. Homicides per 100,000 of the population in the United States are 22 while in Europe, Canada and Japan they range from 1 to 5 per 100,000 (*The Boston Globe*, 1993). While there are those who blame crime on the lack of moral fiber in the perpetrators, most sociologists reject this explanation. Rather, we look for the underlying structures within society that foster such developments. For example, we have known for at least half a century (Shaw & McKay, 1942) that urban areas in which there has been rapid growth in the influx of new immigrants and migrants, with the accompanying conflicts over turf and cultural practices, have higher crime rates than areas in which the residents, though also poor, have experienced little turnover and consequently much more stability.

In American society, large segments of the population, especially African-Americans and Hispanics, remain excluded from the affluence being experienced by the middle class. Furthermore, the media, especially television and advertising, continuously bombard every segment of the population with images of an affluent life-style to which everybody is expected to aspire. For the poor and disadvantaged this creates a dramatic sense of disparity and despair.

Poverty and the perception of poverty are relative. To be poor and discriminated against in 1995 in America is profoundly different from being poor and discriminated against in 1895, when poverty was widespread. Pervasive racism, evident in housing discrimination and lack of access to suburbs even for middle-class blacks; flight of industries from urban to suburban or foreign locations and hence of jobs; intolerable unemployment rates (the rates for African Americans are generally double than the national average and often more than 50 percent for young African American men); exclusion from economic and political decision networks; government's unwillingness to tackle the drug problem in a comprehensive way; and educational neglect; these have done much more to undermine poor communities than the purported changes in values. Inner city mothers and fathers have basically the same hopes for their children as suburban, middle-class families. Where they differ is in the means at their disposal to pursue these goals as well as the structural problems in society that continue to frustrate them (Liebow, 1967; Massing, 1995).

The solutions cannot be exclusively sought in putting more police officers on the street or in building more prisons. Instead of relying on punishment, enforcement, and retribution, we, as a society, need to adopt much more far-sighted, imaginative and honest measures of prevention. We must isolate and address the root causes. These measures must include employment programs for inner city teenagers as well as actual employment and educational opportunities designed to instill hope, a sense of security and stability. Low-paid, temporary, and dead-end jobs will not create or sustain the work ethic. In fact, "to preach a work ethic without providing work is to taunt society's victims and mock its values" (Frankel, 1995, p. 16). This situation is likely to get worse as America moves increasingly into the knowledge age which demands a computer-literate work force.

To settle disputes by impulsive actions and deadly violence is not an invention of ghetto youths. Such practices are modeled daily on television and in action films as acceptable forms of conflict resolution. To be poor today in our affluent society, which unabashedly parades its materialistic values, generates frustrations which may lead the young and impatient to any number of get-rich-quick schemes (that easily outdistance the minimum wage rate of $8500 for a full year's work). From this perspective, it is not difficult to understand the lure of riches to be obtained through the sale of drugs. Little will be done to ameliorate these problems until we realize that they are not *their* problems but *our* problems. When 12-year-old boys believe that they will not live to age 20 and, therefore have nothing to lose, persistent hopelessness and reckless behavior persists. Mechanisms must be developed to strike at the root causes of youth and urban hopelessness.

What is perhaps most remarkable and readily lost in sensationalism is the fact that the vast majority of disadvantaged Americans are law-abiding citizens who go to work each day and who raise their children in the face of these odds.

Creation of a Mobile Society

The concept of a mobile society evokes an image of freeways and automobiles. These may indeed be the most impressive symbols, but there are many other aspects of movement to be considered as well. Whereas work and home were once located in close proximity, be it on the farm or in the craftsman's shop, few people today live within walking distance of their place of employment. Of course, this pattern is also changing as increasing numbers of people are deriving their livelihood from the use of a personal computer at home. While this may be the pattern of the future, most people still commute to work. This daily commute may occur by private automobile, bus, train or subway—even by airplane. The round trip may easily take two hours, of which some considerable portion may be spent in waiting. Having imbibed the notion that time is money, urbanites tend to be always in a hurry and are consequently frustrated and impatient when they cannot be on the move. There tends to be a preference for instant results, be it through the credit card, microwave oven, or fax machine. A perfectly serviceable computer of two years ago must now be replaced because it is too slow.

The pattern of the male breadwinner in the 1950s going from a suburban home to his work in the city has changed substantially in the last 30 years. Now, both men and women are juggling work schedules that require them to travel in different directions. In addition, children need to be taken to daycare, school or afternoon activities, a responsibility typically relegated more to women than to men.

Americans move frequently, with the attendant dislocations of spouses and children to different regions. In fact, the tremendous mobility of capital and industry from city to suburbs, from the industrial North to the South and West within this country (and over the globe as well) has brought with it a great deal of geographical mobility. The rapid growth of sunbelt cities like Houston, Dallas, San Antonio, Phoenix and San Diego has its counterpart in the depopulation of Detroit, Pittsburgh and other rustbelt cities. This transition has come at great cost to thousands of individuals, in the form of loss of jobs, and a reduction in the value of homes in one area while financial inaccessibility of housing plagues another. When Pittsburgh is transformed from a city of steel mills into a city of information technology, how do we balance the new employment opportunities for computer specialists against the early and involuntary retirement of steelworkers?

America's metropolitan areas can be seen as colorful, ever-changing kaleidoscopes. They continue to attract migrants, though, in a largely urban society, they tend to be from other metropolitan areas rather than from the countryside. The quality of life of urban dwellers depends largely on access to employment, education, health care, social networks, and cultural amenities. However, despite formal political efforts designed to achieve these ends, the *good life* is not evenly distributed in urban areas. Nor does it elude just the racial minorities. On average, white middle-class women, who are divorced and who retain custody of their children, experience a 40% loss in their overall standard of living. This frequently also includes the loss of their homes, while data shows that the standard of living of their ex-husbands continues to rise. Despite a 50 percent divorce rate, white middle-class Americans bemoan the absence of *family value*s in the inner city, even though they hardly know its inhabitants. These views not only attest to a deep social gulf between classes and races in our metropolitan areas, they become pernicious when translated into social policy. The proponents of *traditional family values* are punishing poor women and children by removing meager stipends while, at the same time, opposing a raise in the minimum wage, which is already woefully lagging behind its real value of earlier years.

The Influence of Technology on Urban Culture

The modern city of the industrial era is heavily dependent upon technology. One only has to recall the power failure in New York City in 1977 to envision the effects of the loss of only one aspect of our technological society—electricity. The technological infrastructure of modern cities is enormous, complex, and systemic. It is composed of thousands of miles of wire, millions of tons of concrete, tunnels, trains, and more. Technology, in the form of organizational and systems design, development, and maintenance, is also deeply woven throughout city life.

Great amounts of technology are generated in urban settings; and cities are voracious consumers of technology. Cities expand and contract in size and importance depending on whether corporations or governments decide to settle new technologies there. Old cities decline as technology becomes obsolete or too expensive to be replaced with state-of-the-art equipment at that location. Yet it is necessary to point out that however central technology is to urban life, and however dependent we may be on automobiles, soft drinks in aluminum cans, computers, telephones, polyester shirts, coffee, and ice cream, technology may at times be an engine of specific economic, political and social developments. However, technology should not be viewed as a singular or autonomous mover of urban development.

The discussion will now focus on the views of three quite different scholars; a scientist, an architect, and a sociologist. Specifically, the discussion will examine their views on how technology has impacted urban culture and will focus on specific features such as the transportation system, utility networks, skyscrapers, housing and communications. James Trefil (1994), a physicist, wrote *A Scientist in the City* in order to "examine [the city] through the eyes of science and technology" (p. xii). As might be expected, he explicitly excludes social and economic behavior from his agenda, concentrating rather on how specific technologies work, particularly physical structures and materials, energy, transportation, and communication systems. Furthermore, he offers a number of scenarios of the types of future cities that he envisions to be compatible with existing or improved technology. Examples include cities consisting of super skyscrapers 3000 feet (200 stories and more in height); edge cities, and new suburban rings serviced by electric cars and bullet trains; as well as cities from which "nearly all travel could be eliminated" using fiber optics and virtual reality.

The second author, Leslie Kanes Weisman (1992), an architecture educator, in her *Discrimination by Design*, takes a critical look at public architecture and public spaces. She also examines domestic architecture and the allocation of space, showing the profoundly gendered nature of typical domestic construction design. Men and women, by virtue of their position in the power structure, have substantially different inputs into, as well as different experiences and perceptions of, the design of cities including both the architecture and technology. Mark Gottdiener (1994), a sociologist, focuses on the "ability of large companies to carry out businesses [sic] on a global scale" in *The New Urban Sociology*. This factor has transformed cities in the last three decades, bringing about at once more urbanization but also more decentralization. This is particularly evident when we observe the growing high-technology belts around older cities.

All three authors pursue different and sometimes diametrically opposed goals in their books, but they all agree on one thing: Trefil and Gottdiener denounce technological determinism or reductionism explicitly, and Weisman does so implicitly. In other words, while all three view technology as pervasive and enormously important, they view technology as an *instrument of* economic, political and social interests rather than as the *cause* of these. This agreement is significant since, in the popular culture, there is considerable rhetoric about technology running amuck, on its becoming an autonomous force, or (in reverse) touting technology as the solution to urban ills.

Ways in Which Technology Has Made the City Possible

Transportation Systems

The growth of cities to the size they have achieved is only possible with the development of transportation systems capable of supplying large amounts of food and consumer goods as well as efficiently linking people with their place of work. The early cities could be easily traversed on foot or by animal. With the onset of the industrial age, many new cities sprang up and the need to transport raw materials to them and finished goods between them became an important incentive for the development of new means of transportation. The steam engine, that had already powered factories for several decades, was ingeniously placed on wheels and tracks to drive trains in the early nineteenth century. Prior to that, the only efficient means for the bulk transport of goods had been by boat on rivers and oceans. In fact, marine transportation received a considerable boost around 1800 with the perfection of canal building. Substantial investments were made in linking New York City with its rural hinterlands by means of canals. The legendary Erie Canal was a key component of this network (Struik, 1962).

Railways then emerged as competitors. They offered attractive opportunities to investors, who embraced this new form of transportation in such great numbers that the canals rapidly lost their preeminence. The versatility of railroads in transporting freight as well as people, its swiftness and flexible construction, made it worthwhile as a means of short as well as long-distance transport. A pattern emerged in the later nineteenth century in which suburban trains allowed affluent urban businessmen to commute back and forth between their work in the city and their rather spacious estates on the outskirts. Philadelphia's Mainline is just one well-known development of this kind.

Diligent entrepreneurs in the 1870s built trolley lines (initially horse-drawn carriages on rails and later electrified streetcars) fanning out from the center city into the, as yet, undeveloped land. Their efforts were coordinated with construction businesses, which took the opportunity to build affordable housing for working-class and middle-class families (Warner, 1962). This brought about the spoke-like transportation system and settlement patterns in cities like Boston and St. Louis. As a result, Boston adopted the rather immodest designation *Hub of the Universe*. Today it is hard to believe that, at the turn of the century it was possible to go by streetcar from New York to Philadelphia (Trefil, 1994), this in an age when the uses of electricity were still in their infancy.

Public conveyances, including railroads, streetcars, elevated trains and subways, were the primary mode of transportation well into the twentieth century. Even Los Angeles had an efficient and flourishing public transit system, until the automobile became the favored means of transportation over the course of this century. The growth of the automobile was briefly throttled by the depression when buyers' purchasing power was drastically reduced. Then War halted production of automobiles for private use. But these slowdowns only temporarily hampered the triumph of the automobile. Within a few years after World War II, suburbanization and highway construction gave the automobile industry a major boost. Powerful economic and political interests, known as the *highway lobby*, consisting of "large highway construction contractors, automobile makers, oil companies and automobile supply companies" (Shannon, Kleniewski and Cross, 1991, p. 158) forcefully pushed for the conscious reduction or outright destruction of public transportation systems (Snell, 1979).

Also during the post WWII era, pent-up savings generated a demand for big items like homes and cars. At the same time, the production of these goods put thousands of returning servicemen to work, thereby alleviating an impending job shortage. The production of private automobiles shifted into high gear, followed with equal swiftness by the construction of many new housing units on cheap suburban land. The resulting shift in population, culture, and the character of cities has already been described earlier. The primary focus here will be on the profound transformation of local, regional and national transportation systems. Ninety percent of the Interstate Highway System, with its orderly arrangement of even-numbered highways going east-west and odd-numbered ones leading north-south, was financed by the federal government.

Once the interstate transportation grid was complete, circum-urban highways allowed one to drive coast to coast without ever passing through the heart of a major city. In this manner, public funds disbursed to private construction firms created a transportation network that also directly benefited the automobile, oil, rubber, and steel industries. Swift transportation at the periphery of cities via beltways made the intersection of major arteries and beltways focal points of commercial developments, industrial parks and shopping malls. The rapid development of these areas, where land was relatively inexpensive decimated the downtown commercial centers. For example, in Boston, only two, of an original half dozen department stores in the center city in the 1950s, remain today. These two stores, however, have become substantially bigger enterprises due to the proliferation of branches in the malls.

Ease of access by automobiles to areas peripheral to cities when combined with federal tax breaks for homeowners and artificially low gasoline prices acted as a tremendous catalyst to suburban growth. Suburbanites in detached single-family homes provided a market not only for automobiles but also for a proliferation of domestic machinery and appliances, from the lawnmower to the dishwasher (Hayden, 1984). In-so-far as the suburbs became the domain of women and children, two cars were often needed, one for the husband to go to work (as public transportation became unavailable) and one for the wife to do shopping and chauffeur the children.

True, there have been revivals of public transportation, but not as a matter of a comprehensive public policy. Despite the development of the Amtrak train system, there are far fewer lines available than there were a century ago. New cutbacks in the 1990s have rendered the future of long-distance train travel very uncertain. Bus companies and the lines they serve have been reduced as well. Meanwhile, airlines have grown tremendously. Some cities have constructed new subway systems during the second half of this century (Washington, DC, San Francisco, and Los Angeles). Others have extended old ones further into the suburbs (Boston) and suburban train lines have, in many cases, been revitalized.

Public transportation is especially critical to certain segments of the population. For example, women, especially the poor and elderly, rely much more heavily on public transportation. In the absence of a comprehensive governmental commitment to improvement and reconstruction, public transportation will remain cumbersome, unreliable in bad weather, stressful, and even dangerous to use. At the same time, automobile and truck transport will continue to shoulder the burden of transport of people and materials from one place to another.

Urban highway construction received some setbacks in the 1970s due to economic constraints (Lupo, Colcord & Fowler, 1971); but the city of Boston, where a major highway project was stopped in 1970, is now the site of the country's largest construction project. At a price of at least $8 billion, two miles of elevated downtown highway will be placed underground. There is reason to believe that by the time of its completion in around 2004, its ten lanes will be insufficient for the expected volume, since traffic volume tends to expand to fill the available highway space until it is clogged again (Arnott and Small, 1994). One may justifiably ask whether all this expense and effort might not have better been spent on expanding the public transportation system. Instead, newspaper columnists debate the pros and cons of electric cars, while high-speed trains, already well-established in Europe and Japan, are championed by some forward-looking politicians as efficient links between urban centers. But are these alternatives in our immediate future? Furthermore, the question must be raised whether electric cars are as pollution-free as they are proclaimed to be. They may contribute to cleaner cities, but the pollution associated with the manufacture of batteries and the increase in power plant output may overwhelm the benefits (especially if the plants are coal-powered). Also, many want to know, in whose backyard will these plants be erected? In addition, the recent earthquakes that struck San Francisco, Los Angeles, and Osaka/Kobe, Japan, as well as the bridge collapses in Connecticut, New York and California have heightened awareness the vulnerability of urban transportation infrastructures, especially of elevated highways.

Here in the United States we are caught in a number of contradictions. We live in a mobile society that has opted for and habituated itself to individualized, oil dependent transportation. At the same time, our dependence on the private automobile contributes heavily to the pollution of our immediate environment (smog, acid rain) and that of the atmosphere (greenhouse effect, ozone depletion). (See Michael Karian's chapter for further discussion of these problems.) Certainly speed limits, carpools, emission standards, and cleaner fuels represent obvious and appropriate solutions to the reduction of air pollution; but these practices can hardly eliminate the problems caused by a quarter billion cars and trucks on our roads.

Another contradiction is manifest in the fact that our economic system requires the steady (and preferably increased) consumption of big (and small) consumer items, while scaled-down consumption would lead to the badly needed conservation of natural resources. Between the one-person-to-a-car commute and the crowded, time-consuming public transportation there exist some approaches that have hardly been tried in the United States, but that have already been successful elsewhere. In Curitiba, Brazil, an industrialized city of 1.5 million, the introduction of a very efficient express bus system onto third lanes and some one-way streets where no third lane was available has reduced the use of the private automobile by fully one-third. In Porto Alegre, a Brazilian city of similar size, effective use is being made of radio-dispatched vans that combine the energy savings of buses and the flexibility of taxis.

Utilities: The Case of Water

"Water is the city's lifeblood; it drives industries, heats and cools homes, nurtures food, quenches thirst, and carries waste. Cities import more water than all other goods and materials combined" (Spirn, 1984, p. 19). An adequate local water supply was a major prerequisite for urbanization in the past, but rather than relying on natural wells and rivers alone, even the ancients used terracing, canals and aqueduct technology to regulate water in and around the city. In modern America we have gone to previously unthinkable lengths to supply cities and agriculture in desert areas with this substance so essential to life. This is especially true for the sunbelt cities of the Southwest like Tucson, Phoenix, and Los Angeles. These cities are highly dependent on water diverted from distant reservoirs and rivers and on tapping into irreplaceable aquifers deep within the earth. Some cities like Memphis, Miami, and San Antonio are able to cover their water needs from local ground water (Spirn, 1984). New York City's supply is channeled to the city using gigantic, artificial underground rivers.

In past centuries, diseases such as cholera and typhoid routinely decimated urban populations and were only brought under control when citizens could be provided with a clean water supply. Engineers and city officials were justifiably proud at the end of the nineteenth century when they designed and inaugurated elaborate reservoir, pumping, pipe, and sewer systems. Many of the buildings associated with the new systems were decorated with Greek, Roman, or Egyptian style elements, thus consciously celebrating their civilizatory mission. The drop in infant mortality rates and the general improvement of the population's health are closely related to the adoption of such sanitary measures and precedes public health measures based on the germ theory of disease (Cockerham, 1992). Chlorination and fluoridation of drinking water have been widely adopted by municipalities in the twentieth century. Such measures have jointly reduced harmful microbes and improved our dental health.

Yet there is another side to the water issue. We have become accustomed to using huge amounts of pure drinking water to flush away waste; to wash laundry, ourselves, and our cars; and to water our lawns. Most of this water flows into oceans and cannot be reclaimed. Also, through this process, many noxious and toxic wastes are dumped into rivers, lakes, and ground water affecting the very drinking water on which we depend. If this does not become our city's problem directly, it surely affects other cities downstream.

James Trefil (1994), although not addressing the problem of water pollution, asserts that if conventional water supplies dry up or prove inadequate, we might well solve the water problems associated with urban growth by cheaply turning sea water into drinking water. Such unbridled faith in the powers of technology to solve urban problems is somewhat puzzling in an age when the dimensions of ecological damage due to chemical processes caused by the activities of highly industrialized countries are well documented. He counters the arguments of environmental alarmists by claiming that a solution will be found to every problem once it becomes intolerable. It is true that many citizens, policy makers, and technologists labor under the misguided assumption that an elegant and inexpensive *technological fix* exists for all technological problems. It is critical that this assumption be carefully examined.

Given our current state of knowledge about the environment, there is considerable need for foresight and prevention. In the Boston area, we are, in the 1990s, paying dearly for past neglect with the cleanup of the harbor. While an effective drinking water supply system was constructed earlier in this century, virtually no effort and financial commitment were made to maintain the system. As a result, huge amounts of water were lost through leaky pipes, pipe breaks and contaminants entering the water supply. Sewer systems constructed for a smaller population continued to dump raw sewage onto the beaches when heavy rainfalls caused storm sewers to overflow. After President Bush, in 1988, made the Boston Harbor a campaign issue and blamed former Massachusetts Governor Dukakis for a century of neglect, a multi-billion clean-up project began and is now well under way. As of this writing in 1995, considerable progress has been made toward primary and secondary treatments of the effluents of Boston and forty surrounding communities. The marine life of the harbor is making a faster-than-expected recovery; fertilizer is being made from sludge; six egg-shaped digestors dot the skyline and an underwater tunnel, nine miles in length, will soon be carrying the remaining treated wastewater out to sea. This is a hopeful example, but hardly cause for complacency. It must be remembered that technological fixes usually come at huge costs, and time will only tell if these fixes will have negative trade-offs.

Skyscrapers

By the end of the nineteenth century, business activities in the rapidly growing cities were crowded into increasingly congested downtown areas. Communication and transportation systems converged on the center cities and, in turn, forced all major financial, business, retail and wholesale activity to be carried on in a relatively small area. Eventually, land became so scarce and so valuable that older, low buildings were replaced with buildings that grew in the only direction still available—upward. Initially there were considerable technological limitations on the height buildings could attain. These limitations were gradually overcome as iron and steel skeletons were invented to take over the role of bearing walls. Perhaps most important, Otis' elevator, invented in 1852, afforded rapid vertical movement of people and cargoes. Chicago became the testing ground for the first skyscrapers, which by the early definitions were buildings that were more than ten stories tall. Innovative architects like Sullivan, Burnham and Root, besides creating a new aesthetic in the 1890s, availed themselves of new methods (such as the use of metal frame construction and steam powered cranes) and materials. With the rise of an efficient steel industry, cast iron, wrought iron and steel increasingly took their place in building construction, allowing for greater height, thinner walls and more windows.

The skyscraper is a quintessentially American invention symbolizing the aspirations of modernity and giving them an imposing physical form. This type of building soon became the instrument by means of which inter-urban and corporate competition was conducted. By the early twentieth century New York surpassed Chicago with the construction of the 55-story Woolworth Building in 1913. From 1931 onward, the Empire State building (with its 102 stories) stood over all others in splendid isolation, halfway between Mid-Manhattan and Lower Manhattan. For nearly 40 years it was the symbol to the world of all that was grand about New York and America. This symbolic power of the skyscraper is important. At once it embodies technological process, aspiration, and conquest.

Then, in the late 60s and early 70s, a flurry of construction activity bounced the honor of having the tallest building in the world back and forth once again between New York and Chicago. The John Hancock Insurance Company's office building, designed by Fazlur Khan with an exterior steel frame allowing for maximum unobstructed interior floor space (Billington, 1983), took the title to Chicago, only to lose it a short while later to the World Trade Towers in New York. This race was for now suspended when, in 1973, the Sears Tower, also designed by Khan, became the world's tallest building with 110 stories and 1454 foot height (Trefil, 1994).

Meanwhile, by the early 1970s, New York and Chicago were no longer the only American cities with a proliferation of skyscrapers. The skyline of San Francisco was in the process of transformation from gentle hills to steel and glass towers. Boston soon followed suit and now there is only one major city in the country, Washington, DC, that does not have its human-constructed collection of peaks and canyons. Washington remains the exception primarily due to legislated height restrictions as well as the fact that the city does not function as a center of corporate activity.

The story of skyscrapers is fraught with physical challenges and obstacles which engineers had to overcome. They had to design the buildings to withstand high winds without snapping or excessive swaying on the top floors. Methods had to be devised to handle the logistics of constructing a tall building within the confines of a crowded city. Foundation systems had to be designed to properly anchor the huge structures above them.

The I. M. Pei-designed John Hancock Building in Boston, at the time of its construction in the early seventies, earned the dubious title of "largest plywood structure in the world" because its window panes began to pop out one by one and "had to be replaced at a cost that is estimated to have exceeded the building's entire $95 million budget" (Trefil, 1994 p. 58). Trefil indicates that this problem may have been due to the first-time use of double panes of tinted glass, but it is also known that the design of the building was excessively narrow for its height. The excessive swaying had to be corrected by installing a huge damper on top of the building at an enormous cost.

The damper consists of a concrete block weighing several hundred tons which is:

> attached to the building by springs and pistons and resting on a smooth concrete surface. When sensors indicate that the building is starting to sway in the wind, oil is pumped under the block, which is then free to slide under the concrete surface. As the building frame bends, the spring stretches, but inertia makes the block stand still. The system is designed so that the block doesn't start to move until the building itself has reached its maximum deflection and has started back. In this way, the block moves *out of sync* with the building—it moves to the left as the building moves to the right, and vice versa. In effect it plays the role of those sailors leaning over the side of the boat, supplying a force that opposes the one exerted by the wind. The result: the building's oscillations are dampened. (Trefil, 1994, p. 160)

This entire case is still largely shrouded in secrecy. None of this seems to have affected the stature of the star architect, who has gone on to many other projects including the John F. Kennedy Library, the glass pyramid at the Louvre in Paris, and the Rock 'n Roll Hall of Fame in Cleveland. As the scale of the projects increases, so does the cost of repairing the mistakes, and the question of Who pays? is a legitimate one. Likewise it is time to ask, "Who decides?"

Trefil goes so far as to say that "as far as engineers are concerned, the sky is, quite literally, the limit" and he believes "that sooner or later someone with a lot of ego, coupled with political and financial savvy, is going to want his or her name attached to the world's tallest building. When this person comes along, the engineers will be ready" (Trefil, 1994, p. 156). This, then, is the point where we would do well to consider the contribution of Leslie Kanes Weisman and other feminist architects and planners, when they call attention to the fact that our constructed environment is not neutral; that the skyscraper mania of this century should also be seen as a form of "architectural machismo" (Weisman, 1992, p. 41).

Besides being miracles of glass and steel, presumably to be enjoyed by everyone alike, skyscrapers also symbolize the social and economic status of the corporation that builds it. The seemingly playful competition between Chicago and New York looks a little different when we learn that "John Jacob Raskob, a vice-president of General Motors who started building the Empire State Building in New York...[was] worried that his competitor Walter Chrysler would outdo him" (Weisman, 1992, p. 40). Weisman also quotes Philip Johnson, architect of the 645-foot post-modern AT&T Building in New York, as saying, "There is absolutely no need for skyscrapers. They're a sheer fantasy of American Bourgeoisie," [sic] but he then goes on to exclaim, "The more skyscrapers I build, the more it strains the neck a bit, but it's pleasant to see them growing, like a good asparagus bed" (p. 41).

But Weisman's critique extends beyond corporate, male egos; it also focuses poignantly on the social inequities hidden behind the glitz and glamour of skyscrapers. Space is not neutral, but gendered. That is, men and women have different access to and perceptions of urban space. Public space is generally men's space. For example, government and commercial buildings, churches, public plazas and parks. Homes and suburbs are defined as private space and are said to pertain to women. When women function in public spaces it is most likely in subordinate positions as clerks and secretaries in office buildings, or as worshippers in church.

The only type of downtown building that has been designed to be openly inviting to women is the department store. From the 1880s onward, upper-class women were expected to conduct some aspects of their social life and their new duties as consumers in these dazzling buildings. Rather tellingly, the men's departments were located near the entrances, because men were viewed as busy and were not expected to linger. The downtown department stores have dwindled in number and their function has largely been replaced by the shopping mall. As Weisman (1992) comments, "shopping malls are cathedral-like monuments to a new faith in consumption" (p. 44), this time extending to all economic strata, but still predominantly appealing to women. They are relatively safe places for the elderly and adolescents, serving as centers of consumption and recreation.

From the Industrial Revolution onward, American cities have been generally viewed as dangerous, wicked places, frequented by ruffians and women of ill-repute. Genteel women, therefore, had to be protected from them for their own good. Yet the freedom, relaxed social norms, and anonymity which the city provided were attractive to women as well. From the point of view of patriarchal culture, neither the *danger* nor the *freedom* of the city were elements to which women should be exposed. Thus, various efforts have been made over time to restrict women to their roles as mothers and wives in a physically separate urban institution. As Wilson (1991) observes, "Mumford's support for the 'garden city' was based in part on his belief that it would restore women to their primary maternal role" (Wilson, 1991, p. 18). The suburbanization of the 1950s had a similar intent and effect. Yet poor women (i.e., elderly women and women heads of household), are disproportionately confined in the inner cities. Relatively close to the shiny tall buildings we find a concentration of the oldest, often substandard, but relatively affordable housing, in which many women of limited means must live. Since women's use of automobiles has also been limited historically, closeness to public transportation has also been a reason for seeking housing near the center of the city (Weckerle, 1981). Yet public transportation can also be very dangerous in low-income neighborhoods, especially at night.

Actual incidents of crimes against elderly women mostly involve frightening confrontations and injuries during purse snatchings. Without wishing to minimize their importance, crimes against the elderly are actually less common than against the young. But the media play up crimes against the elderly beyond the actual facts, thereby generating a climate of fear that is very debilitating (Markson & Hess, 1981). Still, services for the elderly and opportunities for sociability are greater for the elderly in the city than either in the suburbs or in rural areas.

"Women are still not accepted in many urban public spaces: lounging in cafes, eating alone in restaurants, strolling in woods and public parks" (Weckerle, 1981). The correlate of this nonacceptance is that a woman (even a rather worldly traveler like myself), often feels uncomfortable and fearful in such settings and may stay away from them altogether. Thus, the question should be considered, does the ideal embodied in the skyscraper embody values and views that are inherently masculine in orientation? Have these values led to the development of an urban culture that is subtly (or overtly) hostile to women? What are the implications for technology and its interface with all people in our culture?

Housing

While a great deal of technological innovation has gone into skyscraper construction, the same cannot be said for housing, especially public housing, which often consists of high-rise buildings. The Pruitt-Igoe housing project in St. Louis, built in 1955 (whose 33 buildings were imploded as unsalvageable in 1974) has become the textbook case for the failure of government-financed, privately built housing. Yet on closer inspection, one can conclude that, in addition to warehousing and stigmatizing of the poor, many technical shortcomings made the place unlivable. Elevators stopped only on every other floor; hot water pipes, located on the exterior of the building, would freeze and burst in winter thus producing cascades of ice on the stairs. There were no bathrooms in common spaces on the first floor; no plans or financing for landscaping or good playground equipment. Although public housing on the whole was designed to be well-built, there were many opportunities for private contractors to cut corners on workmanship and materials in order to increase profits.

In the 1970s and 1980s, government policy on housing of the poor shifted toward subsidizing rents to be paid to private-sector landlords and toward privatizing housing projects. In the case of the latter, major refurbishing and tenant-run administration have tended to reduce crime and alienation. Americans are by now conditioned to believe that government-run housing cannot work. Yet it is important to point out that public housing in the United States has, for most of its existence, been underfunded, and eligibility requirements have resulted in only the poorest of the poor becoming its inhabitants (Shannon, Kleniewski and Cross, 1991). That government-built and run housing can be attractive and desirable is evident from many examples abroad; notably Sweden, Germany, England and The Netherlands (Hayden, 1984). The difference lies in the overall more protective attitudes towards the less fortunate in those societies.

By the 1950s, the downtowns of many American cities had declined substantially (i.e., much of the housing was substandard in terms of sanitary facilities), and the population inhabiting it was generally poor and increasingly African-American. Rapid suburbanization, spurred by openly discriminatory mortgage policies and radial highway and belt-way construction favored the out-migration of the more prosperous, white population. As a result, many commercial establishments moved or closed their inner-city facilities. One way to revitalize these areas, it was believed, was by urban renewal, which essentially involved the razing of many neighborhoods and commercial areas. In its place would arise high-income apartment complexes and modern government buildings. This process, led to the removal of poor, ethnic groups without providing for their relocation, replacing them with upper middle class professionals. A classic example of this process was the destruction of the West End in Boston, a multi-ethnic, working-class community. Planners declared it a slum and had it razed, when in fact it was a well-functioning community. The land, thus cleared, was rebuilt with high-income high rises (Gans, 1962).

The skyscraper building boom of the 1970s and 80s, supported by city governments to increase the tax base of inner cities, drew some middle-class people back into the city. This resulted in a gentrification process through massive conversion of solid-stock, low-income apartment houses into condominiums. Affordable housing became correspondingly scarce and homelessness increased dramatically. With public housing becoming rapidly privatized and waiting lists becoming ever longer, seemingly absurd solutions were resorted to, such as housing women and children in hotels and motels at exorbitant rents paid by city governments. To offset this destabilizing development, the city of Boston charged developers of commercial space in downtown high-rises *linkage* payments that were to be used by the city to construct housing in poor neighborhoods.

Suburban housing tends to be economically and racially segregated, and since schools are locally financed they tend to reflect the class position and aspirations of the residents. Thus, upper-middle class professionals have the best school systems, while working-class towns rarely have such a quality of education available for the children of immigrants, racial minorities and the economically disadvantaged. Instead of standards of education that prepare all children of our society for the challenges of the future, inner-city children tend to be left behind and then are blamed for being delinquent in adolescence and unemployed in adulthood. The demographics of the gentrified white city dwellers are such that they are predominantly childless or with grown children, thus having little of a stake in improving inner-city schools. Private schools tend to be the option of choice for those who do have school-age children.

Communication

The communication and information revolutions of the second half of this century, especially the growth of the computer and electronics industries and their applications in everyday life, have had profound effects on the occupational structure as well as on the spatial transformation of urban centers. But these changes have by no means made cities obsolete. In the last thirty years we have witnessed an entirely new industrial complex emerging in different regions of the country. Its main poles in the United States are Silicon Valley south of San Francisco and Route 128 around Boston. These are areas in which innovation is the most important product, although these are also manufacturing centers of the computer industry. Silicon Valley and Route 128 are often referred to as High Tech regions. The Silicon Valley exemplifies innovation and investment as do other sunbelt, high-tech areas in Orange County, California, Texas and Arizona. Route 128 is an example of an old industrial region making a successful transition into the most advanced technologies of industry.

Castells and Hall (1994) call attention to the fact that these developments are part of a new global interdependence that involve major restructuring affecting cities everywhere. Yet in their comprehensive and worldwide survey of high-tech industrial complexes, science cities, and technology parks (all of which may result from different mixes of university, government and private investment inputs) they found that old urban centers proved to be very resilient. So while some major cities experienced a decline, (i.e., did not keep up with these high-tech developments, cases in point being New York and Berlin), London, Paris, and Tokyo did make the high-tech transition and many other cities, among them Los Angeles and Munich came to new prominence (the latter two experiencing remarkably similar in-migrations of skilled technical personnel). As the financial and cultural center of the United States, New York still retains its vibrancy, and with the unification of Germany, Berlin may well emerge as a communications technology leader just as Castells' and Hall's account shows us how the twists and turns of urban development may hinge on a combination of history, accident, and planning.

Issues and Future Directions for the American City

Significant advances in technology have made urban living possible. Foremost among these was the ability to generate an agricultural surplus and then, after several millennia in the nineteenth century, the industrialization of agriculture made it possible for the majority of the population to live in urban areas, be it towns, large cities or suburbs.

The quality of life in metropolitan areas tends to vary by parts of the city and the economic resources of its residents. The concept of *quality of life* of necessity has a subjective dimension to it. But not all is a matter of taste. At the end of the twentieth century, in the richest country on Earth, one could justifiably list the following components of the good life: meaningful work that pays a living wage; properly maintained housing, free of intruders and animal pests; first-rate health care accessible to all; and schools that provide skills, aspirations and dignity. These, I would consider basics. If properly implemented, they would go a long way toward eliminating hopelessness, homelessness, the need to escape into drugs, drug dealing, crime, and violence.

In many European countries such policies exist, including free post-secondary education. Translating Franklin Roosevelt's famous dictum that we should have "nothing to fear but fear itself" into our times, we should not have to worry about our workplaces, treatment at the workplace, and about our future in an age when life expectancies are rising. The stress that arises from these existential fears accounts for a considerable amount of absenteeism, alcoholism, and domestic violence. To attain peace of mind in our hectic urban world also requires appreciation of, and access to, cultural amenities such as museums, theaters, musical performances, public art, parks and recreational facilities.

William H. Whyte, a veteran observer of cities, points out that making urban public spaces open and inviting is key to making them popular. "Good places are largely self-policing," (1988, p. 158) while places that are walled and set apart for security are often precisely the ones that become havens for unsavory elements such as drug dealers.

Taking these insights to the level of an entire city, one can point to a remarkable success story. In Curitiba, Brazil (a city of 1.5 million inhabitants), a recent mayor, Jaime Lerner, and his team of energetic and imaginative planners set out to increase the amount of public space available to all. They created not only more parks and playgrounds, but also turned vacant factory buildings into theaters and multi-level flea markets. An abandoned quarry became an Open University for the Environment, attended by teachers, taxi drivers, journalists, and virtually everyone who interacts with other people. The transformation of public cultural life reached out to the poor segments of the city's population and engaged them in the process.

Being valued and taken into account, the poor became well-disposed toward another innovation: a massive recycling program in which people could trade bags of garbage for transportation tokens. In school, children learned how to separate trash and, in turn, taught their parents. Profits from recycling were allocated to programs for street children who, in turn, were involved in growing plants which the city buys from them.

The public transportation system was redesigned to be cheap and attractive. Some streets were reconfigured into one-way streets to accommodate express bus lanes that provided efficient transport. As a result of these measures, one third of automobile commuters switched to public transportation. Pollution is down, morale is up, and substantial amounts of money was saved by not building a subway. Old buses are recycled as classrooms to teach city youths marketable skills. This is not a fairy tale, but was achieved in the 70s and 80s through the efforts of a farsighted city administration that had a clear vision of creating a sustainable city (Lerner, 1993; Cunningham, 1994).

Curitiba has become a showcase of good urban and environmental sense. Its inhabitants are probably less educated but no less individualistic than those of American cities. We must ask ourselves the following questions and analyze them seriously. What are the obstacles to something like the Curitiba *miracle* happening in the United States? How can similar obstacles be overcome? The example of Curitiba shows how solutions to urban problems are interrelated, that improvements in one area—attention to dignity and morale—can have payoffs in another—cooperation with recycling.

As a society, we have made strides toward eliminating smoking from our environment and reducing lung disease; we now are focusing on obesity as a public health problem. Americans seem to be capable of being mobilized around health issues. What if we were to start with low tech, relatively inexpensive innovations such as pedestrian malls and bicycle paths? Immediate benefits would be that people would be lured into leaving their cars behind. The risks associated with cycling would be reduced. To this we could add the convenience of serviceable bikes which could be brightly colored and recognized as public property, making them unattractive to thieves, as has been done in Seattle. Such measures would bring more people into the streets and out of their sedentary life-style, of which driving a car is a part. Dutch, Danish, and North German cities have bicycle paths parallel to city streets, not just for recreational purposes in parks. Curitiba added 90 miles of bike routes along railroad lines and canals.

Urban gardening is another physical activity, which thrives particularly in poor neighborhoods. It requires low investments in fences and topsoil in empty lots, and brings together young and old of different ethnic groups. Urban gardens are only very rarely the target of vandalism.

These suggestions are not as limited and patchwork as they might appear to those accustomed to thinking in terms of one-shot solutions. They do have spin-offs beyond their immediate benefits, such as increasing sociability, decreasing pollution, fostering appreciation of and care for the environment; maybe even reviving democratic decision-making, especially if such activities were designed to draw in more than their usual constituents. In some parks of New York, the homeless have been successfully employed in maintenance. In many parts of the world, gardening and landscaping are skills taught to school children, thereby nurturing their interest in nature, biology, and genetics, as well as helping to cultivate patient and caring attitudes. We must ask ourselves, Have we done enough to harness the energies of inner-city youth in a positive way? When Mario Salvadori took the curriculum of his civil engineering program at Columbia University and taught it to sixth graders in Harlem, he was engaging children in technology in ways they never imagined (Salvadori, n.d.). Unfortunately, much of what is proposed here is viewed by politicians in this era of fiscal cutbacks as unnecessary and perhaps unrealistic. Still, millions of dollars are appropriated annually for new prison construction. Which, we must ask, is the better investment?

In tackling urban problems, our goal should be to transform cities and suburbs into more humane, nonsexist, nonracist, productive and safe places to be. These goals cannot be achieved primarily by technological means (such as infrastructure improvements, efficient public transportation, and, perhaps, electrically and solar-powered cars, more electronic surveillance, etc.—though these could certainly help). Rather, these improvements require social policies that emphasize community and grass-roots participation; equal access to housing and other vital resources; appreciation of racial, ethnic, and cultural diversity; respect for human dignity inclusive of youths from all backgrounds; and socially productive work for all. This would require government agencies at all levels to listen to ordinary citizens at least as much as they listen to the powerful real estate lobby.

Cities are endlessly fascinating, be it through the intimacy of cafes and community gardens; as repositories and dynamic centers of ethnic and artistic life, whether it is African-American New Orleans, the Italian North End of Boston, New York's Chinatown, Miami's and Los Angeles' different Latin flavors, just to name a few; through the ephemeral such as parades and protest marches; and also because of the miracles of glass and steel, especially when viewed at night from that engineering work of art, the Brooklyn Bridge. Cities have always been centers of great vibrancy. Our combined technological, ecological, social, political, economic, and artistic creativity needs to be mobilized in good faith to learn from past achievements and mistakes in order to build a better future for all of us.

REFERENCES

Anderson, N. (1923, 1967). *The hobo: The sociology of the homeless man*. Chicago: University of Chicago Press.

Arnott, R., & Small, K. (1994). The economics of traffic congestion. *American Scientist*, *82*(5), 446-455.

Billington, D. P. (1983). *The tower and the bridge*. Princeton: Princeton University Press.

Buchan, E. (1922). *The delinquency of girls*. Master's dissertation in Sociology. University of Chicago.

Castells, M., & Hall, P. (1994). *Technopoles of the world*. London: Routledge.

Cockerham, W. C. (1992). *Medical sociology*. Englewood Cliffs: Prentice-Hall.

Cunningham, W. P. (1994). *Understanding our environment*. Dubuque: Wm. C. Brown.

Faris, R. E. L. (1970). *Chicago sociology 1920-1932*. Chicago: University of Chicago Press.

Frankel, M. (1995). Mother Dear. *New York Times Magazine*. May 14. p. 16.

Frazier, E. F. (1920). *The Negro family in Chicago*. Doctoral dissertation in sociology. University of Chicago.

Frink, F. G. (1902). *The garbage problem in Chicago*. Master's dissertation in sociology. University of Chicago.

Gans, H. (1962). *The urban villagers*. New York: Free Press.

Gottdiener, M. (1994). *The new urban sociology*. New York: McGraw-Hill.

Hayden, D. (1984). *Redesigning the American dream*. New York: W. W. Norton.

Klebanow, D., Jonas, F. L., & Leonard, I. M. (1977). *Urban legacy*. New York: Mentor.

Lerner, J. (1993). Public lecture on Curitiba, Brazil sponsored by the Department of Architecture and Planning at the Massachusetts Institute of Technology, Feb. 16, 1993.

Liebow, E. (1967). *Tally's corner: A study of Negro streetcorner men.* Boston: Little-Brown.

Lofland, L. H. (1973). *A world of strangers.* Prospect Heights: Waveland Press.

Lupo, A., Colcord, F., & Fowler, E. P. (1971). *Rites of way.* Boston: Little, Brown.

Markson, E. W., & Hess, B. B. (1981). Older women in the city. In Stimpson, C. R., Dixler, E., Nelson, M. J., and Yatrakis, K. B. (Eds.). *Women and the American City* (pp. 122-136). Chicago: University of Chicago Press.

Marx, L. (1964). *The machine in the garden.* New York: Oxford University Press.

Massing, M. (1995). Hanging out. *The New York Review of Books, 42*(9), 34-36

Mills, C. W. (1943). The professional ideology of the social pathologists. *American Journal of Sociology, 49*(2), 165-180.

Orum, A. M. (1995). *City-building in America.* Boulder: Westview Press.

Palen, J. J. (1992). *The urban world.* New York: McGraw-Hill.

Reep, S. N. (1911). *Social policy of Chicago churches.* Doctoral dissertation. University of Chicago.

Roche, B. J. (1994, September 11). Dr. Life: Mount Holyoke sociologist Richard Moran enjoys debunking commonly held beliefs about crime and punishment in America. *The Boston Globe Magazine.* pp. 21, 42-47.

Salvadori, M. (n.d.). Children and structures. Video.

Shannon, T. R., Kleniewski, N., & Cross, W. M. (1991). *Urban problems in sociological perspective* (2nd ed.). Prospect Heights: Waveland Press.

Shaw, C. R., & McKay, H. D. (1942). *Juvenile delinquency and urban areas*. Chicago: University of Chicago Press.

Simmel, G. (1962). The metropolis and mental life. In E.& M. Josephson (Eds.), *Man alone*, (pp. 151-165). New York: Dell.

Snell, B. (1979). American ground transport. In Skolnick, J. H. & Currie, E. (Eds.), *Crisis in American institutions* (4th ed.) (pp. 304-327). Boston: Little, Brown.

Spirn, A. W. (1984). *The granite garden*. New York: Basic Books.

Stille, A. (1991). *Benevolence and betrayal*. New York: Viking.

Struik, D. J. (1962). *Yankee science in the making*. New York: Collier.

Susser, I. (1982). *Norman Street*. New York: Oxford University Press.

Thrasher, F. M. (1927). *The gang*. Chicago: University of Chicago.

Trefil, J. (1994). *A scientist in the city*. New York: Doubleday.

Warner, S. B., Jr. (1962). *Streetcar Suburbs*. Cambridge: Harvard University Press.

We live in a violent society. (1993, February 8). *The Boston Globe*, p. 4.

Weckerle, G. R. (1981). Women in the urban environment. In Stimpson, C. R., Dixler, E., Nelson, M. J., and Yatrakis, K. B. (Eds.). *Women and the American city*. (pp. 185-211), Chicago: University of Chicago Press.

Weinberg, S. K. (1939). *A study of isolation among Chicago shelterhouse men*. Master's dissertation. University of Chicago.

Weisman, L. K. (1992). *Discrimination by design*. Urbana: University of Illinois Press.

Whyte, W. H. (1988). *City*. New York: Doubleday.

Wilson, E. (1991). *The sphinx in the city*. Berkeley: University of California Press.

DISCUSSION SCENARIO

Separate Ethnic Groups, Separate Cities

A few years ago the idea was pursued in Boston for the predominantly minority community of Roxbury to secede from the city and to establish itself as Mandela City, a city in its own right. This would have given Mandela City access to its own leadership and to federal funding directly. Hold a debate on the advantages and disadvantages of separation with at least four viewpoints represented: representatives of Roxbury, for and against; and representatives of Boston, for and against. Obviously, this scenario can be adapted to other large cities.

Cleaning up Boston Harbor

The cleanup of Boston Harbor has been progressing well in the last five years, and, if the effort is continued until the turn of the new century, all mechanisms will be in place to keep the harbor and coastline free of pollution. However, in 1999, President Gingole and the Congress have decided that the federal government should get out of the environmental business, and that Massachusetts, which backed the President's opponent in the last election, should receive no more federal funding for the harbor cleanup. Homeowners in the area are already paying $1,000 annually for water and sewer. They cannot shoulder any more increases in assessments. What can/should be done? What viewpoints would likely be held by homeowners by the coast? By city councilpersons in Boston? By Congress?

DISCUSSION QUESTIONS

1. As noted in the text, one segment of American society idealizes and romanticizes rural life while another believes the city embodies all that is modern, progressive, stimulating, and innovative. Compare quality of life measures in three settings: a) living in a large urban center such as New York City, Chicago, or Los Angeles; b) living in a community of professionals in Winter Park, Colorado; and c) living in a town of 2500 in South Dakota.
   - What are the advantages of living in each of these settings?
   - What are the trade-offs in each setting?
   - Is it possible to identify certain groups or personalities who would be more adaptable to or have a preference for one community over the others?
2. In Chapter 1, a quote by Naisbitt and Aburdene indicated that currently more people are moving out of the cities than are moving in.
   - Why are people moving out?
   - To where are they moving?
   - Which technologies are allowing more mobility in regard to where one lives?
   - Given the advantages of living in the city, do you think the trend of moving out will reverse itself soon?
   - If it does not reverse itself, how will it affect the makeup of the city 25-50 years from now?
   - If people choose to live away from the city, how will they compensate for the cultural opportunities that they are missing?
3. The author argues for preventive policies as opposed to punitive policies in regard to inner city youth.
   - According to the author, what conditions have led to the gang and drug problems? Do you agree or disagree?

- Identify several preventive policies. Who pays for them?
- Name several punitive policies. Who pays for them?
- As one looks ahead, which policies are likely to have the best long-term effects on the inner city?

4. The urban centers of the United States truly have a diversity of ethnic and racial groups. Reflect on how this diversity:

- Enriches society
- Challenges society and city government.

5. What part did technology play in the shape of the modern city in regard to:

- The isolation of the inner city
- The growth of the suburbs
- The development of the beltway with its commercial centers
- The skyline.

6. What ideas do you have for urban renewal that would make the inner city enticing enough to attract commercial businesses, financial institutions, and other organizations?

7. In what ways is the American skyscraper and the city core an expression of the male ego?

8. Traffic congestion is one of the biggest complaints of city dwellers. What transportation system(s) is/are needed in today's cities that would reduce congestion, reduce pollution, and would not destroy the environment?

CHAPTER 7

Technology, the Arts, and Social Constuctivism:

R2D2 MEETS DEGAS

W. Tad Foster

act bold.
believe,
I see,
Enlightened,
takes hold.
light
fades as
Darkness
to unfold.
answers
and wonder
I search
Confused

"Stairs"
Foster (1987)

Introduction

Birth, life, death—the cycle of life shared by animate objects. What is it then that separates humans from other forms of life? What do humans possess or do that is different from trees or the squirrels who live therein? Descartes asserted that human existence is confirmed because humans think. Perhaps we can go a little further. Humans seem to have an unrivaled need for, and capability of, creation (excluding, of course, the common act of procreation). It is not just that people make things; they want and need to make things. Humans seem to be the only creatures concerned with transcendence; that is, their lives become more *complete* when they know that what they have done has meaning. Humans desire to rise above mere existence. If Maslow (1968) is correct, most people will not achieve actualization, but the need to try exists nonetheless. We see this in the various means by which we ensure survival by creating the things we need and want. We see the need to master the world around us exhibited throughout time and across cultures.

Two forms of human endeavor seem to have existed and progressed from the dawn of time—art and technology. Archeologists contend that while prehistoric humans were developing the tools that ensured their survival (e.g., fire, weapons, domesticated animals, etc.) they also were engaged in expressing themselves via cave drawings. By the time of recorded history, we read of highly developed technologies for constructing shelters, gathering or growing food, waging war, and much more. We also read of writing, storytelling, painting, music, and other forms of art. In short, it would seem that art and technology have always been part of the human experience; co-contributors to the quality of life.

In this chapter, we will examine the meaning and purpose of art in general. In addition, we will consider the interrelationships that seem to exist between art and technology. Next, we will explore how social change occurs and how art and technology function as agents of that change. Finally, we will consider the educational implications of the issues raised in this chapter.

Definitions and Key Concepts

Art, like technology, is a very broad segment of human endeavor involving many forms; each form characterized by different materials and processes. Each form has its devotees, and, in fact, an entire culture has grown up around each.

An article about an artist who creates intricate batiks and textiles from aerial photographs of the earth (e.g., mountains, coastlines, and islands) appeared in a recent issue of the *Smithsonian* (Bolz, 1994) magazine. She electronically converts the photograph and then transfers the image to fabric and other materials. Someone else turns a satellite photograph of the United States, taken at night, into a multicolor poster. During a fund-raiser, a hospital in central Connecticut hired a graphic designer to create a high-quality publication entitled *Aging Successfully*. In this black and white document, the designer combined photographs and text to skillful-ly communicate various aspects of growing older while highlighting the services provided by the hospital. Of particular interest was a two-page collage of photographs depicting human memories. It was a creative and extremely effective presentation.

Daily, people take pictures, publish newsletters, and make things. What is it that makes one picture memorabilia of one's life and another a significant work of art? Is the Chippendale table in one's dining room art or just a piece of furniture? What is it that transforms everyday things—the paraphernalia of life—into works of art? A person paints still-lifes for relaxation; is that person an artist? Is there a clear line of separation between the common and that which is art?

What is Art?[1]

Art is something, like technology, that everyone knows well until one tries to define it. Academics in technology education have struggled with a precise definition for technology. Some definitions treat technology as an object (e.g., computers and other machines); some define technology as means to a practical end (i.e., process). Still others view technology as an inexplicable "noumenon that occurs through the synergistic interaction of knowledge, thinking skills, and physical processes and results in the extension of human capabilities" (Johnson et al., 1989, p. 6). Perhaps, technology is too complex to be accurately described by a single definition. Such is the nature of an academic discussion of other important constructs. The case is no different for art. The definitions are many and varied.

It should be noted at the outset that *art* is considered to be a comprehensive term that is inclusive of all art forms. Occasionally, one reads of *the Arts* as a term indicative of the various form. And it is true that many only think of the *fine arts* (i.e., painting and sculpture) when the term art is used. However, like technology, art is a term in itself that is supportive of all forms (e.g., music, theater, writing, painting, sculpture, and crafts) and will be used that way in this chapter. Use of *the Arts* will be reserved for times when the diversity of forms and cultures is being emphasized.

The *American Heritage Dictionary* (1983) defines art as "1. a. The activity of creating beautiful things. b. Works, such as paintings or poetry, resulting from such activity. 2. A branch of artistic activity, as musical composition, using a special medium and technique. 3. The aesthetic values of an artist as expressed in his works" (p. 39). Whereas this definition is insufficient to support an academic discussion, it is indicative of the full range of definitions offered by various art scholars. In short, art is described as processes, objects, disciplines, and means of expression.[2]

The definition of art used here has been offered by one of the most prolific and profound writers throughout history. According to Tolstoy (1946), art has to be something new arising from an artist's feelings and thoughts.

> Art is a human activity consisting of this, that one man consciously by means of certain external signs, hands on to others feelings he has lived through and that others are infected by these feelings and also experience them.

> Art is not, as the metaphysicians say, the manifestation of some mysterious Idea of beauty or God; it is not as the aesthetic physiologists say, a game in which man lets off his excess of stored-up energy; it is not the expression of man's emotions by external signs; it is not the production of pleasing objects; and above all, it is not pleasure; but it is a means of union among men joining them together in the same feelings, and indispensable for the life and progress towards well-being of individuals and of humanity. (p. 123)

In addition, Tolstoy demanded that productions must meet three conditions to be considered perfect works of art: content, form, and sincerity. The content of a work of art must be important to humankind. The form should be clear so that people may understand it. The work of art must come from an inner need within the artist. All productions that do not meet these conditions, may be pleasing to some, useful to others, and popular in the marketplace, but they would not, in Tolstoy's opinion, be perfect works of art. The point here is one of quality. Art is important to the artist, the society in which it is created, and to all peoples throughout time. Consequently, it is not trivial and must not be taken lightly.

The microchip has made it possible for nonartists to enter the arts by the backdoor, so to speak. With little formal preparation, one can create *music* on an electronic keyboard, interesting visuals using drawing and electronic publishing software, and creative video animations. But is it art? Will it stand the test of time?

In the music industry, technology has made it possible for an incredible proliferation of sounds. In fact, an entire culture has grown up around modern music, usually referred to as the *pop* culture. With a minimal investment almost anyone can make a recording. Is it art? A multitude of individuals and groups make their living making recordings, performing at concerts, and so forth. Are groups like The Rolling Stones and the cranberries artists or businesspersons?

Much of what is done today in the name of art is not really art but products of an industry. One has to listen to a great deal of music to hear something really new and interesting. Music today is big business, and there are distinct formulas for success. However, among the proliferation of tunes and *artists,* there are some notable works as well as some very talented and very serious artists. They create works of art that possess *significant form* that reach out to the listener and leave a lasting impression; an impression emanating from the soul of the artist.

In the end, art is in the eye and ear of the beholder. Art is an extremely diverse human endeavor. Many today would disagree with Tolstoy. In fact, no single definition would be acceptable to everyone. The artists (including musicians, painters, sculptors, actors, and authors) interviewed for this chapter were uncomfortable with the question. They were comfortable talking about what *they* did and how to determine if someone was an artist, but most would not provide a definition of art itself.

Is Tolstoy's definition of art complete and sufficient in every circumstance? Probably not! It is well reasoned and thorough, but many would disagree. The definitions of art are as many and varied as there are motives for doing art. To obtain a more complete picture, let us consider art from that perspective (i.e., according to motive).

Art Defined by Motive

Art for art's sake. Art, in all its forms, is an end in itself—good art does not necessarily have a specific purpose. Artists attempt to create "pleasing forms" (Read, 1972, p. 18); forms that are pleasing to themselves and to others. Objects that will elicit aesthetic emotional responses; "significant forms" that are "arranged and combined according to certain unknown and mysterious laws [that] move us in a particular way and it is the business of the artist so to combine and arrange them that they shall move us" (Bell, 1958, p. 19).

Life is often crude and difficult. The arts help to change that by providing beautiful and enjoyable objects and experiences. Through the arts, the observer can be transferred to a place of beauty, a place where pleasantries can be had by all. And because of the diversity of the arts, there are forms that appeal to just about every taste. For some, it is a day in the park listening to a string quartet and reading poetry; others prefer a rock and roll concert. The endless variety of the arts ensures that there is a form for everyone if they desire to attend to it.

Mumford (1952) believed that art arose "out of man's need to create for himself" (p. 16). He goes on to write that "art stands as visible sign of an indwelling state of grace and harmony, of exquisite perception and heightened feeling focused and intensified by the very form into which the artist translates his inner state" (p. 23). Many artists will tell you that the art in them is crying to get out. Craig Frederick (personal communication, October 24, 1994) a Connecticut sculptor, stated that an "artist has to be an artist to be alive."

Bell (1958) insisted that the art that moves us deeply (as an end in itself) is that form which has transcended its physical reality; "we become aware of its essential reality, of the God in everything, of the universal in the particular, of the all-pervading rhythm" (p. 54). He cautioned, however, that "those who cannot value things as ends in themselves or, at any rate, as direct means to emotion—will never get from anything the best that it can give" (p. 55).

According to this view, art consists of those *significant forms* that move us to emotions that cause us to transcend our present realities. They are forms that are as essential to the life of the artist as air, food, water, and rest. But others contend that art has other purposes. Purposes, that some consider less noble, which are nonetheless essential ingredients in our understanding of the arts.

Art as a form of self-expression and communication. Within this category, art is viewed as providing a variety of means of self-expression, of giving the viewer the opportunity to share a particular emotion or experience, and finally as a means of social criticism.

Several of those offering definitions of art seem to recognize that art has both an aesthetic *function* as well as a more pragmatic one. Hauser (1982), a sociologist, makes it very clear that art without significant form can never function as a form of communication. He argues that, first and foremost, form is what attracts people's attention. Art is the means by which the artist cries out, "I am here . . . What I have seen and felt and thought and imagined seems to me important: so important that I will try to convey it to you through a common language of symbols and forms" (Mumford, 1952, p. 139).

Art as social commentary and constructivist. As mentioned above, art also can be used to communicate one's political position or draw attention to a social issue. Art can also be used to represent aspects of life as the artist would like them to be; to offer humanity a glimpse of life as it should be (Rockwell, 1960). The artist may choose to shock observers as a means of moving them to action. The cranberries' CD entitled *No Need to Argue* obviously is designed to call the circumstances in Ireland into question by using the music and words to sadden, move, and even enrage their listeners. But is this art, or pseudo-journalism?

Art as a means of creating understanding. Joy Wulke (personal communication, November 21, 1994), a Connecticut sculptor who works primarily with light installation and glass sculptures, is not merely trying to express a thought or emotion; she endeavors to allow the viewer to enter into a particular experience. She wants her audience to become a part of her works; to have a perceptual experience that serves as memory triggers of personal events. She is telling a story, *mixing the fanciful with reality.*

Langer (1958) rejected the notion that art should be done only for aesthetic purposes. He wrote that "the function of art is not to give the participant any kind of pleasure, however noble, but to acquaint him with something which he has not known before. Art, just like science, aims primarily to be understood" (p. 10). Hobbs (1980) wrote that "artists who work with images use them as writers use words—to interpret the human experience of the time and place in which they live" (p. 104). He goes on to point out that artists are usually dealing with such issues as: What is the nature of the world? Who are we? What is our place in the world?

Art as worship. Throughout time, art has been closely tied to religious experiences and worship; a means by which the divine is honored by the creature; an expression of love and gratitude for the gifts of life. For Christians (and others), writing, music, and poetry provide personal means of expressing the joy within. Art is a means of communication between self and God, and between self and others. It is also a personal means of exploring the reality of God and one's eternal spirit. Through artistic expression, the soul can soar, can reach out, and touch eternity.

Art as business. No discussion of art would be complete if we did not recognize that some merely seek employment as a musician, novelist, or some other type of artist. Some individuals may develop a noble motive;

others will not. Some are artists simply because they must be or do *something* to survive.

For the most part, the definitions and comments offered above focus on art from the perspective of the artists. Whereas many of these motives also apply from the perspective of the observer, there are others.

Art as entertainment. Many people ask nothing more of the artist than to provide them with something that will help them pass the time of day. As a result entertainment is big business. Humans, especially in industrialized nations, have a great deal of free time and discretionary income; they want and need to be entertained. In addition, an increasing number of people are turning to various forms of art as amateur practitioners. Art classes for nonartists of all types are springing up all over the country. These individuals are not wrestling with *deeper* issues; they are simply there to enjoy themselves.

Art as decoration. Most people will never own an original work of art. Nonetheless, almost everyone, even in the meanest of circumstances, finds a way of using the products of the arts to make their surroundings more pleasant.

In summary, it is instructive to note that, just as in the case of technology, the debate regarding the definition of art seems to stem from an inability to capture the complete nature of art in a brief statement. Art, like technology, defies simplistic definitions. It is, at once, an end in itself, as well as an extremely effective means of communicating thoughts, emotions, and of creating shared experiences. Artists, through their art, beckon us to open our hearts; they invite us to celebrate life; and they provide us with a commentary on the human experience. There is more to life than work, survival, and drinking beer. Artists, through the creation of meaningful works of art, invite us to "live deep and suck out all the marrow of life" (Thoreau, 1974, pp. 75-76).

Who are Artists?

Typically, a list of artists includes painters, sculptors, illustrators, musicians and composers, writers, poets, actors, actresses, directors, potters, jewelry makers, photographers, and other craftspersons. These artists, and others not mentioned, share a common purpose (i.e., making art) but their messages and media are quite distinctive. Certain things work for one art form that do not work for another (B. D'Amato, personal communication, November 18, 1994). Artists choose a particular art form because it works for them or because they find that it matches their talents and interests. For example, photography does not easily capture movement; whereas video is ideal for such purposes. A novel can present multiple stories with incredible detail that excites the imagination. Likewise, the cinema is able to present multiple stories with *real* people and situations. However, for many, the effect of watching a movie based on a particular novel is often disappointing. Too much is sacrificed to ensure that the film will stay within a certain time limit and expense range. This disappointment also makes us aware of the significance of the interaction of the reader's imagination with the author's creation.

Artists are commonly categorized as fine artists (painters, sculptors), performing artists (musicians, actors), writers and poets, and decorative artists (potters, woodworkers), though many work in multiple media. For example, Brian D'Amato (1992), author of a novel entitled *Beauty*, is an accomplished painter and is heavily involved in virtual reality art. Artists can be divided further by their artistic penchant. Within painting, artists may be cubists, impressionist, neoclassical and so forth; musicians may be classical, pop, jazz, folk, rock and roll, or punk rock. Each *flavor* is distinctive and there are a myriad of variations and combinations. Within the *plastic* arts (e.g., painting and sculpting), some artists primarily use subtractive (i.e., they remove materials to *reveal* the object) methods, whereas others use an additive approach (i.e., material, such as paint, is added to the original structure).

Is Art Technology?

As noted earlier, throughout time, humans have made things. Some of those things were to help ensure survival; but even when survival was very difficult, they found time to express themselves in ways considered artistic. As humans progressed through nomadic and agrarian eras, art and technology began to take separate paths, but also were still very much connected, especially in the crafts. If both are human endeavors, what is it that separates them? Brian D'Amato (personal communication, November 18, 1994) contends that:

> The separation of art and technology into separate fields is a Modernist fiction. All art, from cave painting to a computer program, employs some form of what you might call perceptual technology, as well as mechanical techniques. Even figuring out the right medium for glazing an oil painting is technology to some extent. To a greater extent, anyone who works in a new media is by necessity a technologist.

The artists interviewed for this work were asked if they considered themselves technologists given that they do many things that technologists do (e.g., use materials, tools, equipment, processes, and research & development). For the most part, they expressed reservations about being considered *real* technologists. They agreed that there are many similarities, but indicated that they were primarily artists. They used available materials and processes, but were rarely engaged in studying and developing technics. But this same point could also be made for many individuals who are employed in technical fields. Most never go beyond the application of various technologies.

In short, artists and technologists have a great deal in common and should find ways to increase collaboration and dialogue in ways that are mutually beneficial. This is not to say that art and technology are synonyms. It is more like they are parts of the same whole—the creation of objects to satisfy particular wants and needs. To examine this hypothesis further, we will now compare and contrast art and artists to technology and technologists[3].

Similarities and Differences

If we consider technology as the systematic attempts to apply knowledge and cognitive abilities to use materials, tools, equipment, and techniques to create products and processes that satisfy human wants and needs, and extend human capabilities, then there is much that art shares with technology. Figure 1 is a summary of the similarities and differences between art and technology.

For the most part, art or artists differ from technology or technologists in terms of their motives, their attention to aesthetics, the extent to which

Similarities
• Humans use tools, materials, and techniques guided by knowledge, and skills to create things. Art is somewhat less pragmatic, but both art and technology choose technics as means to some end. Both satisfy human wants and needs—the exact wants and needs are different.
• Both are avenues used by people as a means of personal expression (i.e., creativity).
• Both involve research and development. In the process, technical designers tend to use models and prototypes, whereas artists create studies, preliminary works, and works in progress. Everything an artist makes is a prototype.
• Art forms, as well as technologies, have limitations and areas of "best fit."
• Both "disciplines" have a pecking order of status.
• Both have a culture/industry to support it.
• Both have systems of self-advancement. Technology and art grow based on previous discoveries and knowledge.

Differences	
Technology	***Art***
• Form follows function (i.e., technology tends to focus on achieving particular ends using the most efficient at its disposal).	• Form leads function—in fact, some have argued that art without form is not art.
• Very pragmatic systems, often highly fragmented.	• Tends to be holistic; pragmatic but values "higher" purpose.
• Often dirty, crass, and sterile environments.	• Tends to appreciate and create cultured and refined environments.
• Viewed as essential to modern life.	• Viewed by many as secondary, optional, or "window dressing."
• Most technologists are obsessed with "gadgetry," new technologies, and so forth.	• Tends also to focus on new things, but the fascination seems to be with nature and the human experience.
• Tends to be focused on the artificial.	• Tends to focus on the natural.
• Humans tend to be viewed as servants of machines, or, at least, merely components of the "system."	• Machines and systems are viewed as servants of humans.

Figure 1. Similarities and differences between art/artists and technology/technologists.

they focus on developing or modifying the technology they employ, and the immediacy of their feedback (i.e., how soon they know if they are any good). But they are very much alike in that they both are means to certain ends. They are means by which humans enter into the creative process—to create something that is a part of themselves, but a part that will outlast them. As De LaMare (1944) put it, art is "not mere self-expression, but a genuine communion between even a long-dead craftsman and his kindred spirits in any subsequent epoch" (p. 21).

A major point of separation is motive. Materials, processes, knowledge, skill, and thought are used by both groups for different ends. For the artist, the motive is usually to convey beauty or some social statement (i.e., to communicate) or to allow another to experience something vicariously or firsthand. For the technologist, the function is usually practical to modify our environment for our convenience or comfort. It feeds us, entertains us, causes a machine to do something for us, and so forth (aesthetics versus pragmatism).

Artists often focus on how something feels. Technologists usually focus on how well it works or if it works at all. Feelings are irrelevant to many technologists. The challenge for the artist is to make something beautiful, interesting, or socially powerful. The challenge for the technologist is to make something work so that it satisfies some want or need or extends human capabilities. However, even in that, some technologists are very concerned about designing something that is practical but aesthetically pleasing as well.

Finally, artists can make art for years without ever knowing, beyond personal satisfaction, whether or not their art is any *good* as determined by critics and customers. Technologists rarely think in such subjective terms. Success or failure is immediately apparent—it must work.

Systems Model

Technology educators have embraced a model usually called the IPOF systems model (i.e., inputs → processes → outputs → feedback) as a means of understanding technologies and of organizing the content of technology education as general education for K-12 students. Whether or not this is an adequate model for technology education is open to debate. What is clear is that many technologies function and develop systematically. The same can be said of some of the arts. Figure 2 is a systematic representation of artistic activity.

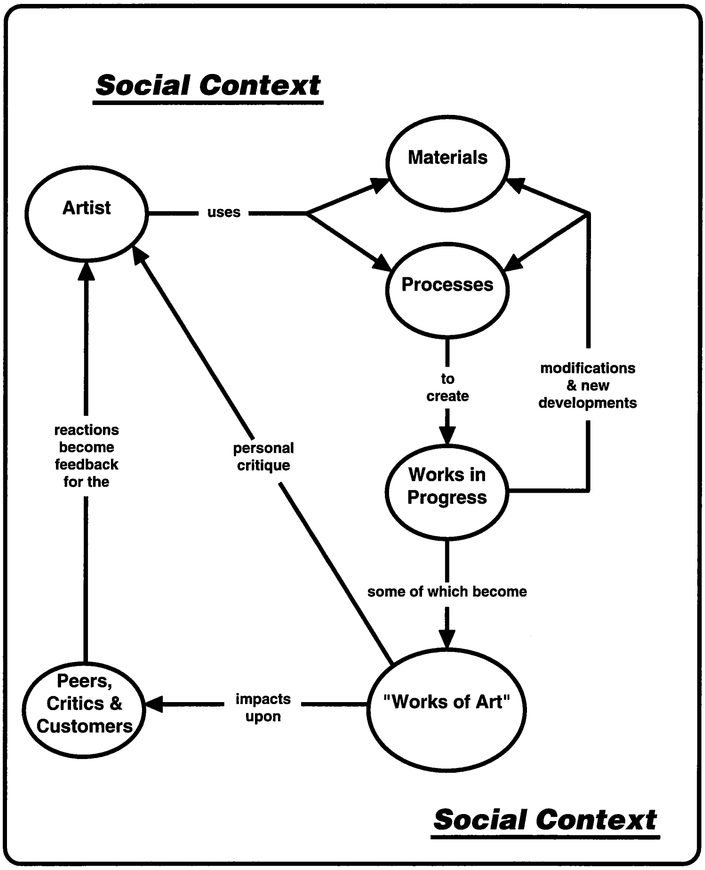


Figure 2. *The systems model as it applies to art.*

Basically, this conceptual map demonstrates that artists often systematically develop works of art. That is, they work out ideas and emotions in actions, sounds, words, or materials using various processes shared with technologists. Their work is being guided by internal feedback and the feedback of their audiences. What is missing from this model is the total effect of time on the system. Over time, the social context, as well as the materials and processes, changes dramatically. Also, artists' abilities to interpret the social context and use materials and processes increase significantly as they mature.

As one considers various occupations, it becomes apparent that there is a continuum that ranges from pure technology to pure art, with a considerable number of occupations sharing the knowledge base, sensibilities, and skills of both. Figure 3 illustrates this continuum.

The focus shifts as one moves from one end to the other, but art and technology share many things in common. Both are human endeavors; and in both, humans work to create products and processes. Both also have *cultures* that provide structure and support for their work.

In the last century, there has been an overwhelming increase in the number of products and processes. If one looks at a timeline of new discoveries, there are thousands of years of relatively little activity—the technologies were basically simple, and human- or animal-powered. However, just after the Middle Ages in Europe, we see the beginnings of the machine age with such inventions as the printing press. By the 1700s in Europe and the mid-1800s in the United States, the progression grew into a full-fledged revolution and the number of innovations became almost overwhelming. With regard to technological innovations, those alive today have seen more innovations in one decade than was seen in most centuries prior to 1800.

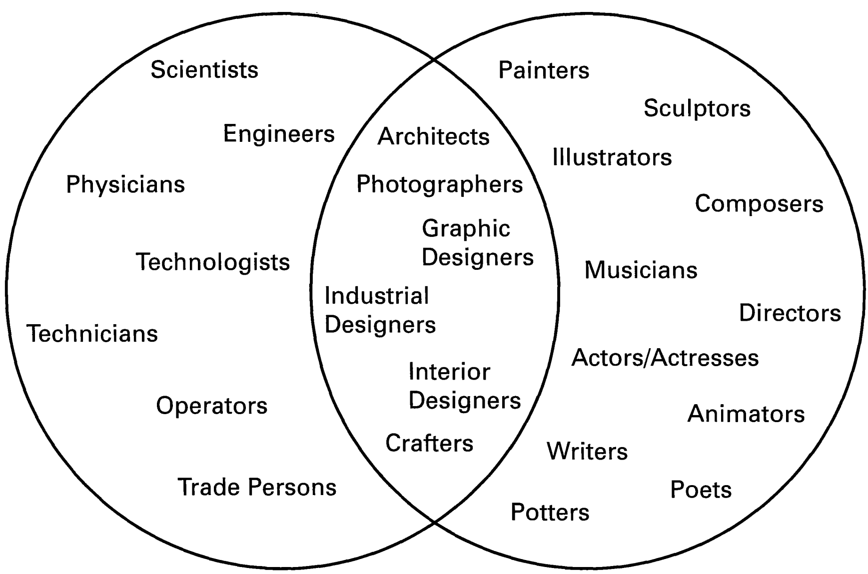


Figure 3. Continuum of occupations for artists and technologists.

The impact of this type of change is overwhelming and it would be impossible to deal with the full magnitude at this point. Consequently, we will limit our discussion to a brief look at the impacts of technology on the arts and later to the issues of social change.[4]

The Influence of Technology on the Arts

One could argue that a major outcome of the Industrial Revolution was the rise of the common person—the creation of the middle class. The nation plunged headlong into the pursuit of material possessions and wealth. As a result, more consumer goods were available to a much larger proportion of the population. But these conditions also created a society that tends to measure quality of life by the amount of material possessions that can be amassed in one's lifetime; a society that tends to be hostile or, at least oblivious, to anything that does not support this end; a society dominated by science, technology, business, and industry; one that is moving so fast that there is little time to be human, little time to assess what we have become and where we are going. In short, beyond entertainers or decorators for a society that is moving so fast it hardly has time to *catch its breath*, artists are treated as ancillary to life. Society has chosen the way of rapid change and overwhelming technological development. Artists feel the rejection; so much so that artists, since the dawn of the industrial age, have been in revolt (Mumford, 1952). Also, some art has been designed to accost the senses—to shock and irritate. Furthermore, also, some art that has been created has adopted aspects of the scientific world. That is, the increase in concern for theory and art as pseudo-science. For example, Handardt (1988) wrote that for Alvin Lucier, a sound-artist at Wesleyan University in Middletown, Connecticut, "sound becomes the medium in Lucier's art for an active inquiry into our basic definitions of, and experiences with, the aesthetic text" (p. 8).

The Industrial Revolution marks the beginning of an incredible era for our society, an era best described as one of constant change. Virtually every new technology sends shock waves throughout society. In the process, older technologies are replaced by newer ones; however, the older technology usually does not die out altogether. Those who prefer the older ways keep them alive, but at a higher price and on a much smaller scale. Earlier it was mentioned that many view art as the creation of something unique. If this is so, then artists, working in the 20th century, have been fortunate indeed; something new is always coming along.

Consequently, technology has a major influence on the arts. Some of the impacts have been very positive; some have been negative. The following discussion of some of the major influences of technology on the arts gives readers the opportunity to judge for themselves which is art and which is technology.

Examples of Change

Technology (more specifically, industry) has, in some ways, helped to ensure the propagation of the arts directly through corporate endowments and sponsorships, and indirectly, by making it possible for more people to have access to the arts. For example, a Hartford art museum has free admission on Thursdays as a result of corporate sponsorship.

The majority of people living in the United States is rich by world standards. Consequently, during the 20th century, more and more people had increased leisure time and disposable income. One result was increased attention to the arts by a larger percentage of the population.

In another sense, technology/industry helped to create an environment in which the human spirit (a topic highly prized by artists of all sorts) has been dominated, if not crushed. Mass production techniques reduced human beings to extensions of the machines they monitored. They were, and often still are, treated as interchangeable and disposable parts of the system. In an environment such as this, it is easy to lose one's sense of purpose. Modern artists have called a great deal of attention to the trapped and dwindling human spirit. In addition, some forms of art (especially the crafts) have enjoyed a considerable resurgence as people attempt to satisfy their creative needs or as a means of returning to simpler, more human times.

Advances in computer technology have made it possible for entire collections of art museums to be recorded on CD-ROM for distribution, thus making them available to a much broader audience. In music, new electronic instruments have allowed a plethora of new sounds and recording techniques. For example, a singer can be accompanied by a whole orchestra while performing alone. A single artist can sing several parts that are later mixed to create a complex harmony. The movie, *Forrest Gump*, is a wonderful example of computer-enhanced video, in which computer-generated images are merged with actual shots to create incredibly realistic scenes (e.g., F-4 aircraft bombing the jungle a few feet behind Gump as he is carrying his best friend to safety).

For many art forms (e.g., music, cinema, photography, and graphic design), advances in technology have resulted in higher quality and a significant increase in novel forms of expression. New materials and processes (especially electronic ones) have allowed for a variety of new forms of expression such as Yanni's music which is a blend of traditional and electronic instruments, or the introduction of computer-enhanced video that has allowed the creation of movies like *The Mask* and *The Terminator* series. Again, while these developments are generally viewed as positive, they are not free of problems.

Caveats

The cover of the February 1995 issue of the *Smithsonian* depicts a computer-generated image entitled *Homage to the Muse* by Charles Csuri, an artist at The Ohio State University. The author of the article (Trachtman, 1995) tells of Csuri's struggle to master and develop various computer programming languages to the point where he was given a joint appointment in the computer science department. The author also relates that the artist's colleagues in the fine arts department were shocked and dismayed by his *obsession* with programming. It became so much of an issue that the university was forced to move him to art education.

Some fine artists who adhere to traditional media tend to think of technology as an affront to their art. But the impressionists were initially treated the same way. Rock and roll is probably an offense to some classical musicians, but those involved with it have been able to produce some very moving works of art. A strict adherence to classical art forms would have deprived the world of recent works such as the *Phantom of the Opera* and Yanni's *Dare to Dream.*

Electronic libraries provide a wonderful means of making art more accessible to a broader audience. They are also great educational tools. However, this innovation causes several concerns. First, it robs the viewer of an actual experience with the real works of art. Even the best picture of a painting or sculpture is just that, a representation. Second, this will cause many museums to reconsider how they might market themselves. For example, why travel to Chicago or Paris, if one can bring their treasures into one's home with little difficulty and distortion. Third, this is just one example of how artists' works are being made available through electronic media and, in essence, becoming *public domain.* Major economic and ethical issues result regarding how artists protect their ideas and creations.

A real threat to art is created by its massive proliferation. Over 40 years ago, Mumford (1952) warned against the multiplication of images made possible by modern electronic technologies and argued strenuously for human limits when technical limitations have been removed. He contends it *is* possible to have too much of a good thing; and indeed, the more intense, the more valuable an experience is, the more rare it must be, the more brief its duration.

Another concern for artists who employ modern technologies in their art is that technology never stands still. There is always another innovation on its way. The result is threefold. First, new technologies (that allow new art forms to be created) are often expensive, thus driving up the costs of doing and having art. Consequently, Michael Cipriano, Chair of the Art Department at Central Connecticut State University, pointed out that most art exhibitions today require corporate or private sponsorship. Second, developing one's skill with new technologies is very time-consuming. Csuri spent 30 years primarily developing his programming skills. Now, he is "working in a feverish race with his own mortality" (Trachtman, 1995, p. 57). Third, the proliferation of technology often overwhelms us. We just cannot take it all in and make sense of it. But the appetite for something new seems insatiable. More and more people are able to do the basic stuff. Artists are expected to do something really special. The outcome is a combination of healthy competition resulting in genius and a glut of mediocrity.

A major dilemma for artists is the increasing difficulty of protecting their ideas and works of art. The electronic production and reproduction of art make it available to everyone. Writers of all sorts throughout history have established rules for quoting another's work. Of course, many have ignored these rules. This chapter could have been a clever compilation of previous works altered significantly to disguise the original authors. Some have argued that it is no longer necessary for another picture to be taken for artistic and graphic purposes. Everything has already been done and all one needs to do is access it electronically. Rock stars struggle to prevent audiences from recording their performances then releasing a *bootleg* album. The same is true of the video industry. As stated earlier, technology has dramatically increased access to the arts. But the massive increase in availability makes it nearly impossible to control ownership.

We are a long way from the *holodeck* aboard the U.S.S. Enterprise (*Star Trek*), but electronic technologies are making it possible for people to transcend the boundaries of physical and temporal reality. In the novel entitled *Beauty*, D'Amato (1992) through one of his characters predicts the following:

> You know, in fifty years everyone's just going to be in his or her little sensory deprivation tank, linked up to the cyberspace Virtual Reality system. The idea of actually making anything is totally beat. That's not where technology is interesting right now. It's all software. Total digitation. We're on the edge of the wedge. (p. 78)

Most of us would agree that escapism is sometimes healthy (e.g., vacations), but not when taken to extremes (e.g., psychosis). It is true that some will use technology to create a reality of their own choosing. But this is not any different than escapism through drugs or alcohol (although the threat of death is greater for those who abuse drugs and alcohol). People choose to escape. This is usually detrimental to the person, as well as society, but it should not be a reason to abandon technological innovation and artistic expression. Television has made *couch potatoes* possible and has helped reduce our emphasis on books and other forms of linear text. But it would be ridiculous to argue that we should not use this innovation. Look what it has done for communication, art, and education. In every application of technology the risks must be assessed, and, if they are too high, the technology should be constrained. Of immense concern is the fact that adequate means of evaluating and constraining technological developments in a society driven by economic interests do not currently exist, but that is a topic for another discussion. The fact that some people will choose to *check out* will not be stopped if we choose to stop technological development.

Finally, to some extent, the use of particular technologies poses an ethical dilemma for artists who employ them. Some artists may reject particular innovations based on who developed them and why. For example, many innovations have been developed by or for the military. However, it does not seem to follow that a particular technology represents the motives of the individuals/agencies who invented and developed it. The military was quick to see the advantages of using airplanes in wartime, but that does not mean that those who fly today condone the use of bombers to destroy cities. Humans have motives; machines do not. How a particular technology is used is largely dependent on the nature of the technology, but its application is based on human will. Fiber optics has definitely helped espionage, but it can also be used to create interesting and beautiful light installations (See Stephens' chapter on *Technology and Civil Liberties*).

The Influence of the Arts on Technology

Artists challenge us to live life to the fullest; to live in a way that honors life and respects humanity. Art is creative expression—the characteristic that makes us truly human. Art is virtually unconstrained in its challenge of the status quo. If technology has been instrumental, as many have argued, in creating an environment that devalues and is hostile to human beings, art is a major means by which that state of affairs is brought into the open and studied in the *harsh light of reality*. In essence, art and artists celebrate human life; artists emphasize that life is to be understood from a human perspective, not from a machine's perspective. Humans have worth and machines are made to serve humans, not vice versa.

In a more direct way, there are several areas (See Figure 3) in which art and technology are integrally connected so that what is done is a compromise between what works best and what is most aesthetically pleasing. For some time, industrial designers have been interested in creating tools that are functional with a pleasing form. Typically, in business, marketing concerns reign supreme; but creative expression nonetheless comes through. Art has impacted technology in a real way: the influence of the Bauhaus on the design of furniture and household goods (e.g., china, cutlery, and so forth), the work of interior designers to create unique living spaces, and the contributions of architects who design human structures that are functional and comfortable but also make an aesthetic statement. Although function still takes priority, form is given significant consideration.

In addition, it is possible to think of many examples of technologies being developed to supply a particular market of artists. For example, some of the recent push for more powerful computer hardware and software has come from those attempting new things in graphics, cinema, and music. A plethora of new devices (e.g., electronic keyboards with microprocessors, video digitizers, and others) has been developed for these and other markets.

Technology, the Arts, & Social Change

In the United States, the 20th century has been a century fraught with change. At the beginning of that century, the majority of the people lived on farms and led a rather *tranquil* life by modern standards. It was a time when life was much more integrated, much less compartmentalized. However, radical changes already had begun. A major population shift to the cities, brought on by industrialization, was already well under way. Railroads, the telegraph, and the *horseless carriage* were significantly reducing the size of the country. The industrial revolution was just that, a revolution in terms of occupations, life-styles, mobility, personal expectations, and so forth.

Recently we have experienced a second revolution brought on by the introduction of very large-scale electronic integration (i.e., microprocessors). Technology has extended human capabilities and increased social choices. With the introduction of each new technology comes many foreseen as well as unforeseen social implications. For example, consider the impact of the microcomputer and telecommunications on the definition of work, on the locations in which work is performed, and on what constitutes a work day (See Bjorkquist and Evans' chapter on Technology and Work for further discussion on this topic). Technology increases options. What we can do quickly becomes what we *must* do and the pace of life increases. We have moved from individual production of items by craftspersons to mass production of identical items made by factory workers to a combination of the two through flexible manufacturing that results in a large output of individualized products.

Customers today are accustomed to getting what they want and have become much more demanding as a result. Society, in general, seems to have moved in that direction. People want and demand more, and they are not all that interested in waiting for it. Individual needs and wants can and must be met, not only in business, but in almost every aspect of life.

It is important for the reader to understand that social change is never a linear, *lock-step* progression. Change usually takes place in many directions simultaneously and very slowly unless a momentous event occurs (e.g., war). In the 20th century, technology has provided many such events. However, there is still a great diversity of subcultures. For example, one group pursues technological innovation with a passion; another strives to return to simpler, more natural times. Rogers (1983), after synthesizing thousands of studies, theorized that change occurs much like the diffusion of dye in water. Social and technological innovations are introduced and then diffused through the system. The rate of diffusion is a function of (a) the nature of the innovation, (b) the personality of the individuals in the system, and (c) the nature of the system itself. Beneficial, nontoxic innovations eventually will be employed by the majority within the system.

The process can be likened to a rock being thrown into a pool of water (Foster, 1989). The rock is the innovation. Most of the water is indifferent to the change (i.e., frozen), but a small percentage is not and it welcomes the shock waves. So begins the process; one molecule (i.e., individual) or a group of molecules at a time accepts the change and in turn nudges its neighbors. Slowly the ripples diffuse until once again the water comes to rest in a different state. The change becomes the status quo.

To what extent is art instrumental in social change? As stated earlier, art is a reflection of what was going on in a particular place and time.[5] Art is a mirror, but art and artists also play an active role in shaping a particular culture. "Art is both normative and exemplary for society not only while it validates humanistic ideals and norms, but also while it makes new habits, morals, and modes of thought and feeling acceptable and respectable . . . " (Hauser, 1982, pp. 311-312).

Rosenberg (1985) agreed that art has a major impact on society, but also argued that there are limits.

> Art cannot assume the social role performed by religions in earlier cultures. Art cannot cure cultural chaos, no matter how effective it may be in giving body to the metaphysical absolutes of individuals. Today, art consists of one-person creeds, one-psyche cultures. Its direction is towards . . . a society in which everyone will be an artist. (p. 317)

It may be that art (i.e., the products of artists) is not so much the issue regarding social change, as the artists themselves are. What role did the oratory of Martin Luther King, Jr. have on the Civil Rights movement? Who is not moved with listening to his *I Have a Dream* speech? Or consider, the rallying cry of the movement, the song, *We Shall Overcome*. These are both art forms that made profound contribution to the Civil Rights cause. We are all aware of the impact of *rock stars* especially on the adolescent generation. But the impact goes beyond this.

A recent issue of a guide to the arts in the New York City metropolitan area contained 117 pages of listings for displays, galleries, museums, auctions, college classes, clubs, and other events in New York City. This is indicative of a huge community of artists, would-be artists, and those who make a living dealing in the arts. It is big business and an incredible industry. And this is just one city. What about Hollywood, Washington, DC, and others?

The *art world* exists as a separate entity within a larger culture. The larger culture provides subject material and support for the arts. The art world provides a context for the *serious* artists who inhabit it. It consists of places where artists can go to find people of their own type, the necessary supplies to do their work, a place to learn and grow, a ready audience, and a market for their work. These artistic communities are a formidable force in society. The artistic communities are not just entertainers; they are often social commentators and social activists (e.g., Farm-Aid concerts).

The art world is also a place, once formed, that tends to influence the art that occurs. Being *in* is just as important in the art world as it is anywhere else in society. Fads exist here as well. Ones perspective is often secondary to other concerns in the current culture. Certain issues and certain media have their attention. It is the brave soul who strikes out on her own, standing alone.

One does not have to drive far from the city to get a different perspective. "I get down about what I see out there, especially in New York City. I view myself as a window, a 'Johnny Appleseed' planting things of beauty" (C. Frederick, personal communication, October 24, 1994). Many are not interested in changing the world. They want to share experiences, beauty, and a piece of themselves; they want people to enjoy themselves and to enjoy their work. If in the process, people are moved to particular action, so be it; but that is not what motivates them to make art.

Whatever the case may be regarding the arts' impact on society, we must not let it die, as Hauser (1982) predicted that it eventually will. Work is not life. Humans should not serve machines and systems. If we have allowed this turn of events to be so, then it is time for change. This is where education plays an important role.

Educational Implications

Artists and technologists share many things in common—may even be members of the same family—and are seeking certain ends by employing various, sometimes similar, means. If artists, technologists, and scientists (if possible, all of society) were somehow brought together for meaningful dialogue; if there were some way to foster awareness, understanding, mutual respect, then, perhaps, our solutions to human problems would be more complete. Perhaps, some future problems could be avoided.

Practically, a greater interaction between art and technology would benefit both. Artists would have a better understanding of materials and processes. Technologists would gain a better understanding of materials from a different perspective. For example, a Connecticut artist is studying the effects of sound waves (i.e., music of all sorts) on physical objects. Accessing this research will benefit architects, civil engineers, and others.

If one can agree that artists often take on the task of making us more aware of life around us, then ensuring that technologists develop an appreciation of finer and the *softer* things would help to ensure that artifacts would be made with those concerns in mind. In the book *Jurassic Park* (1990), the mathematician, commenting on what they have done, states, "your scientists were so busy finding out if they could do it; they never stopped to consider if they should do it" (p. 284). It is essential that we find ways to evaluate risks versus benefits of particular innovations. Many artists call attention to beauty and nature, encouraging us to protect both. Technology is often ugly and often does ugly things to people and nature. We must find ways to move in directions that are true progress.

Schools are divided into discrete disciplines often with little interaction. Students are taught subjects as if there was little or no connection between them. Those educators involved with human endeavors (e.g., art and technology education) have long understood the value of integration.

Many efforts are currently underway to increase integration between educational disciplines. These efforts must be expanded. We must educate the whole student, not just the intellect. We must develop an appreciation of what it means to be human. Society needs members who are thinking, feeling, and doing beings. But the road to educational reform seems to be going in a different direction and support for a marriage of *doing* disciplines with *knowing* disciplines is limited.

For example, an urban school district in the northeast has been, for financial reasons, systematically eliminating many of the *special* subjects (i.e., art, music, health, life management, physical education, and technology education). In doing so, they *inadvertently* have made a statement that pure intellect is the primary domain of education. Doing, creating, and feeling are not important enough to warrant investment of a portion of the limited resources. They, and many other districts, focus almost exclusively on rote learning for the exclusive purpose of preparing for more education. What one does with that education is not important until much later in life. Many children are being treated like machines—facts injected mostly by lecture and seatwork, to be regenerated on demand.

The time has never been more critical for that model to be seriously challenged. It is not that facts are not important. They are. However, they are not important in and of themselves. It is what one can do that is most important in life. *Doing* gives importance and context to *knowing.* It is time for those educators whose disciplines are significantly involved with human endeavor to join together to generate support for a major overhaul of the educational system for most children. It is time for doing to become the central *theme* of education; not to the exclusion of knowing and feeling, but in a way that brings the three domains together in a meaningful way.

Summary

Mumford (1952), in his profound analysis of the interaction between art and technics, sends society a chilling message. He paints a picture of chaos of our own making, stemming directly from the philosophical positions that have developed in our society as a result of our applications of technics. He contends that if current trends go unaltered humankind will destroy itself or go insane.

Art (and religion) compels us to contemplate human nature and the human condition—to compare what is to what could be. But we can become too contemplative, too wrapped up in celebration or escape. Action is also needed. We have the means (many of which are nontechnical) to solve many of the problems facing society. Religion and art approach issues differently; however, both point out the nature of evil. They *show* us a world dominated by truth, love, and beauty, and enjoin us to create such a world now and forever. The question becomes will we? Artists and clerics help point the way and fuel our internal fires; the task is for us all. Without action, the beautiful works of art become ugly tormentors, showing us a world we will never have, and we will hate them for it.

REFERENCES

Bell, C. (1958). *Art.* New York: Capricorn Books.

Bolz, D. M. (1994). Lofty perspectives: The silk batiks of Mary Edna Fraser, *Smithsonian, 25*(8), 142-145.

Crichton, M. (1990). *Jurassic Park.* New York: Ballantine Books.

D'Amato, B. (1992). *Beauty.* New York: Delacorte Press.

De La Mare, W. (1944). *Art and scientific thought.* London: Faber and Faber Limited.

Foster, W. T. (1987). Stairs. *Lighthouse Magazine*, *2*(1), 51.

Foster, W. T. (1989). *Factors influencing the degree of computer use by high school teachers in selected Illinois school districts.* Unpublished doctoral dissertation, University of Illinois, Champaign, Illinois.

Handardt, J. G. (1988). Introduction. In Klaus Ottmann (Ed.). *Alvin Lucier.* Middletown, CT: Davison Art Center, Wesleyan University.

Hauser, A. (1982). *The sociology of art.* Chicago: The University of Chicago Press.

Hobbs, J. A. (1980). *Art in context* (2nd ed.). New York: Harcourt Brace Jovanovich, Inc.

Johnson, S. D. (1988). A philosophical base for developing technology education programs. *Illinois Industrial Educator*, *9*(2), 2-5.

Johnson, S. D., Foster, W. T., & Satchwell, R. (1989). *Sophisticated technology, the workforce, and vocational education.* Springfield, IL: Illinois State Board of Education, Department of Adult, Vocational and Technical Education.

Langer, S. K. (1958). *Reflections on art: A source book of writings by artists, critics, and philosophers.* New York: Oxford University Press.

Maslow, A. H. (1968). *Toward a psychology of being* (2nd ed.). New York: Nostrand Publishers.

Mumford, L. (1952). *Art and technics*. New York: Columbia University Press.

Read, H. (1972). *The meaning of art*. New York: Praeger Publishers.

Rockwell, N. (1960). *Norman Rockwell: My adventures as an illustrator*. Garden City, NY: Doubleday & Company, Inc.

Rogers, E. M. (1983). *Diffusion of innovation* (3rd ed.). New York: The Free Press.

Rosenberg, H. (1985). *Art and other serious matters*. Chicago: The University of Chicago Press.

The American heritage dictionary. (1983). Boston: Houghton Mifflin Company.

Thoreau, H. D. (1974). *The best of Walden and Civil Disobedience*. New York: Scholastics Book Services.

Tolstoy, L. (1946). *What is art? And essays on art*. New York: Oxford University Press.

Trachtman, P. (1995). Charles Csuri is an "old master" in the new medium. *Smithsonian, 25*(11), 56-65.

Author Notes

From the outset it is important to realize that I am a technologist. I have spent my career learning, doing, and teaching about technology. I have published two poems, one of which appears at the beginning of this chapter, but that does not make me an artist. I consider myself a craftsperson when working with woods and metals, and in that sense an artist. But I do not feel qualified to judge art, especially when it comes to what constitutes good art. Consequently, I must rely heavily on the comments of "real" artists.

Throughout this chapter I have included footnotes that chronicle some of my experiences during this project. In a chapter about art, I did not want to omit a personal perspective. It was an interesting journey—one filled with interesting people, ideas, and experiences. A journey that caused much introspection about what is important in life; what it is that makes life rich. It was at times a deeply spiritual experience, an act of worship of the Creator. Peace!

Footnotes

[1]As I write this passage I am listening to Yanni's *Dare to Dream* recording. I am deeply moved by the progression of notes performed by artists using a wide variety of traditional manual and modern electronic instruments. I feel my blood quicken during *A Love for Life*. I am moved to tears during *To the One Who Knows*. During *So Long My Friend*, I know exactly what Yanni is trying to say: "I will miss you, my friend, hurry back." During the performance, I find myself doing just what the artist wanted me to do; daring to dream. I am sitting here celebrating life. Even in work, I find myself glad to be alive—glad to be here. I can think of nothing I would rather be doing at this time. It is well with my soul. Why is it that the intentional progression of musical notes has that effect on human emotion? Why do words, notes, or pictures have the ability to affect us?

During my interviews I met a young artist at the Museum of Art in Portland, Maine who told me that her art was quite wild. When asked why she chose to express herself in that way she said, "In my art I am celebrating life, and I want to help others celebrate as well." A sculptor in Plainville, Connecticut told me that he believed that true beauty was not in the eye of the beholder. In his opinion, there is something shared by all things truly beautiful and that most people would recognize and respond to that beauty. As I listen to this music, my emotional state tells me I agree.

It is something spiritual, something eternal (Bell, 1958). There is, within me, that which responds to beauty—a vivid sunset, the view from atop a mountain on a clear day, the delicate curves of the rose petals, a pine forest laden with snow, music, sculpture, paintings—each of these and many more cause something to move within me. I know I am alive in their presence. Descartes said, "I think, therefore I am (Cognito, ergo sum)." I feel, and *know* that I am. This is a strange thought for a cognitive psychologist.

In physics, there is a principle known as resonance. Certain objects respond to particular frequencies. It is that way within me. Certain emotions resonate to certain stimuli. *America the Beautiful* fills me with pride; the Sistine Chapel fills me with awe. Yanni's music takes me from quiet depths to soaring heights above mountaintops. Such is the aesthetic experience.

[2]The dictionary also recognizes that art is often used to describe skill. For example, one might say that Michael Jordan is an artist with a basketball. But is he? Those who would say so are obviously saying that what he does with a basketball represents pure beauty. But it would be an unnecessary equivocation to define art this way. The seemingly effortless performance of skillful humans is beautiful, but intent must be taken into consideration if we are to make any sense of art as a separate human endeavor. Granted, what Michael Jordan does as a ballplayer is vaguely similar to what Tom Hanks does as an actor, but there is a substantive difference. Artists are skillful, but art as mere skill must be rejected on the basis of motive.

[3]I took a walk around campus one day while preparing for this chapter. I was curious about the differences in working environments created by the different schools, especially art and technology. My first stop—the School of Technology—was very familiar to me. The building houses both the technology and science programs.

What does my working world look like? The corridors are brick like the exterior. There are many doors, several bulletin boards carrying announcements of various sorts, the occasional vending machine, a multitude of high-tech labs outfitted with the latest equipment, classrooms, and offices. Except for a few decorations brought in by individual faculty and staff, that is pretty much it; all business, or should I say, all technology.

Down at the end of the street is the art building. One recognizes it immediately by the *yellow brick road* that leads from the sidewalk to the front door. There are also several large sculptures out front in various locations. I don't know what they are, but they seem to fit well.

As I enter the building, I noticed the standard bulletin boards filled with personal and campus announcements. However, I also noticed that all of the walls are filled with samples of the students' art. With the halls empty they still seemed alive with activity. Almost every inch was used for display.

The world of the technologists tends to be industrial. Plants tend to be cold, practical places. No time or space for anything trivial. The Schools of Technology, Science, and Engineering tend to replicate these sterile environments. Even personal space is carefully controlled or ignored. The artists I visited tend to live in a world filled with beautiful and graceful things. It is a world of studios, galleries, and museums. The tools, etc., are there and many of the spaces are very cluttered; but the tools/equipment don't seem to *own* the space. It is obviously human space.

[4]For additional readings on this subject, the reader is referred to the works of Alvin Toffler (e.g., *Future Shock* and *The Third Wave*), John Naisbit, and the Sophisticated Technologies Project (Johnson, Foster, and Satchwell, 1989).

[5]Recently my daughter shared with me an album entitled *No Need to Argue* by the cranberries. She explained that most of the songs were related to the conflicts in Ireland. Halfway through the album there is a song that really moved me; it angered and depressed me at the same time. As I listened to it over and over again, I wondered about my comments regarding social change. Is anyone listening? Perhaps things over there will not change as a direct result of this album. But maybe, just maybe someone is listening, will agree, and be moved to action. Maybe.

DISCUSSION QUESTIONS

1. Should technologists be concerned with prevailing cultural values when designing and creating products and processes? Should they give consideration to the social impact of what they do or is that someone else's job (e.g., artists or social activists)? If you take the positive position, how could this be ensured?
2. Should educators endeavor to heighten the cultural sensitivities of students? To what ends? How can this be accomplished?
3. Should art/artists ever be controlled by society (e.g., issues regarding pornography)?
4. Should technology/technologists ever be controlled by society (e.g., something like the approval of drugs for human consumption for all new technologies)?
5. In the music industry, there are a large number of artists producing a huge volume of recordings. Is it all art or is most of it merely a means to earn a living?
6. Does it change the meaning of the word *art* to say, "Michael Jordan has elevated basketball to an art form"?

7. In many cases what one wants to do is not what *sells.* So one must spend a great deal of time doing that which others want or what is currently acceptable in order to survive. Is it possible in our fast-paced, high-tech world to remain human? What does it mean to be human?
8. Does the ever-increasing volume of art forms and products negatively impact human appreciation of art?
9. Has the quality of life in the United States in the past two centuries been increased or decreased as a direct result of the arts? How?
10. Does using art, in all its forms, for social commentary and to initiate social change demean it as art?
11. Can art be *ugly* and still be art?
12. Does a country need a conscience? If so, who or what should provide it?
13. Many consider homelessness to be a major problem in the United States. How have artists and technologists contributed to the solution of this problem? How could they?

The Icicle Melts

1. Read the lyrics created by the cranberries for the song entitled *When Icicles Melt.* If possible obtain a copy of the album and listen to it several times. What is the artist trying to communicate? Is this a work of art or social activism? What is the difference? How did you feel during and after listening to this song? So what?

The Icicle Melts

When
When will the icicle melt,
When will the picture show end
I should not have read the paper today
Cause a child, child he was taken away

There's a place for the baby that died
And there's a time for the mother who cried
And she will hold him in her arms sometime
Cause nine months is too long

How could you hurt a child
Now does this make you satisfied
I don't know what's
happening to people today
When a child, he was taken away

There's a place for the baby that died
And there's a time for the mother who cried
And she will hold him in her arms sometime
Cause nine months is too long

There's a place for the baby that died
And there's a time for the mother who cried
And you will hold him in your arms sometime
Cause nine months is too long

Borrow or Steal

2. Works of art and technological innovations are the property of their creators. However, the massive volume of things and advances in electronic media have made it much easier for others to *borrow* or steal them. For example, one takes a creative photograph that is published in a magazine. Someone else scans it into a computer and reuses it for another purpose, but credit is not given to the person who took the photograph. Are patents and copyrights adequate to protect one's artistic property? Should it be protected? If so, how?

SECTION 3
TECHNOLOGY AND THE QUALITY OF LIFE

Social systems are inherently dynamic. Typically, changes are the result of a complex and sustained interaction of numerous forces throughout a system. Simply stated, a basic premise of this book is that social change is complex, multidimensional, and evolutionary in nature. Furthermore, we contend that technology is playing an increasingly more central role in the social change process, both as an impetus for change (change agent) and as a receptor of change. Cultural values spawn certain technologies as well as influence the direction and scope of technological development.

The chapters in Section 2 were designed to explore the role of technology as an agent of social change. In this section, we will shift our focus to an examination of a more fundamental issue, the quality of life which, of course, is almost entirely a function of whatever value system an individual or social unit embraces. In many respects, when we employ the term *quality of life* we are probing at the very depths of what individuals and cultures consider to be valuable and meaningful. It should also be obvious that quality of life tends to be highly personalized. Activities, experiences and belongings that are meaningful to one individual may hold little appeal to someone else. Furthermore, it could be argued that the predominate consumer orientation of our culture has served to numb and desensitize our citizenry to those factors and experiences that lead to a perhaps, even more genuine and meaningful quality of life. Consider for example, the meaning and dignity that often emerge from engaging in genuinely difficult tasks, from delay of gratification, and rigorous struggle with significant issues and problems. Certainly, the best impulses within us all suggest that our definition of the quality of life must extend beyond our possessions, aspirations, passions, and successes.

The open question within the context of this section (and really throughout this entire book) is in what ways does technology fundamentally contribute to or detract from the quality of life? In what ways have those contributions been positive and how has technology been harmful to the fabric of our culture? This section is designed to explore the interface of these questions with some of the most significant aspects of social existence.

This unit contains seven chapters. First, Custer, Kirk & Prince (advanced practice nurses and a physician) examine a host of issues related to the interface of technology with the health care system including medical ethics, the preference for interventionist procedures, and the enhancement of health care delivery through technology. This is followed by Hendricks' (a practicing theologian and social scientist) exploration of the effect that technology has had on interaction patterns between individuals and various groups of people. Stephens (a futurist) then thrusts us into the future with an examination of the effect of technology on civil liberties and crime. His projections into the future force us to consider the ways in which technology use and misuse may threaten our civil liberties in the years ahead. In the next chapter, Karian (a technology educator) explores issues surrounding technology and the natural environment including such issues as the Western attitude toward nature, population growth, technological fixes to environmental damage, etc. Bjorkquist and Evans (vocational and technology educators) then examine how technology has changed the world of work in both positive and negative ways. This is followed by Wolters and Fridgen's (both leisure studies educators) examination of the other end of the spectrum...technology and leisure. The section concludes with Wright's (a technology educator) critique and examination of the role of technology in our consumer-oriented culture. Throughout these chapters, the authors have attempted to examine and present both the bright and dark sides of technology. In their writing, they have been encouraged to be both social and technological critics. We have challenged them to raise the most important questions that will impact our quality of life well into the 21st century.

CHAPTER 8

Technology and the Health Care System

Marvis L. Custer, JoAnne Kirk, & John Prince

Most of us grow up to regard health as the natural, and disease as an unnatural, state of man: so much so that theologians have had to devote much anxious thought to explaining why the gods should have adopted what seems such an arbitrary, unfair and cruel form of retribution—for how else can it be accounted for? But looked at as an evolutionary expedient, disease becomes understandable: nature has invented and exploited it to ease her selection problems, to enable the fittest to survive.

Inglis, 1965, p. 1

Introduction

The American health care system is a multifaceted composite of subsystems that have been woven together to provide for the health of the American people. These subsystems include health care professionals (doctors, nurses, respiratory therapists, dietitians, etc.); health care facilities (hospitals, proprietary clinics, nursing homes, hospices, same-day-surgery centers, urgent care centers); medical equipment manufacturers and retailers (prosthetic devices, artificial body parts, wheelchairs, CT scanners, laboratory equipment); pharmaceutical companies and public and private payor systems. The combination of this complexity and the high social priority afforded to health care in our culture have converged to create a mega-system that, measured in current dollars, will consume more than 16% of the GNP by the year 2000 (Lee, Soffel, & Luft, 1992).

Despite this financial outlay, over 14 million children are deprived of even the most basic of health care. For example, while Medicare dollars are routinely expended for organ transplants, many children continue to go without health-preserving immunizations. The use of our financial resources to resuscitate the failing hearts of octogenarians multiple times before they die is condoned while over 31 million people have no health insurance. These intolerable situations have elevated the debate over health care policy to the national consciousness. The problems and issues that have sparked debate and reform during the Clinton campaign (and subsequent defeat of high profile health care reform legislation) will almost certainly continue to escalate as baby-boomers approach retirement age.

The enormous health care system is grounded in a set of values and principles that are unique to the United States. Central to these is the sanctity of the doctor-patient relationship, established by Hippocrates in the fifth century. The convergence of this relationship with values of autonomy and individuality have yielded a health care system that is unlike any other Western health care system. Another important dimension of this system has been the close association of health care with medicine and medical practice. Indeed, the general public makes no distinction between preventative aspects of health care (delivered by a host of health care professionals, e.g., nurses, dietitians, counselors, ministers, etc.) and medicine (delivered almost exclusively by physicians). Health care, properly viewed, consists of a myriad of professionals associated with the provision of quality health care. Medicine, as a subsection of the broader concept of health care, is one (central and important) component of the larger system. One of the positive outcomes of the current debate over health care has been the increased public awareness of other groups that comprise the vast and complex network of health care delivery in this country.

Technology interacts with the health care system in what are considered both the *hard* and the *soft* sciences. Thus, a comprehensive discussion of technology and the health care system must include ideas and concepts from the fields of education, philosophy (ethics), management, and economics along with fields like medical engineering, biochemistry, microbiology, and mathematics.

This chapter discussion will focus on the delivery of contemporary health care and how its conceptualization and delivery have been influenced by cultural and social values. Another major area of discussion in this chapter will be on technological advances in health care and medicine. We will present a classification structure for these technologies followed by a discussion of how these have impacted the quality of health care as well as the role of expensive and sophisticated technologies in triggering health care reform. Finally, implications for future technological advances and how they may affect the health care system will be considered.

Historical Perspectives

For prehistoric peoples, what was best for the individual was incidental to the survival of all. Consequently, those who fell ill or became debilitated were left behind to die. As the migrant tribes evolved from hunter-gatherer to planter-herdsman cultures, more stable living arrangements brought about the ability to feed and provide for those who could no longer feed and provide for themselves. In this climate, the individual began to assume an enhanced degree of importance. Tribal hunters provided medicine men with animal bones to be ground up to make medicinal pastes while women and children gathered herbs that were boiled into medicinal drinks.

Inglis (1965) cautions, however, that "primitive man practiced nothing that can reasonably be described as medicine at all...diseases were often attributed to the malice of enemies" (p. 7) through the use of detectable devices such as spears or clubs or through mysterious, magical means, undetectable by the human senses. These are the roots from which the current health care system had evolved. In this climate, *medicine* was shrouded in mystery, superstition, witchcraft, and magic and was vested largely in the powers of *medicine* men.

It is important to note that primitive does not necessarily imply a lack of systematization. For example, acupuncture is an example of a highly systematic set of practices based on Taoist philosophy. This has existed for over 5000 years and has enjoyed a surge of popularity and credibility in the West in recent years. While much about specific physiology of the practice remains a mystery and even though it remains on the fringes of modern medical practice in the West, it has nevertheless enjoyed thousands of years of use, as a systematic and coherent set of techniques, Eastern philosophy, understanding of sickness and disease, etc.

The Middle Ages saw the tentative beginnings of classical medicine (practices based on scientific principles) as a separate paradigm. During this period, medical practice slowly began to gain the social status of a profession and began to emerge as an intellectual discipline (although very crude and unsophisticated by today's standards). These tentative beginnings continued to develop throughout the 19th century to include basic counseling and therapeutic functions. As the great plagues ravaged Europe, the health of society as a whole was thrown into sharp focus. Health care teaching included admonishments such as sleeping with the windows closed because of the evils in the night air. Technological advancements of the time included the use of leeches to suck out the *bad blood.*

At the same time that the paradigm of therapeutic, interventionist (doing something to cure whatever disease process was diagnosed) medical practice was evolving, it coexisted with the deeply entrenched beliefs in alternative therapies (nontechnical, nonscientific approaches to the *unwell* in our society known as folk medicine). Medicine of the past concentrated on improving the comfort and well-being of the individual, but remained unaware of the scientific principles of organic disease (Kottow, 1992). Alternative therapies shared the arena with traditional medicine and were able to alleviate some discomfort and suffering. Over time, the gap continued to widen between classical medicine with its emphasis on technical, scientific methodology, and unscientific *folk* practices of the past. A paradigm of classical medicine developed where "rational discourse, scientific knowledge accretion and the acceptance of ethical standards that regulate its activities" came to dominate medical and health care practice (Kottow, 1992, p. 18).

Preventive medicine has been an integral part of medicine as long as there has been a recognized medical tradition. Various Hippocratic treatises dating to the fifth century, B.C., give advice on diet and exercise (Wear, 1993). Representative advice included: "The layman ought to order his regimen in the following way. In winter eat as much as possible and drink as little as possible: drink should be wine as undiluted as possible, and food should be bread, with meats roasted; during this season take as few vegetables as possible for so will the body be most dry and hot" (Jones, as cited in Wear, 1993, p. 45). Further advice stated "Walking should be rapid in winter and slow in summer" (Jones, as cited in Wear, 1993, pp. 47-49). Contrast these statements with the current food pyramid in which grains, vegetables, and fruits are the dominant food groups, and the constant barrage of advertisements extolling the virtues of various kinds of exercise.

The use of inoculations as a preventative technique actually reemerged in Europe during the 17th century to curb the spread of smallpox after centuries of use in the Far East. In like manner, the Hippocratic admonitions concerning diet reemerged as sailors crossing the Atlantic and Pacific oceans died of scurvy as a result of a lack of fruits, vegetables, and fresh water. Elizabethan Admiral Hawkins estimated that poor nutrition cost him as many as 10,000 men during his sailing career. Inglis (1965) observes that "far more sea battles and campaigns were lost through failure to prevent disease and death among sailors, than by inadequate armament or sail, or indifferent tactics" (p. 114).

Preventive medicine may be separated into personal health management or personal hygiene (Wear, 1993) and collective health management or public health (Porter, 1993). The balance between personal health care management and collective health management is difficult to achieve. Obligations of the state to assure healthy citizens balanced with the individual's responsibility to the state for maintaining one's own health have been discussed for over two centuries. Thomas Jefferson believed that the healthiness of the American people was a reflection of the superiority of democratic citizenship. Interestingly enough, American democratic society, with its capitalistic nature and the individual's right to access high-tech health care has moved health care in the direction it is going today, complete with the need to reform the system.

It is beyond the scope of this chapter to present a comprehensive treatment of health care history, it is important to appreciate that theory and practice revolving around sickness and disease date back to the dawn of civilization. While it is clear that much of this history has involved a colorful mixture of mystery, myth, superstition, and dangerous practices, the roots of sound interventionist and preventionist principles also run deep. Any appropriate and balanced treatment of the topic would need to include a fair and sensitive hearing of Eastern philosophy, an appreciation of the early and uncommon wisdom of the Hippocratic physicians, and the knowledge of preventative practices that have evolved and developed through the centuries. Scientific-based medicine as we know it today is clearly far beyond primitive practices of the past. Nevertheless, it is important to note that concepts such as diagnosis, prevention, inoculation, healing, and cure have enjoyed centuries of practice and use. Furthermore, it is equally important that our modern, positivist, scientific orientation not obscure the *wisdom* of what has been through the ages about wholeness, healing, nutrition, mind-body balance, and inner peace (in other words, that we remain open to learning from those with an Eastern orientation to life and health).

Values of the Health Care System

The discussion will now turn to the West, specifically to an examination of the set of social values that permeates the American view of health care and medicine. In 1989, the Center for Biomedical Ethics has identified a set of six primary values that have shaped the post-World War II American health care system (Priester, 1992).

- The first, and perhaps most central, is the coveted value of professional autonomy, including the regulatory autonomy of the medical profession to oversee its own members as well as the clinical autonomy of its practitioners to make independent decisions about their patient's care.
- The second value is patient autonomy, or patients' rights to information about their disease process and the right to make informed decisions about their own care.
- Third is the sovereign right of consumers to choose their own physicians and health insurance plans.
- Fourth is patient advocacy, or the service, benevolence, beneficence, caring, fidelity, and effacement of self-interests whereby health care professionals are expected to look after the best interests of individual patients, no matter what the cost and no matter how the interests of the individual affect society as a whole. (Traditionally this role has benefited healthier insured patients, leaving out the ill who have no physician or health plan to advocate on their behalf).
- Fifth, the assessment of high-quality care has been made with reference to how and in what settings the practice of medicine occurs.
- The sixth and final value is access to care. This value has been defined only vaguely in our culture. Lost in the confusion over its meaning, we debate whether access to care is providing care to all or most of the population (universality) or offering more services to some of the population (comprehensiveness).

Inherent in this set of values are our broader societal values: “strong faith in individualism, distrust of government and preference for private solutions to social problems, belief in American exceptionalism, a standard of abundance as the normal state of affairs, the power of technology, and the uniquely American frontier orientation” (Priester, 1992, p. 87).

These societal values account for the glaring difference between the “what’s best for the whole society” government health care plans of Great Britain and Canada and the individualistic, private payor “I want the best care available for me but I don’t want to pay for the care of anybody else” health care plan in the United States.

Technology and Health Care

No discussion of the role of technology in health care would be complete without focusing on the modern-day miracles that new medical technology has brought to the field of health care. One recent historical example of this is the discovery of x-rays just 100 years ago. The ability to peer into the human body opened the door to the specialty of radiology and the subsequent development of computed tomographic images (CT scans), medical resonance imaging (MRI), and ultrasound. Radiographic imaging, coupled with new artificial intelligence technologies, has led, not only to better diagnostic capabilities, but also to stereotactic radiosurgery capabilities whereby minuscule amounts of radiation can be implanted directly into the brain to destroy invading cancer cells in lesions too small to effectively treat in more traditional ways.

In the early part of the twentieth century a blood transfusion required the transfer of blood from donor to recipient by directly joining a major blood vessel from the donor end-to-end with a corresponding vessel in the recipient (Marks, 1993). By the late 1930s, new technology in the fields of pharmaceutical and medical equipment in the forms of anticoagulants and cannulae led to blood banking. It is now routine to donate your own blood, have it processed and stored, and transfused back into your body during a prescheduled elective surgical procedure. Now a larger, safer supply of blood and blood products is available to the general population in time of need.

Technological advances in the pharmaceutical field continue to develop new generations of antibiotics so sophisticated that they attack only specific, vulnerable parts of disease-producing bacteria. Tuberculosis

(TB) was rampant in the late nineteenth and early twentieth centuries. As late as the 1950s, the disease was treated by confining patients to secluded hospitals, away from their families and the general population. With the development of drugs such as Isoniazid and Rifampin in the 1960s, TB is now treated at home with oral medication that is taken daily over the course of a year. However, more modern drug capabilities are needed since TB is again on the rise and showing *multiple drug resistant* properties among carrier populations including AIDS victims and the homeless. This increased resistance to antibiotics is the result of several causes:

- Patients often demand or expect antibiotics for viruses such as colds which antibiotics cannot touch. Most of the people in the U.S. expect a quick fix from their doctors. When a doctor doesn't prescribe an antibiotic, they look for one that will.
- Farm animals receive 30 times more antibiotics than people do. Some resistant strains of bacterium end up in the raw meat which can be passed on before cooking. At least 500 people die each year from microbes found in meat and poultry, 6.5 million fall ill.
- Milk is allowed to contain a certain concentration of 80 different microbes but states only test for four of them according to a 1992 study. The study found traces of 64 antibiotics at levels that raise health concerns. (Begley, 1994)

Fox (1995) further observes that "antibiotics are totally ineffective against viral diseases, which include colds and flus. There is absolutely no benefit in taking them under these circumstances, and patients must learn that the drugs have the potential to do more harm than good" (p. 4).

Not only is technology capable of implanting pellets of radiation safely and effectively into the brain to treat cancer, and replacing great quantities of lost blood into an accident victim, modern medical technology is also capable of routinely transplanting organs from one person to another. We can see with the eyes of another; breathe with another's lungs; clean, refine, and process bodily fluids with the liver, pancreas, and kidneys of another. Because of modern medical technology, it has become an everyday occurrence to remove healthy, viable organs from a dead donor and implant them into the body of a terminally ill recipient who may live across the country.

In its ideal form, the health care system strives to provide all people with equal access to quality health care. The problem arises from the fact that traditionally the United States' health care system has been more grounded in individualistic values than on the common good. Furthermore, health care has been dominated by two factors, the rapid growth of medical technologies and the fact that these technologies are interventionist in nature. This technology-intensive and interventionist orientation have developed largely because health care consumers believe that they must have the best that medicine has to offer. The wealth of the large middle class is also a contributing factor.

The modern health care system, with its array of technological advances and equipment, is in trouble. Health care costs have been allowed to escalate unchecked in America's relentless pursuit of individualized quality health care. Other factors contributing to costly and inefficient use of health care resources include physicians' desire to protect their incomes and prevent liability exposure. Some physicians have accomplished this by ordering expensive procedures that have often seemed by patients as routine, whether justified or not. New and improved technological equipment and services then were purchased and used in inefficient ways. For example, three Magnetic Resonance Imaging (MRI) machines, at a cost of approximately 2.5 million dollars each, located in three separate hospitals within a 40-mile radius, attest to this inefficient use of resources and disregard for escalating health care costs. Often, primary physicians, who now help structure and manage (gatekeep) necessary services, are uninformed about specialty tests and procedures ordered by physician specialists. We as patients are also part of the problem since we expect *something* to be done when we go to a physician—i.e., we expect tests, procedures, and pills. Insurance companies have also contributed to the problem by paying for technological procedures but not for preventive measures, a practice that is now beginning to change. The recognition of the need for cost-control measures in health care has spawned the emergence of insurance-driven, managed care companies into the health care market. Excessive use of technological equipment and physician specialty services has created the situation in which health care consumers and providers now find themselves—namely, in critical need of health care reform.

Technology has been a driving force in the development of exceptional goods and services that comprise the American health care market. It has also contributed greatly to high medical and health care costs. Many people (35 to 40 million) are without basic health care insurance and, more often than not, are unable to afford the use of many of the technologically-intensive procedures. Competition between hospitals to purchase the best medical equipment available further compounds the problem of escalating health care costs.

Technological expansion has been cited as a major factor contributing to spiraling health care and insurance costs (Lee et al, 1992). Where once the development of new technology (e.g., the x-ray) was greeted with unwavering applause, technological development now is tempered with cost-containment concerns. Society must guard against "...technology [that] increases the quantity of services without improving quality" (Shulkin & Fink, 1993, p. 33). Health care consumers also must be wary of health care providers who promote the use of services and expensive equipment without adequately explaining the necessity of these high-tech services. Managed care is insisting on rationale for procedures and explanations for requested services. This paradigm shift is helping to alleviate the problem of unnecessary use of services and high-tech equipment. This represents a fundamental rethinking of values for many American health care consumers.

Rethinking values and embracing new concepts in how health care is pursued is difficult for the American consumer. Increased quantity, cost, and risk were accepted as the norm in American health care circles as new advances in technology emerged. For example, these changes are altering the use of electronic fetal monitoring devices that have been used in both normal pregnancies and high-risk cases as well. After sustained use of this technology in the 1970s, studies were conducted that found that the quality of prenatal care had not been substantially enhanced by the use of this technology over the use of the stethoscope by a trained practitioner. In fact, the invasive nature of electronic fetal monitoring (introduction of probes into the mother and attached to the fetus) often "...significantly increased the risk of operative delivery (e.g., cesarean delivery or forceps) for the woman" (Grimes, 1993, p. 3030). If the risk was unnecessary but undertaken simply because the technology was available, then a reassessment of priorities and prevention of unnecessary interventionist practice are in order.

A major problem in changing the current health care system is that medical practice and scientific advancement are based upon *interventionist* rather than *preventionist* practice. Interventionist practices have received strong support from health care consumers. A shift away from medical interventionist practice is often greeted with resistance. Witness the number of smokers in society who ignore the Surgeon General's warnings. It is very difficult for a practitioner who agrees that fetal monitoring is not justified to stop using it. This practitioner may experience pressure from his/her colleagues in the community who continue to engage in the practice of fetal monitoring. The practitioner's colleagues may level charges of *negligence,* and patients, conditioned to expect monitoring, may perceive that their doctors are *behind the times*. It is often easier to continue the invasive technologically-based practices than to attempt to fight established medical practices. Most people think that the practice of medicine is a more precise science than it really is. Medical practice is based upon expert knowledge, research, education, experience, the last vendor to visit the doctor, and often trial-and-error methods with individuals, since the illness experience of each individual varies. The level of medical intervention used generally depends upon how these factors merge together. Based on this knowledge, the health care provider decides the type of intervention required.

As technological interventions continue to escalate health care can become cold and mechanistic. The values of touching and nurturing need to be emphasized so the medical world does not become depersonalized (Chinn, 1991). The value of listening to the patient's needs and concerns in an atmosphere devoid of the pressure of assembly-line medical interventions needs to be maintained. How this will be managed in an environment where cost-control is essential is a serious problem, and the outlook is currently not positive. Touching and nurturing are valued by people; but businesses that make value judgments based on their bottom-line are forced to live by a different set of values.

Given the interventionist nature of health care and the rapid growth of medical technology, health care technologies will be examined in more depth. Health care technologies fall into several categories: (a) medical artifacts (equipment, devices, tools, instruments, etc.); (b) biotechnological devices and procedures (prosthetic devices and organ transplantation); (c) information technologies (computers); and (d) organization and systems technologies (running organizations and systems). Because each of these categories contributes to the way health care is delivered and, ultimately, has contributed to the need for health care reform, a discussion of each category is needed.

Medical Artifacts

Mechanical Devices

Large and small hospitals, medical centers, out-patient clinics, and patient homes are all settings where medical artifacts are used. Mechanical devices which serve the needs of the patient and the health care provider are developed in concert with the requirements of the environment. For example, mechanized beds designed to elevate various body parts as needed, blood pressure machines, oto (ear) scopes, ear probe thermometers, suction machines, and examination lights are but a few of the devices routinely incorporated into hospital and out-patient clinic rooms. While these items are convenient and usually necessary, they nevertheless contribute to the cost of routine health care visits. From a business standpoint, these technologies represent overhead.

Medical Equipment

Equipment found in specialty areas of the hospital (e.g., Intensive Care Units, and Ear, Nose, and Throat specialty clinics) are even more technical and costly. Illustrative of this type of equipment are the diagnostic tools such as nasendoscopes (fiberoptic tubes threaded through the nose and down the back of the mouth) connected to video cameras to view the vocal cords. Another example of progressive medical technology is intravenous (IV) machines designed to automatically infuse fluids at specified rates in order to prevent errors in the volume of fluid administered to the patient. Yet another example of high-tech equipment is a colonoscope used to view the lower intestinal tract through the use of a video camera attached to the end of the scope. These are more examples of high-tech equipment that, while highly valuable, contribute to the high cost of health care. Yet, in our American health care system, they are also illustrative of the types of interventions that we have come to expect of a competent and progressive health care environment. Health care practitioners prefer these types of sophisticated technological equipment since error reduction also decreases the risk of lawsuits.

In the past if a person had insurance, the unrestricted use and costs of medical equipment and devices to improve care was seldom questioned. Even less consideration was given to whether the equipment and devices were really essential to quality patient care. Now, the type of equipment needed for a patient's care is carefully scrutinized by attending physicians and cost-conscious hospital/clinic administrative staff, as well as by managed care companies. A private room with specialized equipment is not allowed unless medical conditions justify the decision. Although the use of medical artifacts has enabled the health care provider to improve patient care, now we must weigh their benefits against the cost of such care. It is clear that this represents a fundamental shift from traditional values of freedom and limitless, interventionist practices irrespective of cost.

Biotechnological Devices & Procedure

Biotechnology has been defined as "the engineering and biological study of relationships between human beings and machines" (Webster's II, 1988, p. 175). Biotechnology interfaces with the health care system in numerous ways and contributes to the escalation of health care costs as well. This section will provide an overview of the major categories of biotechnology.

Computerized Biotechnological Devices

Biotechnological devices, powered by sensitive implanted microprocessors, are revolutionizing the constricted environment of the severely disabled. For example, computer-controlled pistons designed to force fluid through artificial heart valves (Schichl & Affeld, 1993) enable a cardiac-disabled patient to walk. Computer-based wheelchair mounted systems allow patients with spinal cord injuries to control their environments (Hawley, Cudd, Wells, Wilson, & Judd, 1992). More recently, robotic software is being used in surgery to help pinpoint specific targets such as minute positioning of an x-ray beam (Benabid, Lavalee, Hoffmann, Cinquin, Demongeot, & Danel, 1992) to provide radiation therapy in previously inaccessible areas of the brain. Devices such as IV pump machines, respirators, and new electrocardiogram (EKG) machines are also equipped with computer chips. These devices currently are being evaluated to balance treatment and diagnostic benefits with cost-effectiveness, personnel education, and inservice training concerns.

Prosthetic Devices

Savage, Rossner, & Finke (1993) define prosthetics as "...adding or implanting some type of artificial material into the human body where tissue integration occurs" (pp. 60-61). Technologies such as artificial hearts and artificial hip and knee replacements are at the forefront of the health care biotechnology frontier and are having a profound effect on the quality of life of many people who were previously disabled. No longer is it always necessary to suffer with diseased or broken bones so long as criteria are met for the technological replacement of these parts. "Physical enhancement...[or]...bioengineering applies engineering and technology concepts....[and]....have provided creative technological solutions for people's physical enhancement needs" (Savage et al, 1993, pp. 60-61). Technological applications to simulate and replace the capabilities of the body's five senses are continually being developed, improved upon, and extensively used by persons needing replacement parts or aids to various body functions.

Artificial body parts began around 1945 with the first external, artificial kidney and the first lens replacement for cataracts. This was followed a dozen years later with the first successful knee replacement. In 1960, the first heart valve was replaced and three years later, the total hip was replaced. Barney Clark was the first recipient of the Jarvik-7 artificial heart in 1982.

Although now the recipients of life sustaining artificial body parts number in the millions, the formal review process is not keeping pace. Animal studies are not reliable because of differences between humans and animals. The Food and Drug Administration requires that artificial hearts and other organs can only be used if the patient is too sick or too old to get a transplant. No wonder previous artificial heart recipients all died. The general expectation is that an artificial organ should be immediately successful and risk-free. This cannot happen. The area of prosthetic devices and physical enhancement is one of the most rapidly expanding fields in medicine, with new and promising technological devices being developed on a continuous basis.

Organ Transplantation

Medicine now has the knowledge base, technological capability, and market demand for placing organs (e.g., a liver, kidney, pancreas, or heart) from one human being into another. It appears to only be a matter of time before the medical technology will have developed the capability to transplant (at least portions of) the human brain. In the future it will likely be possible to interface its processing functions with external or on-board microprocessors which would add a new dimension to our thinking about artificial intelligence. Ethical and economic considerations never before faced must now be addressed in light of medicine's new and evolving capabilities. Who really needs or deserves a new heart? Can the individual afford it, and if not, who pays for it? Do the needs of the individual outweigh what is best for all health care consumers? What do we do with technologies that are capable of manipulating and altering intelligence, memory, and attitudes? These are serious health care issues that have emerged directly from *progress* in the development of biotechnology.

In today's health care economy, a kidney transplant costs between $60,000 and $75,000 if there are no post-surgical complications. Most third-party payers provide financial coverage for this surgery, basing their economically-driven decision to pay on the fact that dialysis is more expensive in the long term than transplantation. Also, kidneys typically come in pairs, so healthy living donors are frequently available. The patient is usually ahead with a transplant since the person can expect to live a normal life if no complications occur during the first year, while the survival rate diminishes every year for a patient on dialysis.

The same is not true of liver transplants. First, no alternative therapy exists to prolong the life of a patient suffering from liver failure. Second, viable livers donated for transplantation are fewer in number than are viable kidneys; thus, the wait for a lifesaving organ may literally take a lifetime. Also, since there is less availability of livers, they come at a higher cost. Consider the fact that with fewer livers available for transplantation, there are fewer of these surgeries performed. This means that less expertise is available in the area and more complications tend to occur after the surgery. As a result, the real dollar cost for this organ transplant surgery is increased. As recently as the early 1990s liver transplant surgeries were considered experimental in nature and, therefore, not covered under medical insurance, whether private or government-funded. Therefore, anyone needing a liver transplant to survive needed to place a $50,000 to $100,000 deposit with the hospital before they were considered candidates for lifesaving transplantation.

The debate over the division of society's needs (typically focused around economics) versus the individual's needs (survival) will continue to intensify as technological capability continues to grow. Serious ethical and legal issues arise as well. Should someone who has liver failure as a result of alcoholic cirrhosis or cancer have the same access to a liver transplant as a child with congenital liver failure? With the technology available to transplant organs from one body to another, who decides whether the surgery is experimental or not?

Genetic Engineering

Health care professionals are looking beyond the removal and replacement of defective organs to genetically manipulating the very beginning of life itself. The Human Genome Project (HGP) is a collaborative international project aimed at sequence mapping, both genetically and physically, the 24 chromosomes in the human body (Engle, 1993; Rossiter & Caskey, 1993; Tauber & Sarker, 1993; Yeager, Nickerson, & Hood, 1991). The Human Genome is comprised of approximately 50,000 to 100,000 genes all contained in the 24 chromosomes of the human being. A gene may contain as few as 800 nucleotides (the basic structural unit of nucleic acid) while the Genome itself contains approximately 3 billion nucleotides.

Certain biochemical and biological processes (for example, the ability of the body to produce insulin) can be either promoted or suppressed by genes, either individually or in combination with other genes. How these genes are expressed depends on three things: (a) the nucleotide sequence of the individual gene, (b) the location of the gene in relation to other genes, and (c) the chromosome on which the gene is placed.

Genetic engineering in the form of gene identification in conditions such as diabetes, cystic fibrosis, obesity, and colon cancer are helping to identify those individuals and families who are at risk of developing these problems. Since these debilitating diseases are known to be genetically influenced, the Human Genome Project (HGP) is expected to yield information about the ability of surgeons to manipulate disease through genetic invitro diagnosis (the ability to diagnose a disease while the fetus is still in the womb) and, hopefully, treat and/or cure it prior to the baby's birth. Already, genes have been isolated that could potentially eradicate cystic fibrosis, obesity, diabetes, some genetically-based cancers, and Alzheimer's disease (to name only several). Several techniques for injecting the desired gene have been used successfully but need further refinement. The most common techniques attach the gene to a virus which has the unique capability of entering a human cell.

If sequence mapping of the human chromosome can be accomplished, then a similar mapping is possible for other selected biological systems. This would allow the development of animal models of human disease so that more detailed scientific study can be pursued (Yager et al., 1991). The need for organ replacement in some well-known conditions, such as diabetes, may be eliminated with this project along with other chronic conditions that contribute to serious disease and death.

The technology that has spawned the advancement of genetic engineering research raises some serious ethical questions. If you *can* know that you carry a gene for a specific debilitating (and incurable) condition, do you *want* to know? Do your future children have the right to be born with the condition? Do you have an obligation, either to society or to your unborn child, to genetically correct any possible defects before they actually occur? Pregnant mothers who are at risk of having babies with Down's Syndrome can, by amniocentesis (extracting a sample of amniotic fluid which surrounds the fetus and looking for an extra chromosome), obtain a prebirth diagnosis. Should this information be used to make decisions about the continuation or termination of pregnancy? What are the implications of using amniocentesis as a routine screening procedure to test for *any* potential genetic defects in the unborn child? Other *advances* in genetic engineering that pose perplexing ethical dilemmas include invitro fertilization, surrogate motherhood, and the *morning after* birth control pill. Advances in genetic engineering will continue to surface these types of questions and dilemmas.

Information Technologies

The computer, as a systems management tool, is ubiquitous in medical applications ranging from patient management to record storage to automated diagnosis of selected diseases to the interpretation of medical images. Some of these applications may simply be number-crunching such as preparing patient bills or processing budgets. Other applications rely on the modern computer's ability to store large volumes of data, and to store these data in such a way that retrieval of such data is convenient (referred to as data base management). Still other applications rely on the computer's ability to process literally billions of instructions per second which allows the computer to make logical decisions from complex data sets. However, in addition to the computer, the individual mind and ability to organize and manage complex systems of information are technology in themselves.

Information technologies have had a major impact on improving the bottom line of the health care system. For example, using an integrated computer network in a hospital-based pharmacy to do a range of activities (e.g., locating patient and physician data, printing labels, etc.) was found to have decreased pharmacist time significantly on a per activity basis (Baker, Grussing, & Stewart, 1992). Computerized dispensing systems have demonstrated increased efficiency of pharmacists and decreased their time spent dispensing medicines (Ishizuka, Horiguchi, Waki, Maeda, & Ishikura, 1991).

Expert systems in medical diagnosis are being used to improve the health care provider's diagnostic ability and to prevent errors. These systems consist of software that incorporates a database of symptoms and combinations of symptoms with a variety of decision-making algorithms based on the expertise of top professionals and specialists. Physicians and other professionals are able to enter a pattern of patient symptoms into the database and obtain expert information. While these expert systems should be used to augment rather than replace the expertise and experience of individual physicians, they are nevertheless becoming increasingly important as health care specialization must be balanced with cost effectiveness.

In order to prevent errors in transcription of information, computer-based quality assurance programs in HIV laboratories are being used (Nunn, Biryahwaho, Downing, Ojwija, & Mulder, 1994). Other examples of essential computer-based quality control programs are in the areas of trauma, burn care, emergency room treatment, and intensive care treatment programs. Although these are not foolproof, computerized systems decrease the risk of human error in the laboratory setting and provide an improved way of impartially monitoring patient standards of care.

Information technology has enabled the medical industrial complex to interface with patient care systems to insure that quality standardized equipment will go from the hospital bedside to the patient's home. Examples of standardized equipment might include intravenous (IV) equipment for home-delivered antibiotics or pain medication, respirators (breathing machines), blood pressure cuffs, and thermometers.

Computers are also being used to provide clinical simulations, virtual reality experiences, and long-distance interactive video as learning tools. For example, medical students are participating in surgical experiences by seeing "...a first-person view of the way a particular procedure is accomplished" (Whiteside, 1993). Inter-active videos also are used to provide unique learning experiences between students and instructors through either long-distance class participation or one-on-one learning experiences between students, instructors, and an educational computer program.

Two examples of revolutionary change resulting from the introduction of the computer and improvements in information technology into health care are: (a) computed tomography (CT), sometimes referred to as CAT scan for computerized axial tomography, and (b) magnetic resonance imaging (MRI). Both CT and MRI scanners have taken the technology of x-ray and added the capabilities of the computer to develop new ways of looking into the human body.

Computerized Tomography

In 1973 the first CT scanner was designed and reported by Hounsfield, a British physicist. The clinical value of this new imaging modality was quickly recognized by the medical community, and a whole-body version of the CT scanner was rapidly introduced (Sheedy, Stephens, Hattery, Muhm, & Hartman, 1976).

Conventional x-rays are shadowgrams of the attenuation caused by interposing a body part between an x-ray tube and a detector, most often an x-ray film. They show images of highly dense material such as bone or foreign objects within the body. They do not provide information about soft tissues such as muscle, internal organs or brain tissue. The CT scanner operates on a different principle. By scanning an object with x-rays at different angles and taking advantage of highly developed mathematical techniques (variously known as reconstruction algorithms), the computer can estimate regional density differences in objects with a high degree of precision. Thus, the success of CT was made possible by the availability of computers. The regional maps of estimated tissue density that is stored in the computer memory can be output to suitable displays such as a video display terminal. The displays then can be viewed directly by the physician, or used to expose film for later interpretation.

CT units which were formerly available for $350,000 are now over $1,000,000. The concern over the rising cost of health care has created pressure to slow down the spread and use of CT scanners (Abrams & McNeil, 1978) until greater efficiency could be established. However, the rate of improvement in CT technology outran formal technology assessment and efficiency studies. These facts point to another need—to increase the rate at which assessment and efficiency studies occur. But who should be responsible for doing the studies?

Magnetic Resonance Imaging

MRI is based on the physical principle of nuclear magnetic resonance. MRI takes computer-assisted x-ray capabilities a giant step beyond the CT scan. The body part to be scanned is moved into the center of an extremely powerful electromagnetic field. This causes the hydrogen atoms in the water molecules of body tissue to align in a polarized fashion. Then a pulsating radio frequency signal is super-imposed on the electromagnetic field, causing the atoms to twitch out of alignment. When the radio frequency pulse is turned off, the atoms realign themselves, giving off a weak signal which is detected by the MRI sensors. By repeating this process at different frequencies, and hence different positions within the area of interest, the radiologist builds up a map of signal intensity across the body part. This information can then be used to produce an image on a video monitor showing the slightest variation in tissue structure.

The diffusion of MRI into medical practice was swift. Lauterbur demonstrated the ability to image biological systems in 1973, the same year that CT was introduced (Hounsfield et al., 1973; & Ambrose, 1973). By late 1982, only about a dozen sites worldwide were using laboratory imagers. Commercial companies were just beginning to capitalize on developing commercial imager systems (Crooks, Ortendahl, Kaufman, Hoenninger, Arakawa, Watts, Cannon, Brant-Zawadski, Davis, & Marqulis, 1983). At this time no medical institution could consider itself to be a major institution without at least one MR imager, and many have more than one.

While conventional x-rays, CT scans, ultrasound, and MRI scans are very useful for showing different types of anatomy, two devices that use radioactive material can detect certain dimensions of *function* since they can detect blood flow and volume, and other metabolic processes. Both positron emission tomography (PET) and single photon emission computerized tomography (SPECT) require the patient to inhale, ingest, or receive an injection of a substance labeled with a radioactive isotope. A sensitive sensor reads the gamma rays given off, and the computer assembles the data into usable pictures.

These processes can develop *real time* records that show a heart beating, for example, but are even more useful in brain studies to identify areas of the brain that are not functioning as a result of a stroke, Parkinson's, epilepsy, Alzheimer's, or schizophrenia. These processes are also being used in scientific research to gain understanding about where in our brain we think about different subjects.

Organization & Systems Technologies

Most of the discussion of health care technology to this point has focused on technology as artifact. This view of technology is too limited. Kasprzyk (1980), in a careful treatment of the etymology of the term technology, points out that its origins are quite distinct from physical objects. Rather, the techné of Aristotle had to do with the systematic use of the rules and techniques of effective argument (rhetoric). The key point here is "the systematic application of rules to processes" easily extends to other familiar applications that have historically been associated with technology. Examples abound in the Industrial Revolution (e.g., mass production, interchangeable parts, mechanization, and de-skilling). With the industrial revolution (through the work of innovators such as Ford, Taylor and others) management and organizational systems were established that should also be thought of as technology. This use of the term *technology* is widely used in management circles to refer to organizational structures. Daft (1988) defined technology as "the tools, techniques, and actions used to transform organizational inputs into outputs. Technology is an *organization's production process*, and includes machinery and work procedures" (emphasis added) (p. 132).

The implications are important for the health care environment. Pacey (1983), in his insightful work entitled *The Culture of Technology*, discussed the development and delivery of third-world health care systems. These include health-care screening, water delivery and purification, inoculation, and nutrition. These systems (and subsystems) can be properly understood as technology. Pacey also made the point that these dimensions of technology represent the nurturing (feminine) aspects of technology, which stand in stark contrast to the male-dominated attributes (conquest and subjugation of the nature by man).

Within the broader health care environment, management technologies are becoming increasingly important. Total quality management (TQM) systems, developed to manage information and organize complexities of the system, have been widely discussed in the literature (Moser, Jr., 1993). A new paradigm shift from *medical* management to *systems* management is occurring with an emphasis on quality management. The focus is on customer satisfaction, identifying and solving problems in the system, and understanding the concept that poor quality or mismanaged health care funds is costly (Yarborough III, 1993).

The whole area of medical informatics involves unique organizational system development in order to compile and categorize the work of various pockets of information. This complex process requires expertise in system organization and management. Health care domains where system organization is used include: "population-based systems, hospital information systems, clinical systems, clinical laboratories, consultation systems, training systems, and robotics and handicapped" (Gremy & Degoulet, 1993, p. 186). Standardization procedures, protocol development, and critical path development are all outcomes of systems management expectations. The ability to develop, organize, and manage these complex systems is a technological skill in itself. Organization of technology systems in the health care industry is becoming recognized as society becomes more high-tech and as the health care industry has become increasingly competitive or is under increasing pressure to control costs.

Summary

Technology, in its various forms, has had a powerful influence on health care in this country. As illustrated in this section, it is clear that the vast majority of technological developments have been from within an interventionist, medical model. The proliferation of sophisticated, medically-oriented technological artifacts has had a major impact on how health care is delivered in this country. The rapid development of information technologies has contributed in major ways to the development of these devices. At the same time, the huge expense associated with the development of these technologies has generated a need for cost containment and efficiency across the system. This, in turn, has fundamentally changed the ways in which organizational technologies are being conceived and implemented. It is important to remember that technology, properly understood, includes the ways in which systems are organized and managed. As such, management technologies (TQM, efficiency studies, cost-benefit analysis, managed care, etc.) may well be among the most important technologies as we move deeper into health care reform.

In this section, we have attempted to present a few examples of how technological achievements are changing the way health care consumers receive services which improve their health care outcomes. Within each of the categories of technology, illustrations were given of how technology has interfaced with the health care system and contributed to the current state of American health care technology. One of the serious challenges for the future of the health care system will be to resolve the discontinuity between expensive, interventionist, physical technologies and the management-oriented, organizational and structural technologies (which tend to be either more preventative in nature and restrictive of the further expansion of expensive, interventionist technologies).

Coile (1994) has aptly captured this dynamic between these two conceptualizations of health care technology when he observed that "the roles for technology under 21st-century health care [will include]: Predicting and managing disease, pinpointing diagnoses/therapy, testing cost-effectiveness, minimally invasive surgery, computerized diagnosis, telemedicine/robotics surgery, electronic community recording, and limiting benefits for high-tech procedures" (p. 361). Already, we are experiencing the tension between these technological roles in our daily lives as health care consumers and providers. More of the same is certainly in store in our future.

Health Care Reform

The American health care system is undergoing tremendous change and is seeking to address the challenges of the future posed by overuse of past resources and the need to adequately use current technologies. These changes can collectively be referred to under the popular rubric of *health care reform*. Political and market forces have pushed the health care system toward change and have forced it to assess the needs and implement the changes needed. Practitioners of health care find that the world is changing daily, due to reform, and that they are faced with the choice of either *catching up* or facing the extinction of careers. Current health care reform has involved several areas; a few will be discussed here and include: (a) political & economic power in health care, (b) the need for ongoing assessment of health care, (c) the cost of health care, and (d) managed care.

Political & Economic Power in Health Care

The Clinton administration has been instrumental in bringing the complex issue of the need for health care reform to the forefront. However, the power of the medical establishment, as well as the power of the opposing political party, has frustrated the Clinton administration's ability to advance its health care agenda. Major objections were also raised by businesses that would have shouldered much of the cost of insuring the uninsured. Businesses lobbied hard against the package. Under the leadership of Hillary Rodam Clinton, a task force developed a list of principles and values that should govern health care reform (Daniels, 1994, p. 425). However, due to the diverse nature of the American population, unequal distribution of health care dollars, and political parties being what they are, these Task Force precepts are being dissected and opposed on many fronts. Power bases common to the arena of health care include: (a) health care providers under the auspices of such professional organizations as the AMA, and (b) insurance companies and the health care system. Politicians, with the help of their constituents who purchase and receive health care, are major players in determining the direction, scope and reality of health care reform. Consumers need to understand the power bases in the health care arena in order to actively participate in its reform.

Health Care Providers

Health care providers include physicians and a host of other professionals including nurses, therapists, and technologists to name a few. Also included are institutions such as hospitals, nursing homes, and home care agencies. The primary care provider at the point of initial contact is usually the personal family physician or, more recently in our health care history, the nurse practitioner. The predominant medical care paradigm in the United States has been one in which the physician is autonomous and the social contract between the physician and patient is one of professionalism based on mutual trust. Medical economics has been based on a fee-for-services-rendered concept. Hospitals traditionally have been dominated by philanthropic organizations whose primary goal was to relieve pain and suffering.

This paradigm is changing rapidly. Over the past two decades, a growing number of for-profit businesses relating to direct medical care (as opposed to the manufacture and distribution of pharmaceuticals and equipment) has emerged. This medical-industrial complex includes proprietary care hospitals, proprietary nursing homes, home care delivery, medical laboratories, hemodialysis clinics (removal of unwanted chemicals/materials from the blood through a cleansing procedure using tubes & machinery), and more recently, stand-alone MRI centers and Surgi-Centers (Relman, 1980, 1991). The ethical and political debate about the role of physicians in these for-profit enterprises continues. In 1980, Relman estimated that 35-40 billion dollars of 1979 health care expenditures were spent on the newly burgeoning medical-industrial complex. While the total dollar volume remained the same, Relman (1991) later revised the percentage estimate for 1979 to 17-19%.

In 1980, the number of proprietary hospitals was approximately 1000. By 1990 this number had increased by about 40 percent to an estimated 1400 out of a total of about 5,000 hospitals. During this time there is little evidence that proprietary hospitals were more efficient, and some evidence exists that they charged more for ancillary services such as diagnostic tests (Relman, 1991). Although difficult to estimate, the percentage of health care dollars spent in the for-profit medical-industrial complex was about $150 billion out of a total of $700 billion expended, an increase of a few percentage points over that from 1980.

The commercialization of the health care system provides a new social contract for the relationship between the health care provider and the patient. The health care provider, as well as the patient, is losing autonomy. More decisions regarding the standards of patient management are being made by government agencies, professional organizations, and insurance companies. Rather than fee-for-services-rendered, the health care provider increasingly will become employed by health maintenance organizations (HMO) or other types of health care alliances and organizations. Physicians likely will receive financial incentives in the future for not ordering tests or procedures. Rationing of health care (as was done with the Oregon Plan, for example) and sharing the market area with advanced practice nurses (nurses with graduate degrees in specialized areas of health care) will become more common in the future.

Use of advanced practice nurse health care providers to their full potential in the evolving health care system will likely improve access to health care in those rural and urban populations in which needs have been most pronounced and previously unmet. This concept is meeting resistance from insurance companies and physicians. While the issues are being posed in terms of adequate education and quality of care, the real issue has to do with the impact on physician salaries, insurance companies' lack of knowledge about advanced practice nurse roles, and the reluctance to share power across the health care provider system. Market share influence and control are the real issues.

Health care providers of all types are well aware of these issues and Congress is quickly learning that these concerns are delaying reform. Yet, Congress will always respond to its most powerful lobbyists and vocal constituents. Until health care consumers can gain a political voice, real reform (equal access and quality of health care for all Americans) will continue to face serious resistance. The Clinton administration has attempted to deal with this directly with limited results. The political climate and the economic realities have yet to converge in such a way that genuine reform is able to occur.

Insurance and the Health Care System

Voluntary employment-based private health care plans constitute the primary source of health insurance for most Americans (Aukerman, 1991). One estimate is that 88% of Americans are insured. Of these, based on 1988 data, 66% of the nonelderly population was covered by employer-based insurance, 10% by private health insurance, and 12% by public health insurance. Essentially all of the elderly are covered by Medicare Part A hospital benefits and the majority of these voluntarily participate in the Part B supplementary medical insurance. Since 1988, fewer Americans are covered by employer-based insurance as businesses seek to decrease costs by hiring part-time workers who do not qualify for benefits.

From the perspective of the insurance companies, payments to policyholders need to be limited. The total group of policyholders is the insurance company's customer. Policyholders who manipulate the system to their own advantage, and health care providers who bill excessive charges are now being more effectively controlled through managed care. This trend must be continued. Insurance company-driven managed care is a method of limiting costs to groups of policyholders. Individual policyholders who sue for unreasonable causes raise the rates of all policyholders if they win. Courts tend to favor the rights of the individual over those of the insurance company, which further exacerbates the problem of insurance rate escalation. Consider, for example the *million dollar* cup of coffee, where a customer of a fast food chain was awarded damages for burning herself with, what was judged to be, an unreasonably hot cup of coffee. Again, society's advocacy of individual rights plays a part in increased health care system cost.

As the cost of health care has increased, the ability of voluntary organizations to provide support to not-for-profit hospitals has declined. This fact, coupled with the increasing transfer of diagnostic and therapeutic procedures outside of the traditional hospital setting and cost-control measures instituted by third-party payors, has created an environment in which the nonproprietary hospitals have been forced to become more commercial (for profit) in order to compete with the proprietary hospitals in order to insure survival. Thus, the entire health care system is becoming more market-oriented and market-driven. While these moves may be necessary to control costs, they also have profound implications for technological development as well as for the quality of health care delivery.

While politicians are debating the future of health care, the new market-driven health care system is emerging. Third-party payors are increasingly demanding competitive bidding on health care contracts to protect policyholder rates. Patients are expected to get second opinions before having certain operations. Since quality of care is so difficult to assess, decisions are being made on bottom-line dollar costs. There is as yet no adequate mechanism for accounting for costs associated with caring for the noninsured or underinsured, nor the costs of medical research and education. The current health care system is struggling to find a way to manage these issues. Society as a whole has yet to come to grips with the changes in a direct and well-informed manner.

Need for Ongoing Change of the Health Care System

Health care consumers are being radically affected by health care reform in the areas of cost, quality, and access to care. Technology, as a systems and mechanical support process, is intertwined with health care and influences the integrated areas of cost, quality, and access to care, setting the pace for health care change. The need for health care reform in the midst of excess health care spending and capitalistic enterprise has brought America to the point it is now with businesses managing the cost of patient care, governing length of hospital stay, and deciding how consumers in America will receive their health care and from which type of provider. The failure of the health care system to identify and manage the care of patients in a cost-effective way has led to the current health care reform environment. Creativity is needed to make health care work. Education of health care consumers and Congressional representatives is essential in order for the nation to manage health care effectively.

As Perry & Marx (1992) phrase it, "...it is first necessary to assess both health technology and the country where the technology will be used...and the infra-structural conditions in which the technology would have to function. Advanced technologies introduced into other developing countries failed because appropriate resources were not in place" (pp. 356-357). Perhaps the United States has chosen individualism at the expense of the common good. Also, perhaps the U.S. failed to adequately assess its own health care infra-structural conditions prior to implementing health care dictates. This analysis of infrastructure should include "analyses of: (a) safety, efficacy and effectiveness; (b) cost and cost-effectiveness; (c) infra-structural factors; (d) social impact and fit; and (e) needs and capabilities of local health care delivery systems" (Perry & Marx, 1992, p. 361). Clearly, political and market influences are certainly driving health care in this direction.

Cost of Health Care

The shift to a market-oriented health care system and the rapid rise in the percentage of the gross national product (GNP) spent on health care has created strong pressure for cost-control. In 1965, approximately 6% of the GNP was spent on health care; by 1975, this was up to approximately 8%; in 1985, it was 10.5%; and by 1989, over 12% of the GNP was being spent on health care (Levit, Lazenby, Letsch, & Cowan, 1991). By some estimates, about 15% of current GNP is being spent on health care.

Cost-control has emerged as a primary motivational factor in health care reform. An understanding of what drives health care costs is an important initial step in beginning progress in reform. Lamm (1991) presents a synthesis of the literature addressing the major factors that are spawning reform including:

- the aging of America's population,
- advances in medical technology,

- the expectations of the American public as to the kind of health care it deserves,
- the fact that most health care is paid for by third party payors (users of the system feel little economic pain),
- the tax system which allows an employee to receive health benefits tax free and thus reduces economic incentives for health care cost containment,
- medical malpractice insurance premiums, and
- the refusal to recognize that infinite needs have run into finite resources.

The enormous cost of technology that enables health care facilities to provide state-of-the-art medical care has driven health care costs beyond the realm of reality. The competition for patients in this health care marketplace has fostered duplication of services adding to the cost of health care facilities. In addition, health care practitioners often order the use of high-tech diagnostic equipment in order to avoid the charge of not conforming to the standards of practice in the local community. However the general public is no longer capable, or desirous, of footing the bill for this spiral into economic oblivion. Seamless health care (patient care episodes managed flawlessly by professionals with different levels of preparation) is one proposed solution, and a major component of managed care, which would help prevent unnecessary economic waste.

Managed Care

The health care and technology literature discusses the need for seamless care and prevention of system failure in order to provide quality and cost-effective patient care. An example of effective seamless care is illustrated when an individual goes to his/her family doctor for an annual checkup. During the course of the exam the doctor detects early indications of heart problems. The person is referred to a heart specialist. Further tests are run based on expert knowledge and assessment and a course of treatment is prescribed in a safe, yet cost-effective, manner. Treatment is likely to include such preventative and nontechnology-intensive life-style changes as regular exercise and dietary changes. After a reasonable period of time, the individual is, once again, fully functional and health care costs have been kept to a minimum. An alternate scenario, and one that illustrates the failure of the system, is if this same individual were to arrive at the emergency room with signs of heart attack. Arrival likely would have been by ambulance, and treatment would almost certainly include a period of hospitalization, perhaps in an intensive care unit. In the absence of preventative treatment, the health care system is burdened with unreasonable costs when the situation could possibly have been avoided.

Seamless access to care and available services can help prevent serious illness. Limited access to care and patients "falling through the cracks" of the health care system can no longer be tolerated and has forced health care onto the national political agenda. Health care access and services for everyone is now being considered a societal right instead of a privilege of the insured minority. This ideal is being promoted by insurance companies and health care experts alike, all under the rubric of managed care. Critics of managed care counter that mandating that everyone first access health care through a primary (general) provider, threatens to eliminate the cherished American value of independent and free choice from health care decision making. This is considered to be undemocratic. If a person knows what specialized care is needed, why must a primary care provider be accessed (and paid) first? The American right to choose is at stake.

Critics of managed care also argue that insurance-driven managed care systems serve mainly to line the pockets of the CEOs of managed care companies. Health care consumers have gone from passively allowing medical providers to dictate health care interests, to allowing for-profit capitalistic businesses to dictate how health care is managed. Neither alternative is positive. The lack of sufficient knowledge about the health care system and health care in general, combined with fear for personal health safety and undisputed faith in the medical profession, has contributed to the ease with which consumers have been manipulated by self-serving health care groups. "The needs of the individual have been given priority over those of the community" (Priester, 1992, p. 90). The HMO model does not completely resolve this dilemma. This model increases pressure on health care providers by: (a) encouraging the practice of increased patient numbers in order to pay for HMO expenses, (b) reducing unnecessary services to consumers to keep HMO expenses in control, (c) providing expected expert services at low rates to encourage consumer participation, and by (d) expecting the provider to balance all of these areas in order to prevent litigation which further increases health care costs. These constraints in the world of health care practitioners also impact the use of technology in America.

Proponents of managed care argue that the primary problem has to do with the distribution of wealth in our society, where some can afford health care while others simply cannot. Managed care is seeking to level the playing field by shifting costs of the uninsured to the insured. Primary care is improving the availability and affordability of health care services. Rural settings are employing more family nurse practitioners in areas previously lacking in primary care physician services. Financial incentives in education and job placement are being offered to primary care physicians in order to attract them to the rural settings. Adjustments to the changing direction of health care are being made by physician specialists of various medical services as well. There is increased reliance on primary care providers (family physicians and family nurse practitioners) by physician specialists for patient referrals. There is also improved communication, by necessity, between all types of health care providers in order to be cost-effective, yet responsive to patient needs and wishes.

Health care reform will continue to be a major issue throughout the 1990s. Reform has become necessary since many people no longer have health insurance and are unable to afford basic, much less, state-of-the-art medical care. Aside from the direct, visible patient care costs, there are the *hidden costs* that are a part of this picture. For example, a pharmaceutical company develops a new antibiotic. In order to market this new drug, years of testing will be required before the FDA will certify the medication as safe to be used in the marketplace. The drug company obtains a patent to protect itself which will hopefully allow time for the company to recoup some of its initial costs. But this patent is only in force for seven years—then this coveted chemical equation in pill form is up for grabs and anyone can market a generic version, typically at greatly reduced prices. Consequently, before the patent expires, drug companies are hard at work developing new drugs that can be patented and marketed, at a higher profit margin. And so the spiral continues.

This social condition is a direct result of American individualism. "Thus, debates over justice over health care often address as their starting point the question of whether individuals lacking health insurance have any right or entitlement to receive services" (Jecker & Meslin, 1994, p.

191). The ethical question here is whether extremes of individualism are carried to the extent of depriving the community of its right to basic health care. Does the nation want to promote capitalism to the extent that many of its people are deprived of basic health care services? If we are not a *class* society, then we must consider issues where the quality of all American's health care is at stake and equality is threatened.

If the ideal of equal health care for all is embraced, then what of the cost to society? Whether society's system of health care is considered unequal or equal, the cost to the American consumer is great. The American health care system consumes triple the amount of the GNP it did 35 years ago. If this rate of spending continues, "health care spending could theoretically approach 100% of our GNP in the 21st century" (Dougherty, 1992, p. 2411). The capitalistic economic system is forcing the issue of health care reform, but democratic values (e.g., the right to choose the health care provider and system of our choice) are being compromised under the new system. These two concepts, capitalistic economy and democratic values, are diametrically opposed, yet success in health care reform is dependent on these divergent concepts merging!

In the managed care environment, controlling the cost of health care is the number one goal. By shifting the emphasis from a disease-oriented system to a prevention-oriented system, health maintenance organizations (HMOs) are seeking to control the escalating costs of health care. HMOs have introduced into the health care system capitalist economics rather than the fee-for-service system of the traditional past. "The economics of capitation will demand a prudent and strategic, clinically driven system that will control the application of technology" (Coile, 1994, p. 361) cost, quality, and access to care. Is quality of care going to suffer under access to care issues? Will quality of care even be a consideration if primary care providers are seeing more than triple their current patient loads. Improved access and the need to increase patient numbers to satisfy managed care company income quotas are reasons for increased patient loads. When health care is handled as a business (under managed care), then the number of patients seen is likely to become more important than the time that was needed to see a particular patient and the quality of time spent with the patient is likely to suffer. If health care providers are pushed too hard and fast by managed care, the quality of the product will need to be questioned. Traditionally Americans have not been willing to compromise the quality of their health care or settle for less than state-of-the-art care.

We are all living an enactment of attempted piecemeal solutions. Examples of solutions found in the literature include "assuring access to care, controlling financial incentives, developing efficacy-based guidelines for medical practice, controlling the cost of technology, reforming malpractice insurance, developing standards for appropriateness of care, and reducing the resources used to monitor medical care" (Shulkin & Fink, 1993, p. 33). Some are working; others are not. However, no real solutions will be forthcoming until we understand how this situation developed, and what market and political forces have brought us to our current dilemma. We must understand the causes before adequate solutions can be found.

Implications for the Future

Areas of Change

Major changes in health care by the year 2000 can be classified into four areas. First, "by the year 2000 the technologic milieu in which we live and work will look more like science fiction than we can now imagine" (Chinn, 1991, p. 252). In the health care arena the state-of-the-art technology so coveted by American health care consumers has an amazingly short half-life. It has been predicted that, by the turn of the century, all hospitals will have computers at every bedside "with ready access not only to the complete data base for the patient but to entire libraries of information that could influence clinical decision making" (Chinn, 1991, p. 252). It will be virtually impossible to work in this high-tech environment without, at least, basic computer skills. The continued growth in the area of information systems, in this case health care information systems, is even now impacting on the field of education as computer literacy skills are part of the health care provider's program of study.

The second area of major change is predicted to be in the types of disease entities that we face. In the future the course of diseases will be impacted more and more by the "limits of our ability to withstand the constant and devastating environmental insults to health and well-being" (Chinn, 1991, p. 252). The human organism is very adaptable, but so too are the bacteria, viruses, spirochetes, etc., that cause many of the most devastating diseases today. One has only to look at the acquired immunodeficiency syndrome (AIDS) epidemic. The health care system, including consumers and researchers, are grappling with how to stop its continued devastation. AIDS is caused by the lentivirus known as the human immunodeficiency virus (HIV). HIV induces cells to inappropriate expression of genes which cause cell death (Ameisen, 1994). HIV does not in and of itself cause disease. HIV infects T cells (a vital part of the functioning of the human immune system), preventing them from activating the body's immune response to opportunistic organisms that would ordinarily be harmless to the uninfected person. While medication can inhibit HIV and help in the treatment of the opportunistic diseases, there is no vaccine nor cure in the near future. This is only one example illustrating that, for every new antibiotic or vaccine that technology enables us to develop and market, there is a disease-producing entity (a bacteria for instance) that mutates into an antibiotic or vaccine-resistant strain. This accounts for the resurfacing of diseases such as bubonic plague which reappeared in the southwest United States in the early 1990s. The spread of once isolated diseases is being facilitated by a rapid increase in population as well as in our mobility.

Coupled with the unpredictability of future disease courses, is the third area of major change in the health care system—the predictable scarcity of resources we are now beginning to experience. These resources include health care services, natural resources, and financial resources. The skewed allocation of resources has been linked directly to the profit motive so ingrained in our society. The allocation of our resources has become a source of intense debate—financially, ethically, and morally. As discussed earlier, this is one of the major factors that has generated the call for health care reform in this country. Our individualistic culture will be forced to flex to allow drastic reforms in the allocation of our resources so that financial gain is not the deciding factor. For example, the decision-making process for transplanting organs should not be driven by which recipient has the most money. It should be based on who has the greatest need balanced by the predictable quality and quantity of life the recipient can expect. In other words, do we transplant a liver into a recipient who is terminal from liver cancer, knowing that the cancer may have already metastasized (spread) to other areas of the body? Or, do we transplant that same liver into a child who was born with biliary atresia (bile duct closure of a normal anatomical opening), bile ducts missing, or malformed which cause the bile to back up into the liver and destroy it? Do we base these life-and-death decisions on the individuals themselves or do we weigh their potential worth to society as a whole? How could such decision making be systematized?

Finally, the increasing complexity of the future is difficult to envision. With the explosion of technology, especially in the areas of information and biotechnology, we will soon be faced with the need to take into account the fundamental complexities of more people with unique points of view. We will, of necessity, be forced to "synthesize more and more *stuff* into less and less time and space" (Chinn, 1991, p. 252). Throughout the world's cultures the unique health care systems (treatment of disease, provisions for health and well-being) will become increasingly complex. The philosophies and healing practices of other cultures no longer will be able to be ignored in the framework of Western medicine.

It will soon be an everyday occurrence to have health care provided by interactive video with the health care provider in a metropolitan health care facility and the patient many miles away in a rural clinic. With the technology we now possess, the health care provider can take the patient's history, discuss his/her chief concerns, and then examine the patient, all without direct physical contact. Beyond that scenario is the potential for dial-a-doc or dial-a-nurse health care where a person actually can call a computer and receive a diagnosis and options for treatment including the outcome-based statistics on which treatment is the best.

Slowly Changing Areas in Health Care

If society looks into the future of the impact of technology on the health care system, it will find areas that will probably not change significantly in the very early 21st century. First, if society is fortunate, human touch and contact will continue to remain important in the health care provider/patient relationship. As Peck (1992) states, "...our society as a whole is increasingly emphasizing touch and other forms of personal therapy" (p. 189). Cooper (1993) found that research done in ICUs identified the importance of caring where..."the nurse blends technological competence with moral experiences and moral principles" (p. 24). The more high-tech our society becomes, the more need humans will have for high-touch to remind us of our humanity and offset the sometimes cold reality of a technological culture. In spite of how technological health care becomes, the need for human touch, caring, and warmth are still there.

Second, it can be anticipated that the world's health care systems will continue to be patriarchal in nature. Additionally, the male-oriented interventionist practices of the present are likely to persist over the more management-oriented and high-touch female-oriented characteristics. These characteristics have become the standard all health care providers are to be measured against. Even as the ranks of the world's female physicians swell, medicine is still viewed as a patriarchal dominant profession because the type of work done (the technologies used) by a physician is perceived essentially as male. According to Cooper (1993), "...dominant values reflect a masculine perspective and are promoted at the expense of the traditional feminine values of subjectivity, engagement, relationship, and care" (p. 23). In addition, "Medicine has been able to convince society that it holds unique qualifications, exclusive competence and undoubted efficacy in matters concerning health and disease" (Kottow, 1992, p. 18). These are strongholds that the health care system currently is working to diminish in order to pave the way for effective reform. Certainly, it is time for interdisciplinary or even transdisciplinary team approaches to attain equal footing with traditional medicine's approach to health care. Society is ready and health care reform is driving the process.

Consequences of Technological Dependency

Even as health care and technological developments are in full swing, Engelking (1994) reminds us of the potential consequences of dependency on technology. They are:

- development of *technogenic syndromes* where there are [undesirable]...side effects of high-tech interventions (such as the lack of human contact);
- anatomization of the body (tissues and organs becoming replaceable, marketable commodities);
- de-skilling of health care professionals resulting from replacement of human capabilities with technology;
- technologic subjugation (limitation of choice and informed consent for use of technology resulting from a perceived mandate to choose available high-tech approaches);

- creation of an illusion of certainty in the presence of expanding uncertainty, coupled with increases in the volume of machine-generated data and risk for error in person-generated data interpretation;
- increase versus decrease in labor complexity and intensity (increases in needed machine maintenance and repair, and in nursing instruction necessary for users to gain proficiency with complex equipment/devices); and
- masking of social problems (deflecting focus away from needed health and social reforms with emphasis on development and use of high-tech equipment and devices).

While we cannot ignore developing complex technology in the health care system of the future, we must realize that the tools of that technology will be used very differently and these tools will need to be tested for cost-effectiveness prior to use. No longer will our technological wonders be used simply because we have them and we can use them. Rationing health care technologies in order to achieve substantial savings for consumers and insurance companies is the future of health care. The health care system of the future will seek to weave together the dual paradigms of health care used throughout the world. There will be a place for medicine, an improved health care system using various types of health care providers working together in interdisciplinary team concepts, and a place for contact with the patient in a more human manner no matter how high-tech society becomes.

REFERENCES

Abrams, H. L., & McNeil, B. J. (1978). Computed tomography: Cost and efficacy implications. *American Journal of Roentgenology, 131*, 81-87.

Ambrose, J. (1973). Computerized transverse axial scanning (tomography). II. Clinical applications. *British Journal of Radiology, 46*, 1023-1047.

Ameisen, J .C. (1994). Programmed cell death (apoptosis) and cell survival regulation: Relevance to AIDS and cancer. *AIDS, 8*, 1197-1213.

Aukerman, G. F. (1991). Access to health care for the uninsured, the perspective of the American Academy of Family Physicians. *Journal of the American Medical Association, 265*, 2856-2858.

Baker, G. E., Grussing, P. G., & Stewart, J. E. (1992, February). Pharmacist work activity before and after pharmacy department computerization. *American Journal of Hospital Pharmacy, 49*, 382-386.

Begley, S. (1994, March 28). The end of antibiotics. *Newsweek.*

Benabid, A. L., Lavalee, S., Hoffmann, D., Cinquin, P., Demongeot, J., & Danel, F. (1992). Potential use of robots in endoscopic neurosurgery. *Acta Neurochirurgica - Supplementum, 54*, 93-97.

Chinn, P. (1991). Looking into the crystal ball: Positioning ourselves for the year 2000. *Nursing Outlook, 39*(6), 251-256.

Coile, R. C. Jr., (1994). 21st-Century health care: Trends and technology. *Biomedical instrumentation & technology, 28*(5), 355-361.

Cooper, M. C. (1993). The intersection of technology and care in the ICU. *Advances in Nursing Science, 15*(3), 23-32.

Crooks, L. E., Ortendahl, D. A., Kaufman, L., Hoenninger, J., Arakawa, M., Watts, J., Cannon, C. R., Brant-Zawadski, M., Davis, P. L., & Marqulis, A. R. (1983). Clinical efficiency of nuclear magnetic resonance imaging. *Radiology, 146*, 123-128.

Daft, R. L. (1988). *Organization theory and design*, West Publishing Co., St. Paul, Minnesota.

Daniels, N. (1994). The articulation of values and principles involved in health care reform. *The Journal of Medicine and Philosophy*, *19*, 425-433.

Dougherty, C. J. (1992). Ethical values at stake in health care reform. *Journal of American Medical Association*, *268*(17), 2409-2412.

Engelking, C. (1994). New approaches: Innovations in cancer prevention, diagnosis, treatment, and support. *Oncology Nursing Forum*, *21*(1), 62-71.

Engle, L. W. (1993). The Human Genome Project. History, goals, and progress to date. *Archives of Pathology and Laboratory Medicine*, *117*, 459-465.

Fox, B. (1995, Winter). Carle comments. *Medical update,* 4-6.

Gremy, F., & Degoulet, P. (1993). Assessment of health information technology: Which questions for which systems? Proposal for a taxonomy. *Medical Informatics, 18*(3), 185-193.

Grimes, D. A. (1993). Technology follies, the uncritical acceptance of medical innovation. *Journal of American Medical Association*, *269*(23), 3030-3033.

Hawley, M. S., Cudd, P. A., Wells, J. H., Wilson, A. J., & Judd, P. L. (1992). Wheelchair-mounted integrated control systems for multiply handicapped people. *Journal of Biomedical Engineering, 14*(3), 193-198.

Hounsfield, H., Bose, D., & Kirkham, M. (1991). Computerized transverse axial scanning (tomography). I. Description of system. *British Journal of Radiology, 46*, 1016-1022.

Inglis, B. (1965). *A history of medicine*. New York, NY: The World Publishing Company.

Ishizuka, H., Horiguchi, M., Waki, Y., Maeda, M., & Ishikura, C. (1991). Computerized dispensing system: Reducing the time of dispensing medicines. *International Journal of Bio-Medical computing, 28*(1-2), 137-146.

Jecker, N. S., & Meslin, E. M. (1994). United States and Canadian approaches to justice in health care: A comparative analysis of health care systems and values. *Theoretical Medicine, 15*, 181-200.

Jones, W. H. S. (1931). Translation of Hippocrates, Regimen in Health (I). In Works, IV. Cambridge, MA: Harvard University Press, Quoted in Wear, A. (1993).

Kasprzyk, S. F. (1980). Technology: A socio-historical perspective, in H. A. Anderson & M. J. Bensen (Eds.), *Technology and society: Interfaces with industrial arts*, American Council on Industrial Arts Teacher Education, McKnight Publishing Co., Bloomington, Illinois, 19-42.

Kottow, M. H. (1992). Classical medicine vs. alternative medical practices. *Journal of Medical Ethics, 18*, 18-22.

Lamm, R. D. (1991). The brave new world of health care. *Annals of Thoracic Surgery, 52*, 369-384.

Lee, P. R., Soffel, D., & Luft, H. S. (1992, November). Costs and coverage, pressures toward health care reform. *Western Journal of Medicine, 157*, 576-583.

Levit, K. R., Lazenby, H. C., Letsch, S. W., & Cowan, C. A. (1991). National health care spending 1989. *Health Affairs, 10*, 117-130.

Moser Jr, R. (1993, November). Quality management in occupational and environmental health programs. *Journal of Occupational Medicine, 35*(11), 1103-1105.

Nunn, A. J., Biryahwaho, B., Downing, R. G., Ojwija, A., & Mulder, D. W. (1994, May). Computer-assisted quality assurance in an HIV serology laboratory. *Methods of Information in Medicine, 33*(2), 170-173.

Peck, M. L. (1992, June). The future of nursing in a technological age. *Journal of Holistic Nursing, 10*(2), 183-191.

Perry, S., & Marx, E. S. (1992). What technologies for health care in developing countries? *World Health Forum, 13*, 356-362.

Porter, D. (1993). Public health. In. Bynum, W. F., and Porter, R. (Eds). *Companion encyclopedia of the history of medicine*, 2, 1231-1261. New York: Routledge.

Priester, R. (1992). A values framework for health system reform. *Health Affairs, 11*(1), 84-107.

Relman, A. S. (1980). The new medical-industrial complex. *New England Journal of Medicine, 303*, 963-970.

Relman, A. S. (1991). Shattuck Lecture—the health care industry: Where is it taking us? *New England Journal of Medicine, 325*, 854-859.

Rodney, W. M., (1991). High tech is most effective when blended with high touch and vice versa: Office technology in the 21st century. *Family Practice Research Journal, 11*(3), 235-238.

Rossiter, B. J., & Caskey, C. T. (1993). The Human Genome Project. *Clinical Obstetrics and Gynecology, 36*, 466-475.

Savage, E. N., Rossner, A. G., & Finke, G. D. (1993). *Bio-related technology.* Albany, New York: Delmar.

Schichl, K., & Affeld, K. (1993). A computer controlled versatile pulse duplicator for precision testing of artificial heart valves. *The International Journal of Artificial Organs, 16*(10), 722-728.

Sheedy, P. F., II, Stephens, D. H., Hattery, R. R., Muhm, J. R., & Hartman, G. W. (1976). Computed tomography of the body. Initial clinical trial with the EMI prototype. *American Journal of Roentgenology, 127*, 23-51.

Shulkin, D. J., & Fink, P. J. (1993, June). Establishing criteria for evaluating health system reform proposals. *Pennsylvania Medicine, 96*(6), 32-34.

Tauber, A. I., & Sarker, S. (1993). The ideology of the Human Genome Project. *Journal of the Royal Society of Medicine, 86*, 537-540.

Wear, A. (1993). The history of personal hygiene. In: Bynum, W.F., and Porter, R. (Eds). *Companion Encyclopedia of the History of Medicine, 2*, 1283-1308. New York: Routledge.

Websters II New Riverside University Dictionary (1988). The Riverside Publishing Co.

Whiteside, M. F. (1993). Part II: Advances in educational technology: IVD, CD-I, and journeys into cyberspace. *Journal of Allied Health, 22*(2), 205-212.

Yarborough III, C. (1993). System for quality management. *Journal of Occupational Medicine, 35*(11), 1096-1100.

Yeager, T. B., Nickerson, D. A., & Hood, L. E. (1991). The Human Genome Project: creating an infrastructure for biology and medicine. *Trends in Biochemical Science, 16*, 454-458.

DISCUSSION QUESTIONS

1. Historically medicine has maintained its primary premise of interventionism. With the proliferation of data on the ability to prevent some disease entities, should the focus of medicine turn primarily to prevention?
2. Will the technological advances of virtual reality and interactive video experiences replace the relationship between the health care provider and the patient?
3. As the health care system of the 21st century evolves, will the increasingly high-tech environment be able to meet the social and cultural needs of the health care consumer? Or will there be an even larger percentage of health care consumers seeking relief from practitioners of alternative therapies?
4. The ability to provide high-tech health care to the American consumer raises ethical questions as yet unaddressed. Should everyone with a failing organ expect to receive a healthy transplanted organ or should those patients whose life expectancy is limited by other factors (i.e., cancer) be denied transplant surgery?
5. As greater strides are made into the mapping of the human chromosome, should every fetus be tested by amniocentesis for possible genetic defects?
6. With the current scarcity of financial resources, and the activity occurring in health care reform, does new technology developed for health care providers and recipients need to be tested for cost-effectiveness prior to implementation? Are studies needed which will evaluate this concept?
7. What will drive technology in health care in the future—will it be the managed care companies, health care providers, consumers of health care or all of these? Who should control the financial "purse strings" of the health care industry and how will this affect the quality of care consumers receive?

8. Should population density be a primary factor in deciding whether to purchase high-tech diagnostic equipment?
9. Given the American value of only the best quality of health care as an acceptable standard, should an octogenarian in terminal kidney diseases be kept alive? How much use of high-tech equipment is too much? Who decides when to stop?
10. What can be done to lessen the impact of lawsuits on health costs?

DISCUSSION SCENARIO

Tough Decisions #1: Who Gets the Transplant?

Your father is 59 years old. He has a history of substance abuse involving alcohol which severely damaged his liver. He now has been hospitalized with severe abdominal pain and the doctor has just explained to you that he is in early liver failure due to incurable cancer of the liver. At this point none of the diagnostic x-rays show a spread of the cancer to other areas of the body. The physician informs you that this does not mean that the cancer has not spread, only that the tests performed have not been able to identify metastatic lesions. You ask about organ transplantation and the physician explains that it is not customary to consider transplantation when a terminal cancer is found because there is no way of knowing how fast the primary lesion has seeded to other parts of the body.

You tell the physician that money is no object and that your father is a nationally-recognized personality. You feel that because you can afford this potentially lifesaving intervention your father should receive the next available liver. The physician refers you to the local transplant nurse who explains that there is a nationwide list of people waiting for available organs. The nurse again explains that terminal cancer is not a qualification for transplantation. You become insistent on receiving a liver for your father as soon as one is available. A liver becomes available in approximately one week; it is a tissue match for both your father and a child born with nonfunctioning bile ducts. Who do you feel should receive this liver?

Tough Decisions #2: To Give Hope or Tell the Truth?

You are a urologist who specializes in prostate cancer. A patient is diagnosed with advanced prostate cancer which has begun to spread. Since this cancer does not respond to available chemotherapy or radiation treatment, and the spread of cancer makes surgery hopeless, you know that the man has, at most, about six months to live. If he goes to an oncologist (cancer specialist) he may be given chemotherapy or radiation treatment although research has shown that these treatments are ineffectual and simply give false hope. What do you tell your patient? Do you try to give him hope or do you tell him the truth? Do you prescribe medication that you know won't do any good?

Tough Decisions #3: Cause of Death

You are a general practice doctor whose patient is slowly dying of Lou Gerigh's disease (ALS), a debilitating disease that attacks the nervous system resulting in degeneration of muscle tissue. Since there is no known cure for this disease, the patient can expect to spend years confined to a bed as paralysis spreads throughout the body. He is in an advanced stage of the disease and has no hope of recovery. His wife calls your house on a Sunday afternoon and asks if you will be home later in the day. She calls back in three hours and says, "He's gone. Would you come over to confirm the cause of death?" What do you write on the death certificate: suicide (which it was) or Lou Gehrig's disease? Does it make a difference what you write? What about life insurance policies? Did his act increase or decrease health costs? As a doctor, is your primary goal to keep people alive as long as possible?

CHAPTER 9

Technology—Social and Interpersonal Interaction

Jean Lichty Hendricks

Technology, unquestionably present in Western social and personal existence, stimulates a merry-go-round of ever-spinning issues. How technology benefits or hinders human life, whether or not technology offers salvation for humanity's ills, and why people respond as they do to certain inventions only begin to illustrate unending questions of technology's usefulness to the human endeavor. From the simple pleasures of play, to the complex capabilities of mass communication, technology influences, in a significant way, countless aspects of relationships between individuals and between groups of diverse people.

Humans not only create their world; they analyze it. Standing on the late 20th century doorway to the *Information Age*, manufacturers and concerned citizens, educators and computer whiz-kids, television preachers and cyber-thiefs, individuals of every sort have influenced, and are influenced by, this technological enterprise. Will the merits outweigh the obstacles? Will humans resolve the ethical issues that advanced technology brings? Will Western society continue its apparent course of corruption (according to some philosophers) or will humans find increasing measures of peace and order in everyday life?

This chapter begins with a broad definition of terms, including the use of the word *technology* and its accompanying variations, as well as the definition of *social structure* and what it means to be human. The chapter continues with a look at how technology affects interpersonal and inter-social relationships within several broad areas of everyday living, including communication, transportation, and entertainment. Finally, some questions are raised and addressed regarding two primary issues in the interface between technology and human endeavors: How does gender bias influence technology and subsequent discussion about technology? And what ethical or religious issues prompted by technological advances can society expect to deal with in the future?

As used in this chapter, technology is a word of multiple meanings and is a concept that affects all people. For one, technology is a human enterprise, a process created by humanity, a process that is inherent to, not separate from, the condition of human beings. "To be human is, among other things, to be technological" (Carothers et al., 1972, p. 19). In other words, technology cannot be isolated from the human environment out of which technology is born. *People* invent; individuals create; artists draw, and engineers design. Throughout history, humanity's creative genius has prompted new ways of dealing with life, from the invention of the cotton gin to the advent of the computer, from the development of wireless communication systems to the production of laser discs.

Technology also refers to artifact or object, one of the inventions or creations, designed and built by human ingenuity. Typically, these items, such as computers, video equipment, or cellular telephones represent technology as something *other*, as *out there*, as intruders upon human values that were created prior to and apart from what is termed modern technology. Too often, critics of the modern world think of technology solely as the aforementioned machines and equipment, rather than as any kind of interplay or approach to life. These inanimate products or machines of technological ingenuity (telephones, artificial limbs, supersonic jets, etc.) represent specific examples of the meaning of technology in popular parlance. Other technological examples of objective *things* that now highly influence human life include nuclear power, biotechnology, mass transportation, and instantaneous communication. Countless, varied, specific devices illustrate the common label for those advances, changes, additions, and pieces of human existence that we call technology.

Arnold Pacey (1983) suggests that technology be defined also in ways analogous to medicine, in that technology *practice* be the concept for which we find meaning. In his words, "technology-practice is thus the application of scientific and other knowledge to practical tasks by ordered systems that involve people and organizations, living things and machines" (p. 6). Those "practical tasks . . . that involve people" have become so commonplace they are rarely questioned: individuals and groups use the scientific knowledge of the telephone many times daily; the presence of automobiles counted in billions is an assumed fact of Western life; just as the television antenna once symbolized the common status of families rich and poor, in the near future, household computers will typify more than just middle-class life.

Another terse definition of technology is similar to Pacey's. "Technology is the interplay of machines, equipment, tools, skills, and procedures for carrying out tasks" (Kammeyer, 1990, p. 90). Thus, technology as used in this chapter can mean object, a creative human process, or an elaborate system so imbedded in everyday life that most people simply accept its *practice.*

Standing *with* technology, as its creators and consumers, are the multitude of individuals and groups who interact in ways that form the structure of society.

> The human experience is the experience of persons in community . . . . A person is, from the beginning, a life related to others . . . . The cosmos, the biological process and culture are different because of the acts and purposes of persons in community. (Carothers et al., 1972, p. 24)

Humans do not act alone; rather, they behave within a much larger design that we commonly term community, or society, or group. Various groups in 20th century North American society, including the family, political parties, educational institutions, or religious sects have made, and will continue to make, decisions that affect their welfare. Today, any one group interacts with another in ways that are influenced by technology. For example, national elections between major political parties would appear far different in the absence of the powerful, image-making influence of the technological media. On a more personal level, advancements made through technology that prolong longevity inevitably create division between the wealthy and the dispossessed, between those who have ready access to health facilities and those who do not, between middle-age children who are caring for aging parents and the parents whose life is consuming many resources. The *Golden Age of High Technology* (Steffen, 1993) is by no means a panacea for divisions and disenchantment that appear to be inherent to human existence.

While individuals indeed participate in community, every person also approaches life from a specific framework that is both socially conditioned and biologically determined. That is, a person views the world through the glasses of being female or male; being Caucasian, African, or from another race; being Christian, Muslim, Buddhist, or agnostic; being a member of the wealthiest or the poorest segment of society. Who we are largely influences how we choose to face our modern environment, including the humanly-created technological environment. These various views raise important questions. Are women more attuned to the issues of reproductive technology than are men? Do both the wealthy and the poor assume that the former will have quicker, easier access to modern technological conveniences? Do certain items created through technology, such as musical instruments and amplifiers, become *status symbols* for those who have little? It may be said that interpersonal and intergroup relationships both *affect* technology, and are influenced themselves by the technological process.

Few would question the premise that technology indeed leads to change. Kammeyer, Ritzer, and Yetman (1990) name three ways in which technology provokes change: "by creating social problems that require people's action . . . by increasing our alternatives . . . by altering interaction patterns" (p. 645). These sociologists cite the example of how a robot placed in a factory noticeably altered the workplace:

> The joking and bantering of pre-robot days were gone. As one worker put it, "I don't have time to talk with anyone. I don't want them breaking my concentration." The robot changed interaction patterns in the factory. (p. 645)

Although technological innovations do not *require* change in patterns of interaction, they provide people with options to do so (Kammeyer, 1990).

The precise relationship between technology and interpersonal interaction, present in glaring and obvious ways or in covert, subtle modes, cannot be easily categorized and labeled. That is, it would be difficult to *prove* direct cause and effect motifs or complicated configurations of how individuals and their technological environment interact. However, the human yearning toward technology may adversely affect the human ability to deal with life itself. Thomas Moore (1992) states the issue in these words:

> . . . we have amazingly efficient cars, but marriage is becoming impossible to sustain. We produce movies and television programs without end, but we have little imagination about living in a peaceful international community. We have many instruments for medicine, but we don't understand except in the most rudimentary ways the relationship between life and disease. (pp. 283-284)

This chapter attempts to describe and to represent some of the patterns between individuals and groups that today seem apparent because modern humans have created a myriad of technological wonders as part of their lives.

Major fields of technological *advancement* or change that affect human interaction today include communication technologies, transportation systems, entertainment trends, and reproductive technology. In fact, changes within these areas likely seem obvious to contemporary readers (who are also contemporary users of technology). This chapter explores *some* dynamics of how individuals and groups relate to one another, vis-a-vis these broad categories, with the following caveat: advances in technology, and subsequent potential changes in human behavior, are likely to occur much more rapidly than the final production of this book. This is the nature of technological and social change!

Communication and Interpersonal Interaction

The proverbial phrase of *mixed blessing*, or ambiguous feelings undergird the framework of approaching how modern communication technology affects individuals and their relationships with one another. For every advantage that computers, telephones, fax machines, and electronic mail bring, they also raise questions related to human interaction. With the advent of increasingly faster communication systems and devices, a communicator asks whether or not speed necessarily enhances interpersonal communication. For every convenience that modern communication modes afford, an obstruction or invasion of privacy may also occur. This chapter offers a brief look at several aspects of communication's enigmatic nature as it touches upon social interaction.

First, computers, telephones, faxes, electronic mail, and any other newly-developed modes of communicating literally place the world at a person's fingertips. For North Americans, whose native language is English, the global economy is even more available and accessible because English has truly become the international language (Naisbitt & Aburdene, 1990). Hence, from an optimistic perspective, contemporary ways of communicating have made interaction *at some level* possible for people who would otherwise have little chance of *speakin*g with one another. That is, business leaders in the United States easily converse, via electronic methods, with their colleagues a continent away. Individuals interact in making decisions that potentially affect the global economy. The *information superhighway*, through electronic mail and bulletin boards, provides an easy link between parties with similar interests from around the world. Corporate leaders may take advantage of the electronic network to tap into less expensive labor markets or to sponsor teleconferences for employees. Consumers may use these electronic systems to do their banking, shopping, and socializing. Such a communication infrastructure has far-reaching advantages for people to interact with other individuals and groups in ways that were not previously imagined.

Conversely, the information superhighway serves as yet another barrier between the *haves* and *have-nots*, between those middle- or upper-class citizens who are able to afford computers (and the time to operate them) and the ones whose lives offer no hope beyond daily survival. Already-existing gaps in economics and education may grow even larger. Thus, the growth of technology raises serious equity issues.

One positive aspect of increased communication technology is the option it has raised of potentially reducing or eliminating prejudicial barriers between diverse groups. If small and large companies have equal access to information, if messages can be sent as easily to one part of the world as to another, and if machines can translate foreign languages of one group into words others can comprehend, then the possibility exists that diverse associations can interact more equally on the proverbial *level playing field.*

However, at the same time that increased communication systems enhance the capabilities for interaction, they also potentially have a negative impact on society. Howard Didsbury (1994) raises a caution related to the blend of computers and other communication technologies (or what he calls *telepower*).

> The enthusiasm and excitement associated with the advent and expansion of telepower calls forth a restatement of serious reservations about the unalloyed benefits of the latest and continuing—advances. (p. 22)

One of those reservations, according to Didsbury, includes the tendency “to have ‘things’ replace human beings and human contact” (p. 23).

Reduced human contact, or increased unemployment, is certain to have grave repercussions on human beings who need and require human interaction. Again, futurist Didsbury (1994) offers a word of caution.

> It is conceivable that one of the causes of many mental health problems in a high-tech society stems from the stresses and strains of its sheer artificiality, its foreignness to living as a human being in some communion with nature. (p. 23)

Assuming that human creatures *require* touch and other tangible contact with their fellow humans, consistent interaction with high-tech communication has the capacity to destroy that which is vital between people.

As one small example, consider the story of a young woman who *interacted* with hundreds of others by way of her computer and electronic mail. On the screen, she was a vibrant personality; her words spoke clearly; she participated in conversations and interactions with both women and men. By reading the electronic system, she would have been considered to be a successful, pert, knowledgeable, and likable individual. At her unexpected and untimely death, these computer companions and *associates* reportedly came en masse to her funeral. However, not even *one* neighbor knew the woman enough to pay respect at her death. In this case, social interaction via electronic means sadly did replace touch and eye-to-eye contact with other humans.

Another common form of communication today, the telephone, has been available for over one hundred years. Few would question its merits or its common presence in North American households. However, this helpful, step-saving device also affects the manner and frequency with which individuals relate to one another. While telephone contact across the miles certainly provides voice reproduction and apparent proximity, such voice connection alone does not always provide the necessary or most desirable human contact. So whereas praise is due to *phone-in* suicide prevention centers, would the world not be more humane if every depressed person had another human being available for touch and consolation? Is it possible that technology, in this case, actually serves to filter out a critical aspect of what it means to be human (i.e., direct, physical human contact).

Thus while telephones provide for convenient access to others; they also may prevent direct interaction between individuals who otherwise might be talking personally to one another. The average amount of daily eye contact between immediate family members, per day, is already minuscule. For example, within the ordinary, busy, middle-class, United States household, friends, acquaintances, and business colleagues all make contact with a family who might otherwise be talking face-to-face with each other. However, telephone usage is another of the ambiguous (partially helpful, partially intrusive) devices created by technology. Calling another for advice or counsel is easily facilitated through the phone and, in fact, may hold great appeal for those who are reluctant to look at and speak directly with other individuals. The telephone appears to have become an important instrument toward socializing young people who have access to phone service. As any parent of a young person knows, this type of intensive social interaction can also be tremendously exasperating and has, at least in part, been responsible for the development of additional technology such as call waiting. At the same time, the telephone denies actual interpersonal, face-to-face, bodily contact and socialization that may meet many human needs. So it is clear that the technology has the capability of placing people into contact with each other and it also serves as a filter or barrier to direct human contact.

Without doubt, the telephone invades the privacy of the household. Callers represented on the other line include pushy salespersons making solicitations, mischievous children playing harmless pranks, psychologically unfit individuals promoting obscenity, and random pollsters interested in matters from personal income to brands of underwear. While these types of calls are typically not welcomed, they do remove the person-to-person interaction between caller and respondent, individuals who might otherwise become angry or frustrated with one another. However, telephone calls that intrude upon private space may actually spark interactions among those who are present when someone answers the ringing instrument.

Transportation and Interpersonal Interaction

A second major area for discussion of how technology influences interaction is the topic of modern transportation systems. Indeed, the world has grown, and continues to grow, smaller. Naisbitt and Aburdene (1990) assert that modern transportation promotes a global life-style.

> The jet set has given way to an affluent, traveling middle class of honeymooners, grandmothers, families, students, business people of all nationalities. . . . *Every day three million people fly from one place on the planet to another.* [author's emphasis] (p. 121)

Today's air terminals are compared to yesteryear's bus stations. One-day business or pleasure excursions to major cities happen routinely for some folks. Elaborate subway systems and extensive interstate highways have literally paved the way for mass movement from place to place. Transportation technology has made it possible for more people potentially to be in contact with others and to do so on an international basis.

Henry Ford's automobile, now a machine that most Westerners take for granted, introduced a means of travel that ideally could enhance the availability for individuals to interact with one another. "Over the river and through the woods, to grandmother's house we go . . . ." became a convenient reality. And en route, family and friends, placed together within the confines of a four-door sedan, have the possibility for much conversation, discussion, and animation among themselves. When the great railway submitted to the family car, public interaction bowed to the nuclear family or other, smaller unit. Great treks cross-country could now happen within the mechanized box on wheels, and the inhabitants inside had the *opportunity* for much verbal and nonverbal interaction. Verifying the words of Kammeyer (1990), specific technology of the automobile has offered a tremendous option for maintaining relationships with family and friends.

But to what extent has the proliferation and increased efficiency of transportation modes adversely affected the way individuals now relate to one another? As commuters race to work on high-speed trains or in personal vehicles, they find little incentive or opportunity to interact with others. Grappling with crowded freeways during rush-hour traffic jams would seem to promote much mental stress. It can only be surmised how the pace of daily commuting affects personal desire to do even more driving, or traveling, on nonworking days. Freeway lanes legislated for *carpools only* may have indirectly promoted some interaction among fellow travelers. Hence, while transportation options have vastly increased, those options may or may not serve to enhance interpersonal relationships.

Certain *by-products* of the transportation industry, such as restaurants and lodging establishments, also affect how people relate to each other. The expansion of hotels and motels for world travelers has reduced the necessity of staying with family and friends on overnight excursions. Conversely, the presence of mini-resort hotels, economically available to middle-class families for a weekend getaway, may serve to strengthen the bonds between parents, children, and other relatives. In sum, increased ease of movement via new transportation modes, plus the industries that transportation stimulated, have posed both interpersonal dilemmas and personal benefits for interaction.

Entertainment and Interpersonal Interaction

In addition to the categories of transportation and communication, another contemporary technology field that motivates varying kinds of interaction among individuals is the huge entertainment industry. From television to electronic games, from talking pictures to three-dimensional movies, high-tech leisure time activities are now a major factor in a society that once enjoyed Monopoly®, Scrabble®, and a deck of playing cards. Today, youngsters spend hours riveted to their electronic games playing opponents who only exist in cyberspace. Entire families challenge one another to fierce technical contests of who can down the most airplanes. Computer-generated chess games can be played across national boundaries. Giant movie screens that encompass and truly *involve* moviegoers will soon become a reality. Unquestionably, because of technological expertise, entertainment and leisure-time activities in the late 20th century will be drastically different from previous eras.

Technology in entertainment has motivated several new life-style patterns. For one, individuals are increasingly becoming even bigger spectators, as opposed to participants. The proliferation of movies and video equipment means more is available to *watch*, and more opportunities abound for watching. A closely-related by-product of the huge video industry is the general privatization of America's movie-going public. Modern technology makes it easier for people to be entertained at home, rather than in the public space.

Another change motivated by computer-induced game playing appears to be an increase in individual, independent entertainment of self, as opposed to group interaction necessary for more traditional *games*, that required at least one partner, if not a small group. In today's world, children can conceivably entertain themselves for many hours, with no need for interaction with any other human. Consequently, whatever social skills people may have learned at one time through playing games around the family table, skills such as how to be a gracious *loser* or how to win without gloating, are not as keenly practiced today. One final suggestion of how technical entertainment has changed life patterns is the notion that intergenerational activities are no longer as common as they once were. That is, those who do not feel confident with *computer-literate* games or with high dexterity technical game controls will not be inclined to interact with a generation whose consciousness is *only* familiar with entertainment via technology. Recreation and amusement patterns of the 21st century do not appear to encourage the goal of bringing humans into face-to-face contact with each other. Consider the major entertainment function that visiting with family and friends played before the invention of television and other, more individualized forms of entertainment. In some countries, group sports continue to play a major role in the socialization and entertainment of the citizenry. It is clear that technology has played a rather major role in rearranging the ways in which entertainment occurs and how people connect with one another in their entertainment activities.

One newly emerging development in technology is the process called *virtual reality*, often included as part of our nation's entertainment opportunities. This computer/video technology enables users to interact with an imaginary three-dimensional world and thus simulate participation in *real* events. The participatory process becomes more and more fine-tuned. Virtual reality, another of the unique technological creations fashioned by humans, for humans, has vast potential to benefit, as well as to confuse its creators.

Technology enthusiasts extol the potential uses of virtual reality for applications *outside* of entertainment. With the assistance of virtual reality, robots are now being trained to act as *battlefield surgeons*, conducting procedures such as that of controlling emergency bleeding. Airplane pilots can gain valuable training, while practice remains in the virtual reality room, rather than on the runway. Virtual reality has positive uses in vehicle design and structure. In simulations of the future, racquetball players will be able to experience the sport without ever setting foot in a court. Individuals may use specially designed programs to enjoy a romantic and passionate evening with a computer-generated partner. The entertainment and leisure-time industries will *continue* to produce inventive games and activities that count on the enjoyment created by virtual reality techniques.

However, will applications such as these have undesirable outcomes as well? Do we live in a society that *wishes* to promote the substitute, rather than what is real? For example, if one becomes emotionally *intimate* with and personally dependent on a computer, rather than with another human being, is that individual emotionally healthy? If virtual reality privatizes game playing and other forms of entertainment, what happens to the concept of teamwork? Indeed, it is imperative to question whether or not *virtual* reality will replace *reality* in tomorrow's world.

Gender Bias and Technology

Having briefly addressed the question of how individuals and groups relate to one another within three specific areas of rapidly changing technology, the discussion now turns to a related question: What role, if any, does gender play regarding interpersonal interaction and technology? In the late 20th century, as in all previous epochs, women and men together live in a given society, and they relate to each other, representing two different genders of the same human species. While this chapter cannot detail the entire history of male/female relationships, the author here asserts that technology, in past and present forms, is inextricably bound to how women and men relate to one another. Conversely, the relationship between men and women influences and affects technology. As individuals have carried out various tasks of daily life, they have used tools, skills, resources, and machines that are the substance of technology. Typically, men and women have done *different* tasks, or operated in *separate spheres* to the extent that gender role stereotypes developed around who performs what tasks. In brief, by the late 19th century, North American men functioned in the public arena, conducting business, running the government, and earning wages for work, while (caucasian middle-class) women were expected to manage the household, raise the children, care for the indigent, and be concerned about the spiritual life.

As technology practices and processes gradually made aspects of life more convenient, those gender-biased stereotypes nonetheless remained. That is, the proliferation of mass transportation meant that men had a quicker way to travel in business affairs. Similarly, as inventors created so-called household labor-saving devices, women managing home affairs were the ones to use them. Ruth Schwartz Cowan (1983) concludes that expectations for men's and women's roles did not necessarily change with the advent of machines and tools.

The technological systems that presently dominate our households were built on the assumption that a full-time housewife would be operating them, since very few people in the last one hundred years (when the foundations for these systems were being laid) wanted adult women to leave their homes in order to work in the labor market, or believed that adult women themselves would ever want to go out to work (Cowan, 1983).

Although labor-saving devices, such as microwaves and automatic washing machines, have dramatically changed the way household tasks are performed, *women* were still expected to perform those chores, at least when such machines were invented. In addition, although convenient appliances eased the burden of housework, standards for cleanliness and childcare within the American middle class rose dramatically between 1920 and 1960, "leaving women with more work rather than less" (Lupton, 1993, p. 15). With women entering the sphere of work outside the home, men have gradually entered the home circles. Consequently household division of labor has become a more complex issue. According to Cowan (1983), however, society today needs a change in attitude, not a change in technology.

> We can best solve the problems that beset many working wives and their families not by returning to the way things used to be . . . , not by destroying the technological systems that have provided many benefits . . . , and not by calling for the death of the family as a social institution . . . —but by helping the next generation (and ourselves) to neutralize both the sexual connotation of washing machines and vacuum cleaners and the senseless tyranny of spotless shirts and immaculate floors. (p. 216)

Technology, in and of itself, does not inherently help or hinder interpersonal relationships. Both males and females, as young boys and girls, need to learn that household management tasks or highway construction jobs are not necessarily gender-related. When gender stereotypes are eliminated, then all humans may make more appropriate use of technological tools and processes.

A topic that is more covert and potentially more complex than household conveniences is the issue of how women have interacted with men and how women have *altered* the professional fields from which much modern technology is fashioned. For example, when the once male-dominated role of secretary changed dramatically to being a female occupation, the role of secretary became devalued. As women steadily enter white-collar roles once totally performed by men, they may bring a changing set of values. In addition, it is now common awareness that women's presence in the previously all-male workplace has brought a threat to men's economic livelihood. The high visibility cases of Clarence Thomas (U.S. Supreme Court) and Robert Packwood (U.S. Senate) have done much to increase the awareness of sexual harassment in the workplace. Practices that were commonplace not too many years ago, which fortified and reflected the dominance of men over women in the workplace are now being reexamined.

Arnold Pacey (1983), among others, notes that women already have contributed much to contemporary technology. However, their contributions have not always been widely recognized or highly valued.

> Women in their traditional roles and craftsmen with their social obligations always had to show their creativity in less egotistical ways; and their achievements are given rather limited recognition because, in technical and artistic terms, they were restrained in their originality by responsibility. (p. 110)

In current decades, historians and other scholars are reevaluating women's contributions in all areas of life, including those areas that we call technology.

One specific technological focus that impacts women's lives as well as the relationship between men and women and between social groups is reproductive technology. Prior to the late 19th century, the presence of well-educated doctors, midwives and female friends controlled the private female biological processes of pregnancy, delivering babies and aborting fetuses. Historically, men have controlled the world of technological advances, even if these biomedical feats centered on women's bodies. Stated succinctly, controversy among individuals and groups surrounds practically every aspect of reproductive and related biological technology. Stated directly, if men menstruated, technology to reduce menstrual cramping would have been developed decades ago. Similarly, various methods of birth control, primarily for women, depend mostly on men for approval and marketing. Hence, advances in technology have not necessarily served to enhance the relationship between men and women.

Recent and continuing developments in genetic engineering also initiate untried grounds for reflection and behavior within society. As examples, only a few potential questions are mentioned here. What groups or individuals will *allow* the growth and birth of a severely damaged fetus? Does the common use of a *morning after* pill promote promiscuity? When technological expertise fails, whose choice about giving birth is given priority? Men and women together will best address the complex issues of reproductive technology because only together can society meet the challenge of ethical and religious issues that coincide with living in an age of technology.

Ethical and Religious Issues and Technology

In addition to discussion of gender bias, the matter of ethical considerations vis-a-vis technology is critically important. This section only *begins* what must become serious, substantive reflection and conversation. When people interact in a technological environment, what ethical or moral values must they consider? Women and men who live in today's high-tech age face decisions and moral dilemmas that will require thoughtful deliberation and human interaction toward a healthy solution. In short, technology mandates interpersonal and intergroup interaction around the topic of technology itself.

Introducing a 1970s forum centered on technology and ethics, Melvin Kranzberg (1980) addresses the mandate in these words:

> The question of whether technology determines our actions, whether it is subject to human control, or whether it has become an end in itself inevitably led to a discussion of the role of technology in relation to the moral order. After all, even if technology were regarded autonomous, perhaps that autonomous force has some ethical imperative embodied within it. On the other hand, if technology were viewed as subject to human control and direction, what ethical norms would be applicable in guiding today's highly complex and accelerated technology? In brief, we were face to face with the central issue of the symposium: ethics in an age of pervasive technology. (p. 14)

Some of the issues that will pose potential ethical questions of how people will interact in a world of complex technology are these: public response to information technology, the role of religion in decision-making, access to medical care for the aging population, technological control of the environment, and distance between individuals who are *marginal* to those in powerful positions. These issues, and more, will comprise the moral *agenda* of the future and consequently will require individuals and groups to interact seriously if indeed we are to remain intact on this earth.

One of the ironies in the public's response to information technology, according to Dorothy Nelkin (1994), is the apparent apathy or unwillingness to question and resist the invasion of technology into the private sphere. Many people like technology or, at the very least, seem to feel powerless in checking its advance. In Nelkin's words,

> But aside from occasional professional critiques and some concern about radiation exposure from computer screens, there has been no popular or organized resistance to the remarkable development and diffusion of information technologies. (p. 10)

In addition, Nelkin is astounded that although recent public outcry over tampering with the body is prevalent, similar meddling with the mind prompts little or no hostile reaction. She states:

> The manipulation of the body for therapeutic purposes or the creation of bio-genetic mice for research purposes becomes a serious moral dilemma. While [sic] the mind, it seems, can be sacrificed for the information agenda. (p. 10)

Although virtual reality "confuses fact . . . and fantasy . . . , the imagined and the real" (Nelkin, 1994, p. 10), the public does not seem to care. When, and if, individuals would begin to criticize the control inherent to wide accessibility of information, current apathy and indifference may have already *won*.

However, in the early 1970s, certain religious leaders had begun to acknowledge that rapid technological advancement inherently promotes the need to watch, question, and perhaps even control such *advances*.

> What shall a Christian think and do about these things? It is too early in the computer era to be certain. For now, it would seem that we will serve this generation best if we are sensitive to some issues that our faith, our ethics, our observations and our anticipations of computers seem to raise. We are thrown back to the question of what good for our neighbors is at stake in this technological event. We ask ourselves what promise and threat this event holds for the liberation, justice and reconciliation of persons. (Carothers, 1972, p. 49)

Religious teachings regarding certain technology practices vary. For example, witness the official Roman Catholic church's stance against artificial birth control. Similarly, conservative religious sects have drawn varying lines regarding what appliances, gadgets, and modes of transportation are appropriate for their life-style.

When technology intersects individual belief systems, people of faith and people who deny faith must be in conversation. Scientist Rustum Roy (1981) agrees wholeheartedly:

> Humanity's highest aspirations expressed in its religions and its highest creativity in shaping its own future via science and technology have lost touch with each other. Humankind must indulge in *cultural* [author's emphasis] engineering or it won't survive. It must interbreed religion and technology. (p. 1)

Roy paints a grave picture of our contemporary situation unless leaders of science and leaders of religion learn how to engage in conversation with one another. Important technology-related issues of the future, such as when or how life may be created, or when sick people may die, will provoke lively, even deadly, debate among individuals of varied religious convictions.

Yet a third important issue that will necessitate additional dialogue among people is the state of our world's ecological environment. Will we agree on how to solve crises that are currently arising within the environment? Technology has the capacity to fashion virtually new worlds; humans will need to interact around the design of those worlds. When it is possible to build biospheres and domed sports stadiums, and when technology can help create a smoke-free environment or a simulated sky, humans must unite in common decisions on what to create.

Finally, we must interact around the centuries-old question of who holds power and who remains marginalized to that power. Oscar Gandy (1994) addresses this potential disparity when he compares and contrasts the *Information Superhighway*, which is in the construction process, with the popular and legendary *Yellow Brick Road.* The *wizards* of information dissemination may not be concerned that all consumers are served equally. In fact, Gandy cautions that:

> critical theorists, concerned with issues of class and power, see the Information Age as merely an extension of capitalist influence beyond its traditional industrial base. (p. 26)

Certain individuals whose *profit potential* is lower, Gandy continues, "will be ignored or bypassed as they stand by the highway trying to hitch a ride to the good life" (p. 26). Gandy is skeptical that the information highway can deliver the kind of *teledemocracy* that it promises. Consequently, individuals who exist on society's edges may remain there, not fully participating in the life of Emerald City, or any other city. In short, even though computer terminals of the 21st century may become as commonplace as television screens of the present, such technology in itself is no guarantee that computer users will have their economic needs met any better than they do today.

Conclusion

Technology is a unique human activity. Todd, Todd, and McCrory (1994) have expanded on this relatively simple statement:

> There are many ways in which humans interact with and use resources. Since humans are both the producers and consumers of technology, the human factor is critical in any technological event. Humans have developed tools suited to human dimensions and abilities. (p. 33)

Humanity does not stand apart from technology, and humans do not stand apart from one another in the face of technology. When people in a technological society relate to friends, family, and associates, they bring with them values, insights, prejudices, beliefs, and doubts—just as do the people in what we may term a simpler, developing society. Technology itself does not change people; it offers them more, or less, opportunity to be as human as they wish to be. It is clear that technology can be viewed as tools. Indeed it is one of the more powerful tools in our culture today. But tools do not change people. People, albeit with tools in their hands, change people.

Technological innovations indeed instigate change in our human environment, so the question is not *whether* but *how* we will live with the change. However, simple cause and effect relationships are inadequate responses in describing how technology influences interpersonal dynamics. Perhaps more important, though, than resolving the issues that surround technology and human behavior is exploring the questions that technology initiates. Some of those important, but unanswerable queries include these: Have we tended to idolize the amount and quality of personal interaction *prior* to the current moment of advanced technology? Does technology per se promote *class* and economic divisions among people? Does television deter family interaction, or does it bring families who would otherwise be scattered into closer proximity? Does new and more accurate information necessarily help resolve problems of human interaction? As technology continues to become an ever-increasing part of our human world, human beings will need to be responsible in assessing the merits and disadvantages of that world.

At this juncture, as at any time when rapid change occurs, we must recognize the importance of dialogue and debate around questions prompted by human technology. Communication, transportation, entertainment, the environment, gender roles and stereotypes, mass information, and religion are all part of human life. If we expect to be actively involved in that life, then we need to ask our questions, continue our wonder, and discuss that which may be both fearful and exciting related to technology in our world. Writer Ian G. Barbour (1993) summarizes:

> Complex relationships between groups and nations are present on planet earth, and we face crucial issues of distributive justice and participation in the allocation of scarce resources. . . . Let us imagine technology used in the service of a more just, participatory, and sustainable society on planet earth. (p. 267)

REFERENCES

Barbour, I. G. (1993). *Ethics in an age of technology.* San Francisco: Harper.

Carothers, J., Mead, M., McCracken, D., & Shin, R. (1972). *To love or to perish: The technological crisis and the churches.* New York: Friendship Press.

Cowan, R. S. (1983). *More work for mother.* New York: Basic Books, Inc.

Didsbury, H. F., Jr. (1994). The wolf is here: The impact of telepower. *National Forum, 74*(2), 22-23, 27.

Gandy, O. H. (1994). The information superhighway as the yellow brick road. *National Forum, 74*(2), 24-27.

Kammeyer, K., Ritzer, G., & Yetman, N. (1990). *Sociology: Experiencing changing societies.* Boston: Allyn and Bacon.

Kranzberg. M. (1980). *Ethics in an age of pervasive technology.* Boulder, Colorado: Westview Press.

Lupton, E. (1993). *Mechanical brides: Women and machines from home to office.* New York: Cooper-Hewitt and Princeton Architectural Press.

Moore, T. (1992). *Care of the soul: A guide for cultivating depth and sacredness in everyday life.* New York: Harper-Collins Publishers.

Naisbitt, J., & Aburdene, P. (1990). *Megatrends 2000: Ten new directions for the 1990's.* New York: William Morrow and Company, Inc.

Nelkin, D. (1994). Ironies in the public response to information technology. *National Forum, 74*(2), 7-10.

Pacey, A. (1983). *The culture of technology.* Oxford: Basil Blackwell Publisher.

Roy, R. (1981). *The tragedy of abundance.* Niwot, Colorado: University Press of Colorado.

Steffen, J. (1993). *The tragedy of abundance*. Niwot: University Press of Colorado-Boulder.

Todd, K., Todd, R., & McCrory, D. (1994). (work in progress)

Wenk, E., Jr. (1986). *Tradeoffs: Imperatives of choice in a high-tech world*. Baltimore: Johns Hopkins University Press.

DISCUSSION QUESTIONS

1. What, if any, were the games your parents played when they were children? What are the most common household games/activities that you played as a child? What do you expect your children will be playing as their household pastime? What do these changes in game activities say about how people and generations interact with one another? How has the role of technology changed the type and method of activities that have occurred over the years?
2. Do you agree or disagree with the statement that men have benefited more by technology than have women? Why? Provide some examples to illustrate and support your position.
3. People are increasingly interacting with one another through the use of many different types of communication technologies. Through telecommunications (the World Wide Web, e-mail, etc.) people are having relationships with people they have never met face to face. Is this positive or negative? In what ways is this more intimate and less intimate than direct contact with others?
4. Would you argue that technology has done more to build bridges between people or has technology been used to construct walls? Why? Provide examples to support your position.
5. Would you say that technology has helped to make our culture more homogenous or has it served to preserve cultural diversity? Of course, you could also take the position that technology has had no effect. Give the rationale for your position.
6. Do you agree with the position that technology has served to erode important interpersonal values such as intimacy and privacy and that the entertainment media have tended to make our relationships with one another more superficial and less intense and genuine? Cite examples and support your position.

DISCUSSION SCENARIO

Interactive Education, or Not?

The year is 2010. You are the parent of a school-age child, of *average* intelligence. You may choose to send the child to a school where classrooms and teachers are the norm (as they were in the 1980s and 90s), or you may choose a totally individualized instructional method, that utilizes computers, modems, interactive television, holographics, virtual reality, and satellite relays that allows the child to progress at a quick, independent rate. Which method do you choose? Why?

CHAPTER **10**

Technology, Crime & Civil Liberties

Gene Stephens

Possibly no field is more interactive with technology and social change than the arena of crime and justice. Each new technology or innovation brings new crimes and new crime-combating possibilities. Examples include supersensitive audiovisual equipment used for industrial espionage and police surveillance; computers used to steal from bank accounts and keep track of felons, etc. The societal mood also shifts (lock 'em up, rehabilitate them, intervene early and prevent crime) as do social and political values (ease of crime control in fascist/controlled societies versus enhanced opportunities for crime in democratic/free enterprise societies). For every socially desirable use of modern technology, there is a socially undesirable adaptation. The technology itself has no morality; it is up to policymakers to control the use and cope with the misuse of technology.

In this chapter, the long history of adaptation of technology to commit and fight crime will be reviewed. This will be followed by a discussion of the nature of crime and how technology is only a tool rather than a precipitator of criminal activity. With this stage set, a lengthy discussion of the roles and uses of technology is followed by a review of legal cases challenging high-tech crime fighting—some chastising offender or enforcer, others upholding the police usage or even citizen utility of the technology. Finally, in a section titled Connections, the future of technology, crime, and civil liberties is examined, with emphasis on ways to use technology within a humanized framework so citizens can be better protected from the criminal element without being forced to live in a police state.

Background

Much of the technology used by criminals and criminal justice officials was first developed to enhance a kingdom/nation's position in warfare—from catapults to battering rams, guns to bombs, helicopters to satellites. Thus, for centuries, the main source of criminal justice technology was transfer from the military (Mathias, Rescorla, and Stephens, 1980). Guns used by soldiers were also used by offenders to rob and kill, and by posse members to bring offenders to justice; helicopters moved from Asian battlefields to American streets, as did low-light level surveillance and battlefield/crowd control tear gas and mace. New high-powered automatic weapons, developed to cope with an unseen enemy in jungle warfare, became the basis for police Special Weapons and Tactics (SWAT) squads and, unfortunately, as the weapons of choice of urban gang members and drug dealers.

By the late 1960s, however, police, courts, and corrections agencies had their own source of funds for developing and deploying technology—money provided under the Omnibus Crime Control and Safe Streets Act of 1968 (Mathias, Rescorla, and Stephens, 1980). Entrepreneurs and high-tech firms scrambled to get their share of the pie and, by the mid 1970s, innovations ranged from lightweight body armor and electrified dart guns (tasars) to micro *bugs* for eavesdropping and *modus operandi* file storage and retrieval.

Some of the most important innovations of the 20th Century include:

1. Fingerprinting: Beginning in 1924 the fingerprints of suspects and convicted felons were placed on file to be compared with prints left at crime scenes, coordinated through the Justice Department in Washington, DC.

2. Forensic analysis: While handwriting analysis to blood comparisons date back a century or more, these and other forensic activities (analysis of body fluids, poisons, firearms, fibers, shoe and tire prints, now DNA prints) began to be coordinated by the Federal Bureau of Investigation and its laboratory in Washington, DC in 1932. With money provided by the Law Enforcement Assistance Administration under the 1968 Crime Bill, laboratories blossomed at state (and even local) levels across the country.

3. NCIC: In 1967 the National Crime Information Center was established by the FBI to centralize crime information and provide it by data processing to police agencies across the U.S. and Canada. In 1971, criminal history files of federal, state, and local agencies were added to the system.
4. Defensible Space: With Oscar Newman's (1973; 1976) book on crime prevention, came a boom in the development of home and industrial security technology that continued into the 1990s.
5. Case Management: Computer programs such as the Prosecutors' Management Information System (PROMIS) have provided methods to micro- and macro-manage huge caseloads in urban courts. Similar software has assisted public defenders, probation and parole supervisors, and correctional agencies.
6. Crime Control: Computer graphic mapping of crime to detect high crime areas and patterns, prediction models of where crime will occur next, and automated command and control systems are all examples of high-tech crime control methods, as are the use of polygraphs, psychological stress evaluations, and voice spectrographs. (Mathias, Rescorla, and Stephens, 1980; Wrobleski and Hess, 1993)

In some arenas, the adaptation of high-tech innovations has not been as rapid or as useful. In transportation, for example, the automobile has been the standard mode to get to the crime scene for most of the 20th Century, with walking being the usual method of patrol in urban areas. After World War II, America's love affair with the automobile blossomed and *steel cocoons*—motorized police patrol—became the norm. Now, police critics point to this distancing of the police from the public they serve as a reason for poor police-community relations and ineffectiveness in fighting crime. In fact, motorcycles, bicycles, horses, roller-skates/roller blades and yes, foot patrol have appeared in the 1990s as methods of getting police back in contact with the citizenry.

Besides patrol cars, other technical innovations have met with criticism from some quarters (Mathias, Rescorla, and Stephens, 1980). Civil libertarians, for example, have objected to the paramilitary deployment of law enforcement *gadgetry*. They point to the social complexities of crime and express fears that the use of technical transfer from the military has produced a *war model* response to social issues. They argue such military hardware tends to give police a totalitarian image that is likely to create further obstacles to good police-community relations.

There is also the problem that technology brings philosophical, legal, and social implications that often overwhelm society, particularly the legal system. For example, it was several years after police began using hidden microphones for surveillance before the Supreme Court began to apply 4th and 5th Amendment restrictions to their use (Mathias, Rescorla, and Stephens, 1980). One such restriction to protect the public from unreasonable government interference was the 1974 Freedom of Information and Privacy Act which declared that every citizen had a right to examine official records and documents of federal agencies (with some restrictions). Further, each citizen had a right to obtain copies of personal information in those records and challenge incorrect information—including that contained in criminal record files—to have it changed. Whereas there have been many problems with this law, it remains the major protection of privacy and accuracy available to the citizenry.

Crime in its Social Context[1]

Crime is a lot like cancer. It is serious, potentially deadly, comes in many varieties, is difficult to diagnose, hard to treat, and almost impossible to eradicate.

Unlike the general perceptions spread via media, government and even academic sources (Bohm, 1986; Barak, 1994), crime is not the product of a few sociopathic individuals. As French sociologist Emile Durkheim (1971) found in developing his *collective conscience* theory, no one believes or obeys all of the laws of a society all of the time. Therefore, everyone is somewhat deviant. Studies in the U.S. confirm this theory, as annual questionnaires of high school seniors in randomly selected schools find that about 9 in 10 admit to having committed at least one felony crime—shoplifting and drunken driving being the most common. In this author's Sociology of Crime class, undergraduate students are asked to

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[1] *Unless otherwise referenced, material in this section is taken from: Stephens, G. (1994, July-August). The global crime wave and what we can do about it.* The Futurist, *28 (4), 22-28; and from Mathias, Rescorla, and Stephens (1980).*

write a paper entitled *My Life of Crime* in which they confess their offenses and then try to theorize why they did it and what would have been the proper societal response. In over a decade of using the assignment, no student has failed to admit to at least one offense punishable by jail or imprisonment, and the vast majority have revealed a long pattern of minor—and sometimes major—crimes beginning in their pre-teens. Crime then is normal, not abnormal behavior in society, especially among adolescents.

There are, of course, many types of crime, from the serious personal and violent crimes of murder, rape, and assault to the street property crimes of burglary, larceny, and auto theft, plus white collar crimes such as embezzlement, computer fraud, and tax evasion, and less commonly recognized crimes such as providing unsafe working conditions and producing lethal products. There are literally thousands of offenses written into law by legislative bodies, as well as thousands of other violations carrying criminal penalties in the form of agency rules and regulations. Then there are the so-called victimless crimes or crimes with willing victims, such as gambling, prostitution, drug use, adult pornography, and adult sexual acts (such as sodomy and fornication).

The complexity of defining crime (See Figure 1) is illustrated in a simple but incomplete typology (Mathias, Rescorla, and Stephens, 1980, p. 39).

The Crime/Culture Connection

The connection between crime and culture cannot be overemphasized. There are high-crime and low-crime cultures around the world. In the years ahead, many low-crime cultures may become high-crime cultures because of changing world demographics and politico-economic systems. In general, heterogeneous populations in which people have an abundance of political freedom (democracy) and considerable economic choice (capitalism) are prime candidates for crime, unless a good socialization system is created and maintained.

To understand why this is so, we can begin by recognizing that the very nature of crime is culturally defined. What is legal and desirable in one

Crimes against Persons	Crimes against Trust and Ethics
• Homicide • Suicide • Assault • Kidnapping • Rape and sexual molestation • Robbery	• Traditional white-collar crime • Embezzlement • Consumer Fraud • Food and drug violations • Mail fraud • Securities fraud • Breaches of trust • Organized deception of the public • Environmental violations
Crimes against Property	**Crimes against the State**
• Larceny-theft • Shoplifting • Hijacking • Arson • Burglary • Fraud • Vandalism	• Political crimes • Espionage • Sedition • Sabotage • Treason • Breaches of the peace
Crimes against Morality	**Criminal Syndicates & Organized Crime**
• Pornography • Prostitution • Drunkenness • Drug offenses • Consensual sex acts • Gambling	

Figure 10-1: Typology of major crimes in America.

culture may be viewed as a serious crime in another; for instance, making a large profit on a business transaction is highly acceptable in the United States but, until recently, represented illegal profiteering in China. Those who were convicted were executed. Even within a single culture, the definition of a crime may change through space and time. Gambling is legal in a number of U.S. states but illegal and imprisonable in others. Over the past two centuries, the use of alcohol, marijuana, opium, and other drugs has been legal and illegal at various times in most U.S. states.

A culture in which the citizens are very similar—sharing similar ethnicity, religious beliefs, income levels, and values, such as Denmark—is more likely to have laws that represent the wishes and desires of a large majority of its people than is a culture where citizens come from diverse backgrounds and have widely disparate income levels and lifestyles, as in the United States. For this reason, homogeneous cultures normally have a lower level of law violation than heterogeneous cultures.

In addition, some cultures have a tradition of discipline—a belief that laws ought to be obeyed and that offenders (including you personally) should own up to violations and pay the penalty. Usually these are homogeneous cultures in which the citizens are well socialized and believe the laws represent their best interests. In some island cultures, violators of laws and customs actually penalize themselves, even in instances where their offenses would never have been discovered. By contrast, in cultures where individualism is strong, and belief and respect for law is low, laws are often broken and violators go to great lengths to avoid capture and conviction. If caught, they often deny responsibility and continue to combat charges even after conviction (through repeated appeals). Usually these are heterogeneous cultures, where the citizens disagree about the laws and are poorly socialized to obey them.

Responses to Crime

Societal responses to crime have differed over the years but have traditionally fallen into several categories, including: retribution, deterrence, incapacitation, reformation, rehabilitation, and restitution/reconciliation.

Retribution

The retributive approach (revenge, just desserts, an eye for an eye, balance the scales of justice) has been the most prominent response, as in primitive times, a wrong or injury committed by the member of one clan/tribe/family against a member of another group was often avenged by attempting to destroy the other clan. In 1927 B.C., the Hammurabi Code reformed this approach by calling for *lex talionis* (an eye for any eye)—doing equal harm in retaliation. The *lock 'em up* attitude seen in the U.S. in the 1990s has been primarily a retributive response, although the call for longer sentences and an end to parole can be seen as an incapacitation response disguised as deterrence.

Deterrence

Real deterrence comes in two forms: (a) *specific*, meaning the offender is persuaded not to commit a crime for fear of suffering a penalty, and (b) *general*, meaning members of the public are dissuaded from committing crime as a result of seeing the penalties suffered by offenders. Cesare Beccaria (1738-1794) and Jeremy Bentham (1748-1832) envisioned the *rational man* being deterred from crime by the threat of pain being inflicted for commission of the crime in only slightly greater amounts than the potential offender could hope to gain in pleasure from the criminal act. Both assumed the offender would be caught and punished and that the pain inflicted would be soon after the act; otherwise, no deterrent effect could be expected. In recent years, few have been caught (one in five major crime cases reported to police has resulted in an arrest), and far fewer have been convicted (FBI, 1994). The rational man, therefore, would not be deterred, and other literature indicates many offenders are not rational in that they do not even consider the possibility of being caught (Walker, 1994).

Incapacitation

Incapacitation, on the other hand, does not rely on persuasion; it relies on physically incapacitating the violator. Some have suggested that *selective incapacitation* of hard-core offenders would reduce crime substantially (Peterson, Braiker, and Polich, 1981). Others have questioned the idea that *the few* rather than *the many* commit serious crimes or that if *the few* were incapacitated, they would not be replaced by others, if presented the opportunity to fill the vacuum (Cohen, 1983; Visher, 1987).

Reformation

Crime reformation came to the U.S. with the Quakers. Under their theology, crime and sin were much the same, and thus crime like sin should be responded to by seeking to get the sinner/offender to repent and reform. To help achieve this end, the Quakers built penitentiaries and reformatories as places where offenders could spend long hours thinking about their crimes/sins, repent of them, and reform their ways.

Rehabilitation

In the 20th Century, a new term, *rehabilitation,* was born via the development of the social sciences. The idea here was to *treat* offenders and *cure* them of the problems that led to crime and provide societal coping skills (e.g., education, vocational training, and personal counseling) so that the individual could be placed back into society with an opportunity to succeed as a law abiding citizen. Somewhat similar to reformation in intent, rehabilitation was most prominent in the 1960s and declined in favor during the late 1970s and 1980s. Still, many programs continue to exist and operate with little attention being directed toward achieving the goal of rehabilitation. Finally, many of the new, evolving technologies (from drug implants to genetic surgery) could facilitate this goal, albeit at a price to civil liberties.

Restitution/reconciliation

One final approach being tried in many localities is *restitution/reconciliation*, a system in which cases are mediated or arbitrated to achieve a consent agreement by all parties involved. The decision typically includes restitution paid by one side to the other for property losses or injuries and treatment sought for drug, alcohol, anger, etc., that led to the offense, followed by reconciliation of the parties and a return to community life.

Roles and Uses of Technology[2]

Technology has and will continue to be used to facilitate committing of crime, preventing crime, combating crime, and responding to criminal behavior. Much of the past and present technology in this arena was reviewed earlier in the background section of this chapter. The primary focus here will rather be on emerging technology and will be divided into seven groups: opportunity reduction, surveillance, enforcement, imprisonment, electronics, drug and behavior control, and genetic engineering. It is important to remember that technology has no morality; it can be used by criminals or authorities to enslave humans or emancipate them, to curtail life or to enhance it. Policy and its administration (by all involved) will determine the uses that predominate.

Opportunity Reduction

One area in which emerging computer technology can be expected to have a major impact on reducing the opportunity of break-in or theft from habitats (from crack houses and organized crime *safe* houses to private residences and businesses) involves the creation of *smart houses*—buildings controlled by a computer *brain* (Atlas, 1988). Already available in primitive forms, these smart houses are being promoted by the National Association of Home Builders (NAHB) and are designed to make struc-

[2] *Unless otherwise designated, information in this section is based on Stephens, 1990, July-August; 1992, May-June; and 1992, Nov-Dec. In some cases a citation is given which provides supplemental data.*

tures both more convenient and more secure. In the area of safety, the computer can deny access to the home except to people *programmed* for entry. To check status, retina identification, or other methods such as DNA bar coding (in the next century), can be used. If an unauthorized person enters the dwelling, the house immediately recognizes the foreign presence via body heat and pressure sensors and can immediately video record the individual's actions while telephoning the owner, security and/or police. Soon the dwelling may be able to take action to protect itself, such as by creating a vacuum or spraying knockout gas into the interior.

Another new technology that could add to opportunity reduction is *smart materials* (Williams, 1993). These include building supplies, from bricks and mortar to pressed wood and plaster board, that have hundreds to thousands of microsensors mixed into the product that are equipped to sense anything that threatens the material. Here the very fabric of the building is capable of raising an alarm when being harmed (whether by severe weather, vandals, or burglars).

Similar *smart* devices are being used to protect vehicles, some of which already have voice warning systems telling potential thieves to *back off* or *leave the vicinity*. Car alarms and locks have become so effective already that a new type of crime was spawned in the 1990s, as enterprising but vicious individuals began to *carnap* or *carjack* their prey—attack driver and vehicle while it was occupied, often even in motion, rather than trying to disarm the sophisticated security systems.

Surveillance

Both computer and computer-assisted communications technologies have brought surveillance capabilities to a much higher level as the century nears an end. Already, thousands of drivers are dialing *9-1-1* or other emergency numbers to relay tips to authorities on drunken drivers and other suspicious activities—often from cellular car phones as they drive (Drunks beware, 1994). Also, camcorders (again often mobile) are being used to record crimes, criminals, and even possible abuses of power by authorities, such as in the Los Angeles riots and the Rodney King beating cases in 1992.

Electronic banking offers another source of constant surveillance by authorities, while it offers a bonanza to computer-wise criminals. By early in the 21st Century, it is believed that all monetary transactions will be electronic, creating a cash-free society (Warwick, 1992, Nov-Dec). In such a world, an electronic record of all transactions will be available to trace, making it difficult to launder money, hide drug and organized crime profits, and avoid paying taxes. Conversely, breaking electronic security codes will open the way to riches for thieves.

Birth-to-death monitoring of any individuals—suspects or *criminal types* by police, potential *marks* (victims) or police activities by criminal organizations—has been facilitated by computers and new high-tech audiovisual devices (Stephens, 1995). Examples include microphones that can *hear* through walls from great distances and cameras that can *see* through walls, even from helicopters and satellites. In the workplace, computers keep tabs on every action of their operators, from unauthorized phone calls to frequent work breaks.

The computer is also being used increasingly to collect massive amounts of information and store it for retrieval in many ways, such as by inputting an individual's social security number (Stephens, 1995). By networking computer data banks from many public and private agencies, it is increasingly possible to create a birth-to-death dossier on any individual. Soon DNA IDs will make it possible to store and disseminate lifelong activities of any individual on a worldwide basis. For law enforcement intelligence, this will provide a bonanza, as well as for crime groups checking out potential members or their enemies. For the average citizen, however, it poses a serious threat to privacy.

The next step is to collect and disseminate data under a universal designator. Probably the best approach, based on emerging technology, would be DNA bar codes, unique to each individual (except twins, triplets, etc.). The U.S. military already requires creation of such bar codes for every employee (Army readying, 1992), and homes for the aging often require such identification of patients. Some day-care centers require DNA coding of children in their care. Soon it can be projected that DNA bar codes will be placed on birth certificates, facilitating the identification and dossier development processes.

While possibly a little further down the road, *telepathy* may provide the ultimate method of surveillance and the ultimate form of intrusion (Stephens, 1995). Here even criminal thoughts might be sufficient for suspicion and even arrest. While scientists in the Western world tend to pay little attention to phenomenon that cannot be seen, heard, smelled or documented, brain scans show mental activity. This activity can be recorded and brain waves do exist. Is it then so farfetched to imagine that such mental activity can be projected, intercepted, interpreted, and even replied to and altered?

Enforcement

As far back as the 1940s, Chester Gould's comic strip character Dick Tracy wore a wrist communicator via which he could be in audiovisual communication with his fellow police officers, his family, or anyone he desired to see and hear. By the mid 1990s such technology was real, albeit expensive. As the capability improves and the cost is reduced, the Dick Tracy wrist communicator becomes a reality for police, parole/probation supervisors, parolees/probationers, and, of course, for facilitating communications among all people, including criminals. There would be no reason for a police officer to be out of service as long as he/she was wearing a communicator and parole/probation supervisors could check on clients and see their surroundings and associates at any time.

Pick up any airline's magazine or travel publication and find advertisements for foreign language translation devices, including ones that give written and oral translations of thousands of words into several languages at prices ranging from less than a hundred dollars to a few hundred. Simple trend *forecasting would indicate that within a very few years, an almost universal translating device will* be available, where hundreds of languages and dialects will be able to be interactively translated on demand (Stephens, 1992b). Thanks to micro electronics, compact devices could be attached like hearing aids and extras could be carried by police for use when questioning witnesses and suspects at crime scenes or by parole/probation supervisors when talking with clients. By bouncing signals off of satellites, such person-to-person, instantaneous, language-barrier-free conversations could be held worldwide.

DNA identification at crime scenes will also be facilitated by having the almost universal DNA data banks and dossiers mentioned earlier. Any single cell of evidence (from a spot of blood to a strand of hair to a drop of semen or a scale of skin) can be used to identify a person who was at the scene of the crime. Jury studies have indicated forensic evidence supported by scientific testimony is the most compelling evidence in criminal cases (Lipkin, 1991). However, with only a single hair or scale of skin necessary to identify individuals, the problem of *planting evidence* will need to be addressed.

More than 30 artificial or *bionic* human body parts were available by the 1990s (Snyder, 1993), and several others (including ears and eyes) were under development. Once perfected, these new eyes and ears may be much more than *equal* replacement parts; they may be *superior* in many ways to the original, incorporating the new audiovisual technology to allow the recipient to see or hear through walls from far away (Stephens, 1992a). Police surveillance would certainly be improved as would the ability of thieves and private investigators to gain information on activities ranging from industrial espionage to infidelity evidence for divorce proceedings.

Nanotechnology refers to micro-machines that can be measured in billionths of an inch, meter, second, etc. (Roland, 1991). These devices offer other possibilities for law violators and law enforcers. One likely use will be nanocomputers that will be able to store, retrieve, and disseminate information from units so small they cannot be seen with the naked eye. Yet, using new technology, such machines might be able to hold all the information a criminal needs to pull the most sophisticated caper. At the same time, this technology will provide police with criminal history, *modus operandi*, and outstanding warrant files on an immediate basis. Combine the nanocomputers with new *organic* bionics and the day may come soon when such computers can be tied into neural networks, becoming organic memory chips (Stephens, 1992a; Bleecker, 1988).

Imprisonment

If the crime-and-punishment paradigm continues to predominate in society, technology can provide new, cheaper, and more effective ways to incarcerate and incapacitate offenders. One possibility will be undersea prisons. Already, scientists have been experimenting with long-term undersea living, and in Japan, undersea hotels for recreation and tourism are being developed. Undersea prisons could be both self-supporting and almost escape-proof, as inmates could plant and harvest seaweed and other aquaculture products and would face the bends and other problems in escape attempts. Another possibility is *space prisons*, where inmates would mine asteroids for precious minerals and would find escape difficult (Stephens, 1992b).

Most U.S. prisons in the 1990s have been heavy on security and warehousing and light on rehabilitation and resocialization programming. If this trend continues, the correctional officer reverts to his/her old duty of guarding inmates, a role easily filled by robots (Stephens, 1992b). As artificial intelligence progresses, more sophisticated robots are emerging, and the capacity to watch, protect, and quell disturbances among inmates would not be a difficult task for the technology. Robots also will be increasingly used by police in bomb threat, hostage-holding, and standoff situations.

One biotech innovation may have a marked effect on imprisonment—the discovery of the genetic key to aging. The body apparently has a genetic clock. Research is ongoing to discover the key to this clock and to seek to slow it down, stop it, or in some cases, speed it up (Stephens, 1992a; Vogel, 1990). Obviously a life sentence would take on new meaning as would a sentence by the court to be aged 20 years to save prison space and still push the individual beyond the high-crime-prone years of 15-35. Finally, research on hibernation and suspended animation could lead to the ability to *stack* inmates, in effect turning prisons into meat lockers to accommodate society's lust for incarceration.

Electronics

As demand for prison space increased in the 1980s and 1990s, the advances in electronics provided a new alternative, electronic monitoring (Hosten, *et al.*, 1995) At first, the use of bracelets and anklets placed on offenders was monitored by computers via a telephone hookup. More recently, radio signals and international grids have also been added. Originally, the idea was to relieve prison overcrowding by providing a safe alternative; but in recent years the concept has spread from use for middle-range offenders (i.e., too involved in criminal activities to be probated but not so dangerous as to need full-time incarceration) to use with minor offenders. They have also been employed with pre-trial release programs (instead of bond), and have been used with juveniles, drawing criticism of an overuse of restraint by some.

Still, if one really wants to relieve overcrowding and retain feelings of safety, an innovation now possible would be to add *electroshock electrodes* to the monitoring devices (Stephens, 1990, July-Aug). These would be similar to the products designed to confine dogs to their yards. Such an adaptation has been a subject of science fiction writing and films for years but is only now technologically feasible. One possible objection, of course, would be the charge that such a program would constitute an 8th Amendment cruel and unusual punishment violation. But one could also ask whether this is more cruel than 24-hour-a-day imprisonment.

Drug and Behavior Control

The biotech revolution offers a whole array of new behavior control methods, from drugs to electronics to computer devices. While narcotics and designer drugs are sold daily on the streets in violation of the law, similar drugs provide daily relief to millions who suffer from a wide variety of physical and mental problems. In the future, an emerging group of drugs will be used to control behavior to an extent only imagined in science fiction (such as soma in Huxley's *Brave New World*).

One such upcoming drug will be the *sober-up pill*, first tested in the U.S. and now undergoing human testing in France (Stephens, 1992b; Lusks, 1981). This compound *blocks* the clouding of the brain by alcohol and thus, no matter how much one drinks, the dehabilitating effects on the brain are masked by the drug. Whereas, the pill poses ethical dilemmas to some, it can be expected to have a major impact on crime and vehicular safety, as half of major street crime and more than half of serious traffic accidents are associated with alcohol abuse. Add implant technology (such as the female birth control device Norplant) and the day may come when the court orders a *sober-up implant* for the drunken driver or the alcoholic vagrant.

Another use of implants likely will be to deliver synthesized body chemicals to potentially violent or otherwise chemically imbalanced individuals (Stephens, 1992b). Biotechnology is uncovering the causes of much violent behavior (such as an inadequate production of the soothing hormone serotonin). Additionally, scientists are identifying ways of alleviating this problem by providing a constant supply of the hormone through a chemically synthesized compound inserted via implant into the body. Similar approaches could be used to attack epilepsy, Alzheimer's disease, and other dehabilitating problems.

Psychologists have argued for years over the effectiveness of so-called subliminal messages. Based on the belief that the subconscious motivates human behavior, rapid visual and low-level verbal messages delivered constantly over a period of time have been used to try to direct behavior (Harmon, 1995). Used to sell refreshments at theaters and other commercial products, the technology has recently been used to try to reduce crime. Several department stores have placed anti-crime messages—*Be honest; Do the right thing; Be a good citizen*—along with the background music to deter employee theft. These techniques have met with some limited success. Other possibilities for the future include constant messages mixed with music in prisons and possibly even a subliminal implantion for parolees, probationers, and others.

As nanocomputers are perfected, the implant possibilities become almost infinite. A microcomputer could monitor and report on all bodily processes in an individual and, paired with a variety of chemical implants and electrical stimuli capabilities, could *control* behavior and render the individual *predictable.*

Genetic Engineering

As remarkable and possibly frightening as the drug and behavior control technological innovations may appear, they pale in comparison to the changes possible through genetic engineering. Beginning with the decoding of DNA in the late 1950s and escalating through the Human Genome Project of the 1990s (Lyon & Gorner, 1995), the capacity to mold humans and even to create new life forms has arrived. This author has coined the term *participatory evolution* to describe this process (Stephens, 1981; 1992a).

Already, genes associated with alcoholism have been deleted from individuals by *genetic surgery*, as have genes associated with certain genetically-based diseases and conditions. Very soon, genes associated with violence and other crime-prone behaviors will be found, and genetic alteration can be expected to be recommended as a viable solution (from deleting offending genes to inserting desirable genes).

Another innovation that has already begun is choosing the traits to be programmed genetically into the unborn child. By sperm-egg manipulation and genetic alteration, children can be *designed* to meet parents' and possibly society's preferences. Will the desire to stop crime lure social engineers into eliminating from the gene pool traits that could lead to violence and other undesirable behavior? We must ask, at what cost to creativity and diversity? Or will society find a way (or the will) to preserve individual rights to the point of limiting the use of genetic manipulation to reduce criminal tendencies?

If the *perfect* individual could be created, another soon-to-arrive biotechnology, human *cloning*, could provide the basis for a crime-free master race envisioned by the Nazis and others.

Finally, in England, human genes were recently mixed with pig's genes to create human-like livers in the pigs. Plans are to *harvest* these livers for the rapidly expanding body parts replacement market (McKeown, 1992). This could be a crime prevention step, as black market body parts have already cost thousands of lives of citizens worldwide. But it also poses both ethical and practical problems, as the next logical step is the creation of chimeras (part human, part animal creations) for sale for special purposes (from sex slaves to telephone line stringers). As detailed elsewhere (Stephens, 1992a), this development could lead to a variety of new crimes (such as bird-humans preying on fish-humans) as well as creating a variety of new law enforcement needs (such as air and underwater patrol). Ethically and socially, how would *humanoids* be treated: as full citizens with full Constitutional protections or as animals to be handled by the Society for the Prevention of Cruelty to Animals (SPCA)? Could the *new* offspring sue their genetic creators for malpractice? Is the very process of genetic engineering dehumanizing?

Summary

Before turning to a direct examination of specific challenges to civil liberties posed by new technology, a repeat emphasis seems to be in order. Technology is amoral. Its morality is gained by policymaking and policy implementation. Failure to recognize and cope with emerging technology leaves the way open for entrepreneurs to do as they will with it. In a free enterprise nation, this usually means doing what is most profitable. For those who would like to channel technology into providing social *good* (broadly defined), the challenge then is to stay ahead of technology, develop contingency plans for its introduction and control, and gain consensus for and implement those plans as the technology arrives. Bemoaning the new technology will not produce any protection of society or any ethical/effective use of the innovations. Likewise, waiting for pronouncements from higher levels may be an exercise in futility, as practitioners may find that they must make ethical decisions at the street level as the pyramid structure of management is flattened and decisionmaking is pushed downward.

The Threat to Civil Liberties[3]

Emerging technology not only provides new techniques and opportunities for those who would commit crimes and new approaches for criminal justice system employees, but it also poses threats to long-cherished Constitutional protections. New communications threaten citizens' rights to privacy as well as protection against self-incrimination. The prohibition against cruel and unusual punishment, the pledge of equal protection of the law, and other Constitutional provisions also face serious challenges at least partially due to the development of technology.

Privacy

Although the world *privacy* does not appear in the U.S. Constitution or its Amendments, the courts have carved out a right to privacy through interpretations of the 4th, 5th, and 14th Amendments. The 4th protects the "right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures." It also requires that any search be based on *probable cause*, and that such searches be restricted to specified areas and materials, etc., that are believed to be fruits of or specifically connected to the criminal activity. The 5th Amendment provision that no person "shall be compelled in any criminal case to be witness against himself or herself" adds to the assumed right of privacy. Here the use of personal items as evidence in criminal cases is restricted to prevent *fishing expeditions* without probable cause. The 14th Amendment's *due process* clause has been used to broaden privacy rights when it requires the government to show a strong public interest before interfering with the private lives of individuals. This major principle has

[3] *Some material in this section based on Stephens, G. (1990). Impact of emerging police and corrections technology on Constitutional rights. In F. Schmalleger. Computers in criminal justice. Bristol, IN: Wyndham Hall.*

evolved over the years as a means of limiting the government's right to interfere in marital and family affairs, from abortion to child rearing.

Through case law, this right has been held to provide the individual protection from government intrusion into the home or any other place where citizens have a reasonable expectation of privacy. In *Katz v. U.S.* (1967), for example, the Supreme Court ruled that the failure of the Federal Bureau of Investigation (FBI) to obtain a warrant of probable cause before placing a monitor (*bug*) on the outside of a telephone booth was a 4th Amendment violation, as the person on the phone had a reasonable *expectation of privacy* of his conversation in the enclosed booth.

But no right is absolute and there are many current exceptions to the *expectation of privacy* standard. The first major exception came a year after Katz when, in 1968, the Supreme Court ruled in *Harris v. U.S.* that items in *plain view* of an officer who is *legally in place* can be seized without a warrant and used as evidence in a criminal prosecution. In 1984 in *Oliver v. U.S.*, the Court ruled that even No Trespassing signs and locked gates were insufficient to stop police from going into privately owned open fields for plain view surveillance purposes. In 1986, *California v. Ciraolo* extended plain view to airplane flyovers of private property and in 1989, *Florida v. Riley* added helicopter observance.

Warrantless searches of cars following arrest (*New York v. Belton*, 1981), of students by administrators (*New Jersey v. T.L.O.*, 1985) and of offices of government employees (*O'Conner v. Ortega*, 1987) have been among the other exceptions passed, as well as a series of cases upholding drug testing regulations by employers in several critical areas (e.g., *National Treasury Employees v. Von Raab and Skinner v. Railway Labor Executives Association* in 1989). Finally, in *California v. Greenwood* in 1988, the court upheld a police search of a homeowner's garbage, holding *expectation of privacy* was not to be judged by the individual's expectation, but instead by society's belief that the expectation was objectively reasonable. In sum, the court held that the expectation of privacy was not reasonable in these cases and/or the government had a compelling interest that warranted an exception to the rule.

Given this, what can one expect from the court in reaction to emerging and soon-to-be available technology? If a microphone can hear or a camera can see through walls from miles away, is it *reasonable* to expect privacy, even in one's own home? Given the *Greenwood and Oliver* decisions, in particular, can any individual or the public *reasonably* believe that any spoken word or body movement (no matter where it takes place) can be expected to remain private?

With increased computer networking, privacy will likely face further assault. As government and private agency computers become *friendlier* or more compatible, credit, tax, medical, educational, entertainment, and other computer-based information will be gathered in a single data bank to provide a life-to-death dossier on every individual. Even if no one is constantly listening or watching the individual, that person's activities can be recovered through computer access, from the first grade teacher's note in his file regarding *violent outbursts*, to a misfiled bankruptcy by the credit bureau, to mistaken criminal charges.

The dossier will be even more complete in years to come as the cashless society emerges, being replaced by universal electronic debiting and still later by simple genetic recognition. Each individual will have a single account including income and a line of credit, which will be deficited automatically for any purchase. Thus, a record of each individual's every purchase (product or service) will be in the dossier.

Even more serious threats to privacy will come early in the 21st Century when memory transfer and later telepathy become generally practiced. Transfer of RNA structures (which encapsule memory) from one individual to another or to the public domain will further reduce the privacy of thoughts. This process will be accelerated when agents skilled in telepathy begin to read individual thoughts or scan thought waves in search of *intelligence*. Can anyone believe that the Courts will find a reasonable expectation of privacy even of one's thoughts in the face of such technology?

Self-Incrimination

The 5th Amendment provides that the individual does not have to confess or help authorities in any way if accused of a crime. The government must prove its case without the assistance of the accused. People cannot be forced into self-incrimination. In addition, in *Miranda v. Arizona* (1966), the law was interpreted to mean that authorities were required to inform individuals of their rights if they were under suspicion or in custody and were to be questioned.

In *Mapp v. Ohio* (1961), the Court provided protection of the individual's privacy and self-incrimination rights by ruling that evidence seized in violation of due process could not be used in state court actions. Thus, illegally obtained materials and illegally coerced confessions were to be excluded. As seen earlier, however, many *good faith* exceptions (from searching household garbage to airplane and helicopter flyovers) have been made.

In a 1988 case (*Andrews v. State*), the Florida Court of Appeals upheld a lower court ruling that genetic fingerprint (DNA) evidence was sufficiently reliable and thus admissible in court. In 1993, in *Daubert v. Merrell Dow Pharmaceuticals Inc.*, the court liberalized admissibility standards for forensic evidence and expert testimony. These cases and others (such as the O.J. Simpson murder trial) likely will open the floodgates for genetic identification and other personal evidence, despite arguments that it is a form of self-incrimination.

As noted earlier, genetic identification can be accomplished by an expert from a single human cell, whether it be a hair, a scale of skin, a speck of blood or a drop of sperm. Thus, as genetic identification kits (already on the market) become available to every police officer, security agent, and private detective, almost irrefutable genetic evidence will become increasingly available. *Planting evidence* will take on a new meaning, as the accused's gun will no longer be necessary; one hair, planted on the body, will be sufficient for incrimination.

Dossiers also can incriminate, as records of purchases of guns, drugs, or pornography may point to the individual as a suspect. Much data in computers is inaccurate, but, like credit bureaus, the burden of proof of the inaccuracy has been placed on the individual rather than on the agency, a trend that can be expected to accelerate in the future.

Electronic and video scanning will mean that individuals may be incriminating themselves while in the *privacy* of their homes. In the more distant future, memory transfer and telepathy may lead to self-incrimination through the *dangerous* act of thinking.

Cruel and Unusual Punishment

The 8th Amendment provides that punishment for crime carried out in the name of the people shall not be *cruel and unusual.* In 1972, the Supreme Court held that because of discrimination and failure to consider mitigating circumstances, the death penalty was cruel and unusual (*Furman v. Georgia*). Justice Brennan (1972) wrote "even the vilest criminal remains a human being possessed of common human dignity and severe penalties cannot be inflicted arbitrarily. Furthermore if there is a significantly less severe punishment adequate to achieve the purposes for which the punishment is inflicted, the [death penalty]...is unnecessary and therefore excessive."

But in 1976, the Court held in *Gregg v. Georgia* that a carefully drafted statute that minimized the risk that "it would be inflicted in an arbitrary and capricious manner" could make the death penalty acceptable if it was not "disproportionate" to the crime involved. By 1994, three-fourths of the states had new death penalty statutes and the federal government provided for capital punishment for more than 60 crimes.

Still, the 1976 requirement that the penalty not be *disproportionate* led to its being restricted to murder, and the *humane* carryover from Furman was leading to new methods, such as lethal injection. In noncapital cases, flogging and other corporal punishment methods have generally been determined to be unconstitutional, as have mind-control methods.

The Violent Crime Control and Law Enforcement Act of 1994 has raised another Constitutional issue. Sixty new federal crimes can now be punishable by death. Here, drug trafficking, even when the drug trafficker is not directly connected to a specific death, was added to the list of crimes that can be punishable by death.

Technologies of the 21st Century will raise many more 8th Amendment issues. Already under question is the *overreach* of electronic monitoring—placing 24-hour-a-day surveillance and restrictions on persons awaiting trial, and minor offenders who normally would only have to meet once a month with a probation supervisor, and juveniles who, in the past, would have been personally supervised and assisted rather than watched and restricted. Companies leasing or selling monitoring systems have grandiose ideas for expansion; for example, keeping tabs on *predelinquents* and even preschoolers. If electrodes were to be added to monitors in order to shock errant clients, even more 8th Amendment questions are raised.

Surveillance, 24-hours-per-day, could be considered cruel and unusual, as inmates in prisons have sometimes rioted or attempted to burn or trash their institutions in the face of video camera surveillance in cell blocks. Cryogenics (freezing) followed potentially by suspended animation (removing the blood and putting the individual in *storage*) may become potential solutions to overcrowding and prison control. In the face of massive prison overcrowding, these, along with other forms of human hibernation, offer possible solutions to immediate correctional problems. But are they Constitutional?

What about sending subliminal messages to inmates for days, months, or years on end through the sound system of the prison intercom, or implanting a subliminal message device in the brain of a suspect? Is this cruel and unusual punishment?

Even though experiments with ultrasound have found it lacking as a nonlethal weapon, it may nevertheless provide the ultimate solution to the prison riot situation. Piping high pitched sound over improved intercom systems would momentarily render everyone in the affected area unconscious and allow the staff to enter, disarm, and regain custody. Would the *compelling interest* of this government institution be greater than the cruelty to the inmates?

Genetic engineering also promises new methods of punishment and treatment, from genetic surgery to *cure* the offender by removing or altering deviant traits to implanting synthesized body chemicals in order to keep the offender under constant control. Will these methods become part of the sentencing of the courts or will they be deemed cruel and unusual?

Finally, if the death penalty continues, which among the new technologies will provide *humane* extermination and which will be deemed *cruel?* Ultrasound at extreme levels can quickly destroy the individual; in the near future ultrasound will be provided at levels that will literally dematerialize human beings and, indeed, all matter in the area (a la Star Wars). It will be fast, effective, and efficient. Humane or cruel?

Remember, the Court has usually ruled that the phrase *cruel and unusual* in the 8th Amendment requires the penalty to be *both* cruel and unusual to be unconstitutional. Thus, any penal practice that can survive court challenges for a protracted period of time is, at least, no longer *unusual.*

Equal Protection

The 14th Amendment provides for due process and equal protection of the law for all persons accused of a crime. Most court challenges have been that rich and poor are not treated equally or given due process protections. For example, in *Bearden v. Georgia* (1983), the Court ruled that a person could not have probation revoked because of failure to pay required restitution to the victim, unless the *ability to pay* was first established. The Pennsylvania Supreme Court in 1988 (*Commonwealth v. Melynk*) held that a defendant could not be denied participation in a pretrial diversion project simply because he was indigent and thus could not pay required restitution. But the California Court in 1988 (*Vasquez v. Cooper*) also ruled that a defendant who was indigent did not necessarily have to be given credit for jail time served if convicted, because, in some cases, wealthier persons also remained in jail prior to trial.

New challenges to equal protection can be anticipated as increasing numbers of homeless are being criminalized by curfew and anti-panhandling laws passed in many localities. Immigrants, particularly illegal aliens and noncitizens, also face new discrimination.

But the greatest challenges are likely to come in the 21st Century as truly new classes of *citizens* emerge as products of the biotech revolution. First, there will likely be the slightly different individuals: *humans* with computer chips in their brains or *brain transplants* or computer-replaced brains. Does equal protection allow these individuals to be charged for the crimes committed by their replacement brains, or should the original owner be culpable?

Other challenges may begin further into the 21st Century with the development of chimeras (human-animals), androids (human-machines), genetically-altered humans (gilled humans, winged humans), and clones (duplicate humans). Given the track record of treating all new residents differently and often denying them the basic rights that others share, how will these *creatures* be treated under the equal protection clause? First we will need to redefine *human*. Then equal protection will have to be used to determine who faces the court system and who faces Society for the Prevention of Cruelty to Animals (SPCA) proceedings.

Other Potential Threats

The impact of technology on civil liberties can be seen, to a lesser extent, in other areas as well. For example, the 1st Amendment protects the rights of freedom of religion, speech, and assembly. The Court has been diligent in protecting these cherished rights, even holding unconstitutional some practices that might have a *chilling effect* on the individual's exercise of these freedoms (such as taxing churches or wholesale censorship of literature).

But in the future, how can such freedoms be protected from the chilling effects of the cashless society, electronic monitoring, constant surveillance, computer networking, and life-to-death dossiers? If every word, deed, purchase, and perhaps even, thought (telepathy) is to be recorded and available for scrutiny, how can a person feel free to worship, speak, associate with, and think as he/she pleases?

The O. J. Simpson murder case in 1994 highlighted a serious 6th Amendment problem that has existed for years, balancing the right to a speedy and public trial with the right to an impartial jury. The difficulty of providing both has become painfully apparent. Even more difficult is finding an impartial jury while maintaining the right to a *free press* (an extension of the 1st Amendment Freedom of Speech). In the Simpson case, technology was a constant issue as alleged results of blood and DNA tests were discussed at length in the media, weeks before the trial even began and long before a jury was chosen and sequestered. *Court TV* and the fascination of media with crime scenes and crime investigation have put even more pressure on criminal justice personnel to release details (including forensic and other technological evidence) to the media for public airing as soon as possible, and long before jury selection. The next step, to make the viewers the jurors, is almost certain to be proposed and promoted. Imagine jurors going to the kitchen for a snack, or dozing off during crucial testimony. This would present serious Constitutional problems.

Another 6th Amendment dilemma is the use of videotaped testimony. Does this deny the defendant the right to be confronted by his/her accusers and to compel the witnesses to testify? Is the *impersonal* videotape the equivalent of *face-to-face* confrontation in court? And will videotaped testimony lead to use of the videotape based on strategy (e.g., to make the victim appear more vulnerable by interviewing him in a hospital bed or to decrease the witness' credibility using poor lighting to make him/her appear shadowy).

Major 21st century legal battles can be expected as the defense and prosecution will attempt to introduce evidence from *memory banks* (the stored RNA memory chains of victims and witnesses), providing an exact recall of the events of the alleged crime according to the stored memory of the individual. Is an individual's *memory* private? Can it be recalled by force with or without a warrant? Is the individual's memory accurate? Will memory recall provide an exact chronicle of events, or will it simply be the individual's highly subjective version of events? Should memory recall be given any more credibility than a polygraph test, which is normally excluded from courtroom evidence? Several recent studies have suggested that memories are often *false* or *created* by investigators and/or therapists (Loftus, 1994; Ofshe and Watters, 1994). Finally, the reasonable bail requirement of the 8th Amendment, already in contention because of the use of pretrial electronic monitoring, will undergo further challenge when prosecutors attempt to require electrodes or chemical control implants as a requisite of bail.

Some might wonder why the 2nd Amendment's right to bear arms was not addressed above as a significant civil liberty. While it is true that the Brady Bill and the 1994 crime bill restrict the ownership of a few weapons, and require background checks and short waiting periods to purchase others, there is no threat to civil liberties here, at least not in the traditional sense. The 2nd Amendment reads in full: "A well-regulated Militia, being necessary to the security of a free State, the right of the people to keep and bear Arms shall not be infringed." The Amendment does not provide for the personal ownership of arms nor does it guarantee the bearing of any particular weapon and certainly not all weapons. The Court has held that the right to bear arms under the 2nd Amendment was not an individual right, but only a societal right if a well-regulated Militia was deemed necessary (*Presser v. State of Illinois*, 1886). The National Guard has clearly replaced that need, but it is doubtful that such an interpretation will silence the National Rifle Association (NRA) and other adamant gun owners.

There is another civil rights debate surrounding guns, however, that may require future action. As new, more deadly weapons emerge (from lasers to nuclear to ultrasound) the Constitutional questions may begin to center around new rights that might be carved out of the Constitution. Does the plethora of guns in society threaten the rights of individuals peaceably to assemble (1st Amendment), to be secure in their persons, houses... (4th Amendment) or to be deprived of life, liberty, or property without due process (5th Amendment), as well as other Constitutional protections? It has even been suggested that everyone be required to have a gun (or be prohibited from having one) to provide equal protection (14th Amendment).

Concluding Comments

How can technology be used as a positive force in dealing with crime and justice? It has been stated that all technology is a two-edged sword (capable of doing great good and great harm to humankind) and that technology is amoral, with policy and implementation giving each adaptation its moral position. Clearly, however, technology, despite its threats, offers much hope to the world and, in particular, to making society safer and individuals better able to cope within the limits of the law. But to achieve this *promise,* policymakers will have to be more vigilant than in the past, anticipating new technology and its uses and misuses and developing contingency plans to foster some uses while thwarting others. Failure to anticipate and monitor technology leaves the usage in the hands of those who will abuse it for fun and profit with indemnity.

High-tech, low-cost construction methods (such as mass-produced modular units and mile-high skyscrapers) can do much to solve the homeless problem and provide affordable living for low-income families. Nanocomputer implants that continuously monitor bodily functions will alert people to imbalances or better yet, will correct problems. Computers and, later, organic memory chips will offer alternatives to traditional education and may provide every citizen with the *wisdom of the ages* as well as instant access to a myriad of data banks and educational/entertainment options, thus eliminating the ignorance option as we know it today. The list goes on of the ways technology can be used to alleviate social ills.

Again, however, technology alone will not solve social problems. Technology is only a tool, and will prove beneficial only if used within the context of a community of citizens concerned with and dedicated to making life better for all.

As for dealing directly with crime and the fear of crime, several options were enumerated earlier. In particular, smart homes and cars should combat both theft and break-ins and the fear associated with them. Implants of new, often synthesized body chemical drugs can keep disturbed citizens calm, cool, and collected, while court-ordered implants may be used instead of incarceration to control individuals who have already broken the law. These implants may also prove to be effective in helping alcohol and drug offenders overcome their addictions and dependence on dehabilitating narcotics. Subliminal devices with anti-crime messages may be used both to prevent crime (such as in department and convenience stores) and to rehabilitate offenders. Whereas some of these technologies could be abused and could threaten civil liberties, with carefully crafted policies these innovations offer a clear-cut alternative to the harshness of current approaches (e.g., incarceration and even the death penalty).

In the long run, however, the futurist's dream of a *high tech/high touch* world will depend on a change in philosophy as to the best approach to deal with crime and justice in society. As long as the emphasis is on retribution and deterrence after the fact of crime, Machiavellian uses of technology will continue to appeal to the public and will likely continue to be utilized. Recent polls (Patterson, 1994) have indicated an increasing willingness of citizens to give up cherished civil liberties (even 4th and 5th Amendment protections) in the hope that crime, and the fear it imposes, can be reduced. The problem may be that the solutions—*unhandcuffing* the police and *locking up* all violators—may produce more threats to individual safety than they alleviate and are unlikely to have any real impact on the crime dilemma as they are all *reactive* approaches.

So how can technology be harnessed to prevent crime and protect the citizenry? Above all, we need to move from a *war* model to a *peace* model in our approach to crime. Already some scholars are suggesting such a change, as shown by a recent book entitled *Criminology as Peacemaking*, edited by criminologists Harold E. Pepinsky and Richard Quinney (1991). At present, police too often treat a community as if it were enemy territory. They drive around in patrol cars looking for troublemakers to arrest. Friendly contact with the inhabitants is often negligible, and citizens respond by regarding the police as an occupying army.

The peace model, exemplified by community policing, fits well with the emerging information era, where success will depend more on cooperation than competition and reconciliation more than retribution. Under the peace model, we will search in this shrinking, multicultural world for a consensus of values on certain big issues and on fair and effective ways of resolving the inevitable conflicts of values in less critical areas (noise levels, sexual preference, gambling, drug use, religious rituals, etc.) without imposing one group's preferences on another. Legal sanctions need to be reserved for acts that truly endanger the citizenry.

Proactive rather than reactive methods must be used in reducing crime. When a crime is prevented, there are no victims and no costly repercussions such as trials and incarceration. However, a preventive approach would require a change in the traditional structure, role, and methods of criminal-justice systems. In the traditional system, violators are apprehended, taken before a court, and, if convicted, sent to institutions or placed under supervision. Such a system does relatively little to prevent crime, since most convicted criminals are eventually turned loose without having been *cured* of their criminal tendencies.

Under a reformed criminal-justice system, the traditional law-enforcement agencies would expand their scope to create partnerships with the community and other social-service units and expand the role of the police to include crime prevention. Police officers often can anticipate when someone is likely to commit a crime, but traditionally have waited for the crime to occur before acting, viewing their duty as law enforcement, not social work. Under the reform (or peace) system, police could get out of their cars and once again seek daily contact with the citizens they serve.

The community-policing approach involves a return to the nineteenth-century role of the police: protecting and serving the community by being constantly aware of neighborhood problems and ever ready to help solve them in cooperation with their employers, the citizenry. Under this model, police would get back to their roots in the community by communicating with citizens through neighborhood councils and meetings, foot patrols, crime-watch organizations, etc. In addition, security agents hired by business and private organizations would cooperate with public police to establish and jointly preserve the peace.

In such a system, technology would clearly be under the control of the citizenry. Police, for example, would look to the community to decide what uses of surveillance equipment were acceptable to stop a rash of break-ins in a neighborhood and what types of information were acceptable to include in dossiers on citizens.

Whether computer trials are acceptable would be a citizen decision, ameliorated by the fact most cases under a peace model would be mediated or arbitrated with a goal of solving the immediate problems through restitution by the offender to the victim and the long-term problems through appropriate treatment. Here again the decision to use subliminal or nanocomputer or synthetic drug implants versus undersea or space imprisonment would be negotiated with a *consent agreement* being the outcome sought and arbitration to find the equitable and effective solution being the backup system.

Whereas these *soft* approaches may seem alien to a citizenry conditioned to the war model, they will make sense to individuals reacculturated to a peace model. *Wars* on crime and drugs have brought little success and have created many innocent casualties. These new approaches could tame technology and finally bring *peace to the 'hood.*

REFERENCES

Andrews v. State, No. 87-2166 FL (October 20, 1988).

Army readying DNA dogtags (1992, May 10). *The* (Columbia, SC) *State*, 3A.

Atlas, R. (1988, March-April). Secure homes: The future of anti-crime technology. *The Futurist, 22*(2), 25-28.

Barak, G. (1994). *Media, process, and social construction of crime.* New York: Garland.

Bearden v. Georgia, 461 U.S. 660 (1983).

Bleecker, S. E. (1988, May-June). The bio-logic age: The merging of man and machine. *The Futurist. 24*(3), 60.

Bohm, R. M. (1986, June). Crime, criminal and crime control policy myths. *Justice Quarterly, 3*(2), 193-214.

California v. Ciraolo, 476 U.S. 207 (1986).

California v. Greenwood, 108 S. Ct. 1625 (1988).

Cohen, J. (1983). Incapacitation as a strategy for crime control. In M. Tunry & N. Morris (eds.), *Crime and justice: An annual review of research* (vol. 5). Chicago: University of Chicago Press.

Commonwealth v. Melnyk, No. 1681 PA (September 12, 1988).

Daubert v. Merrell Dow Pharmaceuticals, 53 CrL 2313 (1993).

Drunks beware. (1994, Sept. 19). *The* (Columbia, S.C.) *State*, p. 9A.

Durkheim, E. (1971). *The rules of sociological method.* (S.A. Solovay and J.H. Mueller, Trans.). ed. by G. E. G. Catlin. New York: Free Press.

Federal Bureau of Investigation (annual). *Uniform Crime Reports.* Washington, DC: U.S. Government Printing Office.

Florida v. Riley, No. 87-764 FL (January 23, 1989).

Furman v. Georgia, 408 U.S. 238 (1972).

Gregg v. Georgia, 428 U.S. 153 (1976).

Harmon, A. (1995, Nov. 5). Subliminal (buy more!) messages (work hard!) are back (be happy!). *The* (Columbia, SC) *State*, D-1, D-8.

Harris v. U.S., 390 U.S. 234 (1968).

Hosten, J., Sennott, J., Winkler, K. (1995 Summer). Keeping tabs on criminals. *Journal of Electronic Monitoring*. *8*(3), 1-2, 4-7.

Huxley, A. (1969). *Brave New World.* NY: Harper & Row.

Katz v. U.S., 389 U.S. 347 (1967).

Lipkin, R. (1991, Dec-Jan). The quest to break human genetic code. *Insight*, 46-48.

Loftus, E. (1994). *The myth of repressed memory*. New York: St. Martinís.

Lusks, A. (1981, Oct.). The "sober-up" pill. *The Futurist, 15*(5), 23-28.

Lyon, J., & Gorner, P. (1995). *Altered fates*. New York: Norton.

Mapp v. Ohio, 367 U.S. 643 (1961).

Mathias, W., Rescorla, R. C., & Stephens, E. (1980). *Foundations of criminal justice.* Englewood Cliffs, NJ: Prentice-Hall.

McKeown, L. (1992, July 14). Pigs might become organ donors. *The* (Columbia, SC) *State*, 1D, 6D.

Miranda v. Arizona, 384 U.S. 436 (1966).

National Treasury Employees Union v. Von Raab, 439 U.S. 656 (1989).

New Jersey v. T.L.O., 469 U.S. 325 (1985).

Newman, O. (1973). *Architectural design for crime prevention*. Washington, DC: U.S. Government Printing Office.

Newman, O. (1976). *Design guidelines for creating defensible space*. Washington, DC: U.S. Government Printing Office.

New York v. Belton, 453 U.S. 454 (1981).

O'Conner v. Ortega, 480 U.S. 709 (1987).

Ofshe, R., & Watters, E. (1994). *Making monsters: False memories, psychotherapy, and sexual hysteria.* New York: Scriberís.

Oliver v. U.S., 466 U.S. 170 (1984).

Oregon v. Mathiason, 429 U.S. 492 (1977).

Patterson, J. (1994). *The second American revolution*. New York: William Morrow.

Pepinsky, H. E., & Quinney, R. (1991). *Criminology as peacemaking*. Indiana: Indiana University Press.

Peterson, M. A., Braiker, H.B., & Polich, S.M. (1981). *Who commits crime*? Cambridge, MA: Oelgeschlager, Gunn & Hain.

Presser v. State of Illinois, 116 U.S. 252 (1886).

Roland, J. (1991, March-April). Nanotechnology: The promise and peril of ultratiny machines. *The Futurist, 25*(2), 29-35.

Skinner v. Railway Labor Executives Association, 489 U.S. 602 (1989).

Snyder, D. (1993, September). Repairing the mind with machines: The supernormal possibilities of neural prosthetics. *Omni*, 14.

Stephens, G. (1995, Nov-Dec). Crime in cyberspace. *The Futurist, 29*(5), 24-28.

Stephens, G. (1994, July-August). The global crime wave and what we can do about it. *The Futurist, 28*(4), 22-28.

Stephens, G. (1992a, Nov-Dec). Crime and the biotech revolution. *The Futurist, 26*(6), 38-42.

Stephens, G. (1992b, May-June). Drugs and crime in the twenty-first centutry: New approaches to old problems. *The Futurist, 26*(3), 19-22.

Stephens, G. (1990, July-August). High-tech crime fighting: The threat to civil liberties. *The Futurist, 24*(4), 20-25.

Stephens, G. (1990). Impact of emerging police and corrections technology on Constitutional rights. In F. Schmalleger, *Computers in criminal justice*. Bristol, IN: Wyndham Hall.

Stephens, G. (1981, April). Crime in the year 2000. *The Futurist, 25*(2), 49-51.

Visher, C. A. (1987). Incapacitation and crime control. *Justice Quarterly, 4,* 513-43.

Vogel, S. (1990, May). Clockwatching. *Discover, 11*(5), 38-41.

Walker, S. (1994). *Sense and nonsense about crime and drugs*. (3rd ed.). Belmont, CA: Wadsworth.

Warwick, P. (1992, November-December). The cash-free society. *The Futurist, 26*(6), 19-22.

Williams, G. (1993, April). Smart materials. *Omni, 15*(6), 42-44; 46, 48, 91.

Williams v. Illinois, 399 U.S. 235 (1970).

Wrobleski, H. M., & Hess, K. M. (1993). *Introduction to law enforcement and criminal justice*. (4th ed). St. Paul, MN: West.

DISCUSSION QUESTIONS

1. Why will it be difficult to protect the "right to privacy" in the 21st Century?

2. Intrusive technology that poses great threats to civil liberties should be banned. Discuss the positive and negative arguments for this statement.

3. On balance, do you believe that emerging technology will make citizens more secure?

4. Do you think emergence of "humanoids" via biotechnology will enrich earth's culture and encourage tolerance of others; or do you believe that humanoids will ever become a reality?

5. Will 21st Century technology make the presumption of innocence and fair trials impossible? Explain.

6. Reactive traditionalists, who rely on punishment after crime, will never allow creation of a humanized criminal justice system, which relies on proactive preventive measures to control crime. Why do you support or disagree with this statement?

7. Why should the peace model in crime prevention and control be more effective than the war model in reducing crime in the future?

8. Should a judge have the right to include, as part of the sentencing, the following acts:

(a) Norplant implants to a mother who abused her 5-month-old baby?

(b) A permanent monitoring device for a serial rapist who has just been released from prison?

(c) A gene implant to force a chronic alcoholic to be sober?

9. Under what circumstances could a child sue his/her parents and doctors for genetic manipulation?

10. What might be lost if, in an effort to prevent crime, we eliminate all genes from the gene pool that cause all criminal behavior?

11. Some areas in England, where the shops have been burglarized repeatedly, have set up video cameras that provide virtually complete surveillance around the clock. Would you support this action in our shopping centers? Explain.

DISCUSSION SCENARIOS

Fly-by Justice

"But they invaded my privacy, your honor. It isn't fair. I had a fence and No Trespassing signs."

"Yes, but you were growing marijuana in your basement. It was clear from the heat-sensing, infra-red cameras."

"What about my privacy rights? They didn't have a search warrant. They were just flying over my property in a general sweep of the area. There was no probable cause."

"Well they had a right to be in the helicopter and they weren't in a no-fly zone, so it seems to me they didn't need a warrant. Five years in prison! Next case."

Is the judge right? Any chance to win on appeal? Based on what? Is this ruling fair?

Convicted by the System

"You turned me down because I have a criminal record?"

"Says so right here on the computer."

"But I've never been convicted of any crime."

"Well, it says here you were arrested for armed robbery five years ago."

"That was a mistake. They let me go 30 minutes after I was booked. They caught the real robber and apologized to me."

"Well, I'm sure you're right, but we don't hire anyone with a criminal record."

"But I don't have a record."

"All I know is you were arrested, and we've got to assume you did something wrong."

Could this happen with today's computer records-keeping systems? Are "dispositions" always recorded on the record? Should they be? What glitches in the criminal justice "system" could lead to such a problem? How can it be remedied?

Who's Responsible?

Michael Jordan, widely known athlete, in the year 2004 received a partial brain transplant from the dying Henry Kissinger. Jordan was immediately made a U.S. diplomat and was highly acclaimed for his negotiation skills. But in 2009, Jordan assassinated U.S. President Malcolm Holcomb, former leader of the American Nazi Party, after Holcomb announced a policy of limiting immigration to the United States to members of the Arian race. Jordan was convicted in the lower courts of political assassination and sentenced to life in prison despite his plea that his body was only carrying out the will of Kissinger's brain. Jordan has appealed the conviction and this landmark case now lies in the hands of you, a Justice of the U.S. Supreme Court. You must reverse or uphold the lower court decision and give the legal reasoning for your decision. What is your finding?

Crime or Lunch?

Mary Birdheart swooped down from the sky and picked up little Jenny Rhodenstern. Her conscience cried "no, no," but Mary had an overwhelming desire to introduce her infant son to the flesh of the tender, young humanoid child. Overcome by her genes, the winged woman joined her delighted son in devouring the mouselike Jenny. A case for criminal court or the Society for the Prevention of Cruelty to Animals? What civil liberties apply?

Unguarded Thinking

"One more violent fantasy and we'll put you in the jail young man," the "thought police" agent telepathically warned the adolescent.

"You know better than that. I've recorded that bloody mess you were dreaming and I'm putting it in your permanent dossier."

"Alright, that's it! You're under arrest! I heard that thought, and I'll tell you I don't appreciate your sass. Come along."

Any rights violated? Any way to protect them?

CHAPTER 11

Technology and the Environment

Michael Karian

Somewhere around 400 A.D., a group of Polynesian sailors arrived on a 64 square mile island paradise in the middle of the South Pacific, 1,400 miles from the nearest habitable island. On this island, a civilization flourished with the fertile, subtropic soil producing lush vegetation, huge pine trees for building ocean-worthy craft, and an abundance of crops. The large trees also supplied lumber for moving and erecting the large stone statues for which Easter island is now famous. The people lived on chickens, sea birds, porpoises, and fish. The population grew to an estimated 7,000 people. However, the first known visitor to the island—a Dutch explorer by the name of Jacob Roggeneen—reported in 1724 that he found the place to be a wasteland with no vegetation over ten feet tall and a population that had dwindled to about 2,000 inhabitants. As best scientists can explain from pollen analysis and archeological digs, the civilization of Easter Island met a tragic end of starvation. They had populated beyond the carrying-capacity of the rich resources of their island and paid the ultimate price—extinction (Diamond, 1995).

Easter Island serves as a microcosm of the earth. The effects of human technology activity on the environment have more serious direct, indirect, and long-term implications for the quality of life than perhaps any other human activity. Deterioration of the environment as a result of technological advancements include, but are not limited to, global warming, water and air pollution, ozone depletion, deforestation/desertification, and waste disposal of all types including hazardous and radioactive wastes. In affluent (i.e., developed) countries, these problems are largely the result of high per capita resource consumption. In traditional (i.e., developing) countries, these problems result primarily from overpopulation and the lack of sufficient economic resources and appropriate infrastructure to provide for that population (Garrett, 1988).

Degradation of environmental quality is now perceived by experts as being of sufficient seriousness so as to threaten humanity's very existence. Gibbons and Neuman (1985-86) expressed the gravity of this view, asserting that:

> never until recent times have we faced the destruction of our environment and our extinction as a species. To preserve our planet and civilization, we will have to make changes as dramatic as those that are pushing us to the brink. (p. 72)

In essence, the exploitive value system that has governed human action, especially in the Western world, for the past 2000 years is now in question. More than any other time in history, we are at a turning point where changes are essential if human life, as well as most other life on the planet, is to survive into the 21st century. As was the case on Easter Island, we too, are living, not off the interest of our resources but off the principal. This fact coupled with the largest population to ever inhabit the earth, and a population growth rate unparalleled in human history, is dramatically straining the environment.

The purpose of this chapter is to explore the interactions between humans, technology, and ecological systems in an effort to identify how the current situation has developed and why change must occur. The chapter will begin with an examination of the interface between humans and their environment. This will consist of an analysis of socio-cultural change and environmental perceptions, a brief description of the global environment, and a discussion of the concept of human management of nature. Environmental impacts of technology will then be addressed. Different categories of impacts will be presented, major contributing factors analyzed, and contemporary ecological issues examined. The discussion will then shift to political, technical, and social responses to environmental issues, followed by conclusions and educational implications.

Definitions

Since a number of words will be used in this chapter that may have different meanings to different people, a definition section has been included to assure that the reader understands the meanings intended by the writer.

Affluent countries. These are countries in which the majority of the population has above-average global resource consumption patterns; typically known as developed, Northern, Western, or first-world countries.

Environment. The environment refers to the global ecosystem including the atmosphere, lithosphere, and hydrosphere, and all living things contained within those systems (Karian, 1991).

Environmental education. Environmental education refers to an approach to education "aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward their solution" (Stapp, 1969, p. 54).

Environmental impacts of technology. Environmental impacts refer to both positive and negative effects of human application of technology upon the environment.

Socio-cultural/environmental/technological (SET) education. SET education enumerates a comprehensive, interdisciplinary educational approach to the study of global ecological issues that addresses the socio-cultural, environmental, and technological influences of those issues.

Traditional countries. Traditional countries are those in which cultural norms remain heavily based upon old-world traditions; typically known as developing, Southern, less developed, third-world, or underdeveloped countries.

Humans and Their Environment

In this section, the interactions between humans and their environment are outlined. In order to facilitate a comprehensive analysis of those interactions, changing environmental perceptions associated with socio-cultural change are discussed, followed by an overview of the global environment and human attempts to manage it.

Socio-Cultural Change and Environmental Perceptions

Interest in and concern about technological consequences varies from one society to another, usually dependent on the society's level of technological development. Societies with low-level technological development traditionally have little concern for the impacts of technology. According to Todd (1985), this is because the technology used in those societies is strictly survival-oriented and has typically evolved over a long period of time. For the most part, environmental effects in these countries tends to be regional in nature, and the technology has relatively limited spheres of undesirable influence. For example, wood and other dried vegetation are the primary sources of fuel, but the smoke of many small fires is diffused across the country. By contrast, more affluent countries burn much more fuel, especially petroleum, the fumes of which pollute the local community as well as countries downwind.

Many authors (e.g., Miller, 1990; Pytlik, Lauda, and Johnson, 1985) have described the relationship between a society's concern for the environment and its technological development. In low-level technological (i.e., hunter-gatherer) societies, cultures are dependent on the environment and, therefore, people affect it very little. Such a relationship between humans and the environment can be termed *humans <u>in</u> nature*. For example, Native Americans have historically recognized their dependence on nature and, therefore, have viewed that relationship as sacred. Nature is not something to be abused or exploited.

Impacts begin to become a concern in emerging technological societies, when increased use of technology brings with it a host of other consequences including obvious environmental degradation. At this level, environmental concern remains secondary and impacts are only addressed after noticeable damage has occurred. This situation is reminiscent of early agricultural societies, and is typical of industrial societies (i.e., most countries) today. The problems encountered in Los Angeles are typical. The smog and ozone problems encountered by the city, as a result of the emission of thousands of cars as well as industrial smoke and exhaust, finally got so bad that on 135 days in 1987, the ground ozone level exceeded the level established by the Clean Air Act (Portney, Harrison, Krupnick, & Dowlatabadi, 1989, p. 69).

Because a society at the industrialized level is able to exert greater technological control, the relationship can more accurately be described as *humans <u>against</u> nature*. In such a society, humans tend to use technology to try to overpower or control nature. Such a perspective, however, is based on a number of assumptions about how the world operates and what the role of humans is, or should be. Gordon and Suzuki (1991) referred to these assumptions as *sacred truths* with which we have all grown up. Included in these assumptions are beliefs such as nature is infinite, growth is progress, science and technology will solve our problems, all of nature is at our disposal, and we can manage the planet. As it turns out, these assumptions are not only inaccurate, but behavior, practices, and policies based upon these beliefs now threaten the existence of human, animal, and plant life as it currently exists on the planet.

Pytlik, Lauda, and Johnson (1985) have expanded on the consequences of such a perspective:

> humans have relentlessly manipulated and attempted to master the natural environment in the twentieth century. This process has produced countless effects that make life more enjoyable. We have controlled the atom, conquered space, redirected rivers, and developed synthetics; and the future of science and technology promises even greater exploits. Unfortunately, exploits can turn into exploitations, and our efforts to control our natural environment have brought mixed blessings. (p. 214)

As a society becomes more technologically developed, the more important it is for scientists, engineers, and ordinary citizens to address the appropriateness of technological innovations. As innovations become more and more sophisticated, the scope and seriousness of potential impacts increases, as does the importance of future planning. In fact, this kind of planning and debate over the appropriateness of various technologies has begun to take place in the world today as concern for environmental quality has steadily increased. This is particularly true in countries that are undergoing the most rapid technological growth (Todd, 1985; Young, 1990).

Corresponding with this increased concern about the environment has been the increasing popularity of the concept of living within nature's boundaries, rather than trying to dominate and control it. To extend the previous relationship between humans and the environment one step further, this concept might well be labeled *humans and nature*. Whereas the first two terms roughly correspond to what Toffler (1980) has termed the first and second waves of civilization (agricultural and industrial societies respectively), perhaps the construct *humans and nature* summarizes the emerging third wave (information society) orientation toward the environment. This view of nature has been presented in *The Third Wave:*

> In the past decade, a worldwide environmental movement has sprung up in response to fundamental, and potentially dangerous changes in the earth's biosphere. And this movement has done more than attack pollution, food additives, nuclear reactors, highways, and hair-spray aerosols. It has forced us to rethink our dependency on nature. As a consequence, instead of seeing ourselves as engaged in a bloody war with nature, we are moving toward a fresh view that emphasizes symbiosis or harmony with the earth. (Toffler, 1980, p. 290)

The movement to which Toffler refers is illustrated by the 1987 Montreal Protocol in which more than 50 nations agreed to reduce or eliminate chlorofluorocarbons and other ozone-damaging chemicals (Makhijani, Bickel, & Makhijani, 1990, p. 53). Figure 1 depicts the evolution of these changing perceptions of the environment, as well as two other, more pessimistic, future possibilities.

The Global Environment

Before moving further into a discussion of the impact of technology on the environment, the basic elements that compose the environment will be discussed. The global ecosystem operates through various natural cycles within three different components. The atmosphere is in gaseous

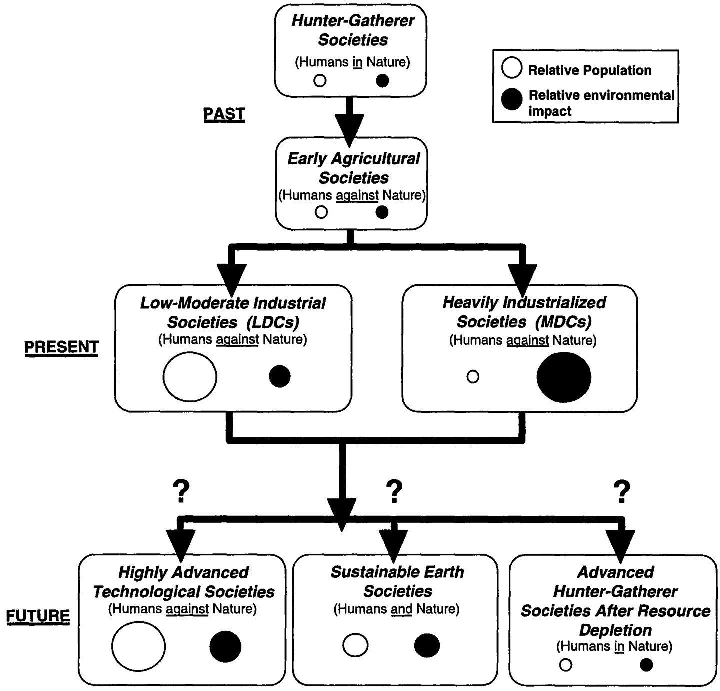

Figure 1. The evolution of changing environmental perceptions (Miller, 1990, p. 43).

form and envelopes the earth, extending approximately 80 km (50 miles) from the earth's surface. The lithosphere consists of the solid portion of the earth and includes the topsoil necessary for most plant life. The final component is the hydrosphere, the aqueous portion in either a solid (ice), liquid (water), or gaseous (vapor) form. These three components of the biosphere are shown in Figure 2.

More than 40 chemicals essential to life compose these three environmental components. Six of those chemicals make up approximately 95% of the mass of all living things. These are carbon, oxygen, hydrogen, nitrogen, phosphorus, and sulfur. These chemicals exist in all three components of the biosphere, in varying amounts depending on natural cycles. Two major cycles that illustrate the connectedness of the components of the biosphere are the carbon cycle and the hydrologic (water) cycle.

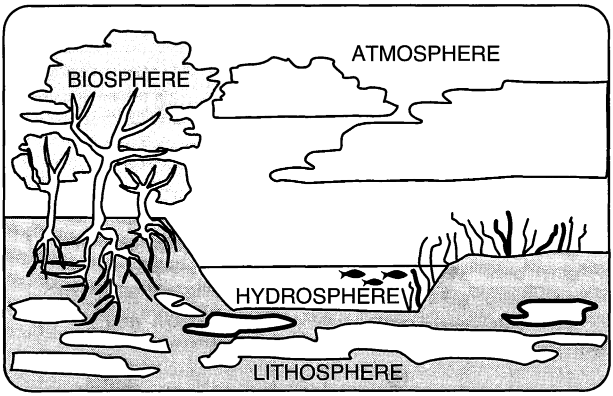

Figure 2. Components of the biosphere (Pickering & Owen, 1994, p. 4).

The carbon cycle involves the absorption of carbon dioxide (CO_2) into the oceans and by plants during the process of photosynthesis. The respiration of organisms on land and in the oceans then releases CO_2 back into the atmosphere. Some remains of plants and animals, which are made up primarily of carbon, also stay solid and therefore remain part of the lithosphere both on land and under the oceans. Eventually, this carbon is released, once again, into the hydrosphere and atmosphere (see Figure 3).

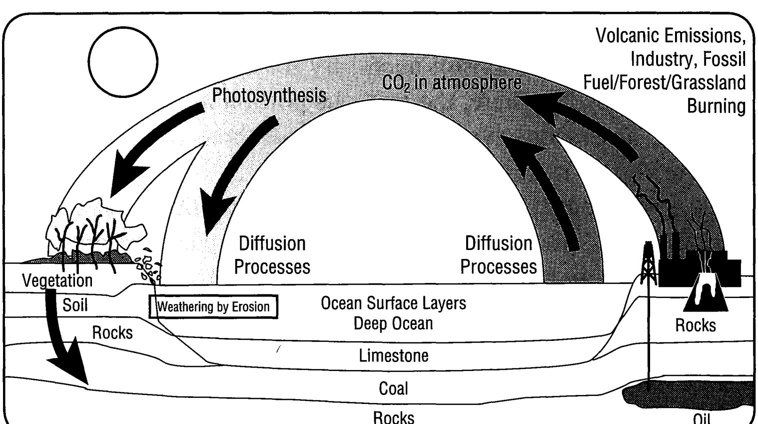

Figure 3. The carbon cycle (Pickering & Owen, 1994, p. 83).

The hydrologic cycle involves a similar exchange between the three elements of the biosphere. Clouds in the atmosphere obtain their moisture through evaporation of surface water, largely from oceans. That moisture then condenses in the form of rain and falls to the lithosphere where it begins its journey back to the sea (see Figure 4).

Under natural conditions, an ecosystem has the ability to maintain constant internal conditions despite the dynamic state of natural cycles upon which it depends. This remarkable capability is known as homeostasis. Whenever change in one or more elements of the system exceeds the homeostatic capability, however, a condition known as environmental stress occurs. Today, this occurs primarily as a result of external change due to human technological activity. Notable examples include the extensive use of fossil fuels, deforestation, use of fluorocarbons, discharge of industrial waste into the water and air, etc.

James Lovelock, a prominent scientist, has extended the concept of global cycles and systems. Naming his hypothesis after the Greek goddess of Earth, Lovelock's *Gaia hypothesis* suggests that the planet is not passive to the evolution of life through adaptation. Rather, the earth is itself a living organism, operating as one expansive dynamic system in which life on earth takes an active role in making and remaking global conditions. This *living force* is believed to control the planet by regulating temperature, atmospheric composition, and other physical characteristics. In rather

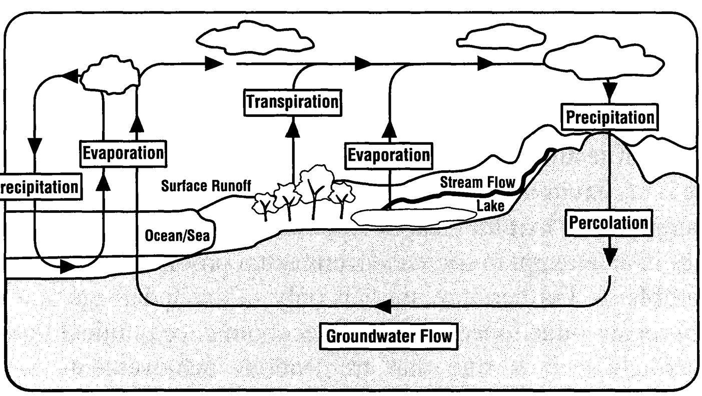

Figure 4. *The hydrologic cycle (Pickering & Owen, 1994, p. 140).*

dark tones, Lovelock suggests that Gaia has no particular affinity to specific life forms, including human. In fact, 95% of all life forms that have lived throughout the history of earth have become extinct (Cowley, 1988; Lyman, 1989; Porritt & Winner, 1988).

The Management of Nature

Human knowledge about the environment has increased tremendously in recent decades. However, there remains evidence that the tools of science and technology that we rely on to manage the planet, do not, and cannot, provide us with sufficient expertise to do so. The interconnectedness of the components of the biosphere is not reflected in the means by which we presume to understand and manage nature. In other words, our scientific knowledge is not sufficiently holistic for us to truly comprehend the biosphere in its entirety. The system is simply too large and too complex to be completely understood, let alone controlled or managed on a large-scale.

Scientific inquiry generally consists of systematic knowledge derived from observation of specific natural phenomena. Scientific data obtained in this way does not provide an understanding of the myriad of global interactions among the components. As a result, as Gordon and Suzuki (1991) concluded, "science has not provided and will not provide in the foreseeable future, the knowledge that we need to dominate and control nature" (p. 53).

Many believe that the solution to environmental degradation lies with the application of today's technology or, better yet, the development of new technologies. Such an approach epitomizes society's confidence in the ability of technology to solve environmental problems. However, in the area of environmental management and control, it is becoming increasingly clear that the rush to embrace the development of new technologies in an attempt to solve environmental problems has triggered still more problems. Furthermore, there is only so much damage that technology can repair—due to technological, economic, or political limitations.

Nevertheless, it is true that tremendous achievements have been brought about by technology, particularly within the past two generations.

In recent times, technological growth has extended human potential well beyond what was previously thought possible. In light of such achievements, it would be very easy to presume that such growth could continue indefinitely. Missing from that perspective, however, is an understanding of growth in a finite environment (e.g., population growth, energy use, waste management, etc.).

Despite technological achievements, it is critical to remember that the earth remains a finite system with limited resources. Although those limits have been extended in recent times through the use of technology, the boundaries cannot be stretched indefinitely without the threat of complete collapse of the system as occurred on Easter Island. Thus, looking to technology as the sole answer to solving environmental problems without fundamentally changing our mode of operation is not only futile, but threatens our very existence (Alcorn, 1986).

Our civilization is totally dependent on a finite resource base which we are consuming at an accelerating pace. Furthermore, those resources are not distributed evenly among the people of the earth. Affluent countries consume the lion's share, justifying their consumption on economic grounds. Such a perspective assumes that we must consume large amounts of resources to support our production, and that we must keep our production high to be competitive with other industrialized countries—which have the same philosophy. Hardin (1968) refers to this type of condition as the *Tragedy of the Commons* in which individual economic gain takes precedent over the public good. The commons—a village pasture used for grazing livestock—is adequate for all that use it, until too many people overuse the limited resource. Soon the commons is stripped of grass and everyone's cattle are starving.

The concept of the tragedy of the commons has application to numerous environmental conditions including energy, forest, and fisheries use. There is no blueprint, no Master Plan directing our technological development or resource consumption. The ecosystem and resource base cannot tolerate having all people on the earth living at the consumtive levels of the industrialized elite. At least some of the solution lies in changing values and life-styles. (See Wright's chapter for a more thorough discussion of our consumptive life-styles.)

Environmental Impacts of Technology

There are innumerable impacts of technology on the environment. In an attempt to quantify them, categories of impacts are presented in the following section. Major contributing factors of these impacts will then be discussed. Finally, contemporary ecological issues will be addressed within the broad categories of atmosphere, lithosphere, and hydrosphere.

Categories of Impacts

Impacts can be classified into one of four categories as follows:

1. Expected/Desirable,
2. Expected/Undesirable,
3. Unexpected/Desirable, or
4. Unexpected/Undesirable.

Expected impacts are those that are planned for in advance. These are of two types. They can be either desirable or undesirable. Expected desirable impacts generally provide the impetus for the application of a technology; although, as we have already noted, there is certainly no general consensus across society as to the desirability of many technologies. In other words, it is expected that technologies are specifically applied to extend human potential in some desirable way. On the other hand, it is often possible to predict negative results prior to the application of a technology. For example, the building of a major dam typically does predictable damage to the ecosystem that is inundated with flood waters. Such effects are considered expected and undesirable.

Unexpected impacts are those that cannot be anticipated before implementing a technology in a given situation. As with expected impacts, unexpected consequences can also be desirable or undesirable. Applying a technology may have results that were not anticipated, but would generally be considered desirable. A new dam may create marshes which unpredictably attract species of birds or aquatic life that were nearing extinction. The opposite could also be true if an unanticipated result of technological activity produces an undesirable effect. Destruction of the ozone layer by escaping chlorofluorocarbons and halons is an example of an unexpected and undesirable effect.

Most commonly, discussions regarding technology and the environment focus on the detrimental effects of technology on natural ecosystems. This is due, at least in part, to the fact that of the four types of consequences presented. Undesirable impacts are of most concern, particularly when they are unexpected. Examples abound to illustrate this situation: industrial and agriculture chemicals that have leeched into the soil and ground water, acid rain, carbon dioxide buildup, herbicide carryover in agricultural soil, etc.

Effects of technology on the environment can, of course, also be constructive. Advances in technology have brought about such things as wildlife disease control and saving of endangered species facing starvation and extinction from natural droughts. Technology has reclaimed natural wilderness (as well as destroyed it), protected the integrity of ecological systems (as well as disrupted them), and prevented catastrophic occurrences (as well as created them). As Alcorn (1986) reported, "It is the use to which technology is put that determines its desirability, not the nature of the technology itself" (p. 166). Negative consequences, however, have increasingly impacted the global biosphere and, as a result, remain a major unresolved global issue. A growing world population coupled with ever more powerful technology have increased environmental stress on the biosphere in unprecedented ways.

Major Contributing Factors

A complex mix of poorly understood factors has contributed to the degradation of the global environment. The increased use of resources has contributed to resource depletion as well as pollution and waste. This trend is particularly apparent in more affluent countries where new ways are continually found to consume ever larger amounts of energy and other resources for the primary purpose of increased convenience. In fact, affluent countries make up only one-third of the world's population, but consume approximately two-thirds of the world's resources (Brown, Flavin & Wolf, 1990; Miller, 1990).

There is also broad agreement among most experts that human population growth is an increasingly serious contributing factor to the degradation of the environment. One notable critic of this view is Julian Simon, an economist, who contends that population growth is not a problem because such growth accelerates progress. He pointed to the rise in production and in standard of living that accompanied the growth in population in the United States this century, as an example. He further contends that there is no environmental or resource crisis because no meaningful physical limits exist that humans cannot overcome (as cited in Berreby, 1990).

The majority of researchers, however, agree that population growth is a significant contributing factor to environmental impact. Human populations cause increased agricultural demands (e.g., increased land, energy, fertilizer and pesticide use), as well as nonagricultural demands (e.g., urbanization and direct resource use). In traditional countries in particular, where population growth continues at an exponential rate, the demand for resources continues to escalate while the available supply of resources continues to erode (Miller, 1990; Pickering & Owen, 1994). The story of Easter Island illustrates the devastating conclusion of a civilization whose resource demands continue to exceed resource regeneration.

In further describing the interactions between these two factors, Rowley and Holmberg (1992) suggested that total environmental degradation can be determined by multiplying the population, level of affluence (per capita consumption), and technology in use (see Figure 5). According to those authors, "population is now more clearly seen as a multiplier of the interaction between consumption per person and the technologies to supply that consumption and dispose of the waste" (p. 324).

Contemporary Ecological Issues

Each of the three major components that comprise the global environment is experiencing environmental stress as a result of human technological activity. Those components and the major contemporary issues associated with each are briefly described here.

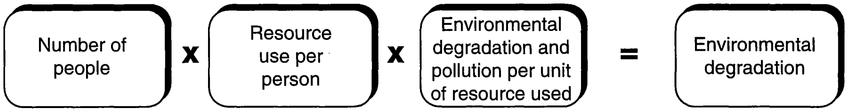

Figure 5. Causes of environmental degradation (Miller, 1990, p. 18).

The Atmosphere

Global environmental stress is occurring in both the lower atmosphere (e.g., air pollution and acid precipitation) and the upper atmosphere (e.g., climate change and ozone depletion). The effects of lower atmospheric disturbances can more readily be measured, whereas changes in the upper atmosphere are more subtle. Hence, upper atmospheric perturbations are more difficult to measure, assess, and document. Both categories of disturbances are discussed here.

Air pollution. One such atmospheric disturbance is ground-level air pollution. Although there are many different types of pollutants, the five most common are carbon monoxide (CO), sulfur dioxides (SO_2), hydrocarbons (HC), nitrogen oxides (NO_x), and particulate matter (PM). Those pollutants result primarily from the combustion of fossil fuels, either directly as fuel for transportation systems, industrial plants, and homes; or indirectly for electricity generation. Once in the atmosphere, those pollutants react (in the presence of sunlight) to create photochemical smog.

Worldwide, nearly 13% of humans are exposed to excessive levels of SO_2, and over 20% are exposed to unhealthy levels of particulates. During especially polluted periods, estimates are that, in some cities (e.g., Athens, Greece), the number of human deaths is up to six times higher than when the air is relatively clean. In the United States, approximately 2% of total deaths are caused by SO_2 alone, and property damage as a result of those contaminants exceeds $15 billion per year (French, 1990; Pytlik, Lauda & Johnson, 1985).

Acid precipitation. Another major environmental stress on the earth's lower atmosphere is the formation of acids from atmospheric pollutants which eventually return to the lithosphere and hydrosphere as acid precipitation—commonly known as acid rain. Large quantities of SO_2 and NO_x, also produced primarily by the combustion of fossil fuels, combine with moisture in the atmosphere to form sulfuric and nitric acids. Those acids then return to earth in the form of rain, snow, or fog. Research indicates that acid precipitation is responsible for up to 50,000 premature human deaths per year, as well as causing the acidification of numerous rivers and lakes. High acidity levels are also responsible for the leeching of many heavy metals into lake and river beds as well as damage to tree foliage and degraded soil quality. In addition, damage to buildings and other structures in some regions has been estimated to be as high as $6 billion annually (Fisher, 1990). Thus, while acid rain may appear to be relatively insignificant, especially when compared with the obvious devastation caused by practices such as strip mining and toxic waste dumping, it nevertheless poses a serious and long-term threat to the quality of life.

Climate change. Human induced climate change is another major upper atmospheric perturbation. The global climate is regulated as a direct function of the amount of *greenhouse gasses* that are located there. High frequency (i.e., short wavelength) solar radiation can pass through these gasses and warm the surface of the earth, whereas low frequency (i.e., long wavelength) heat is prevented from reradiating back into space. In this way, the temperature of the earth's surface is controlled through what is commonly referred to as the *greenhouse effect.*

Because the global climate also changes in natural cycles as a result of the earth's tilt, distance from the sun, and sun intensity, some authors contend that research regarding human-induced climate change remains inconclusive. However, scientific studies have documented rapid accumulations of many greenhouse gasses since the early 1800s. These include carbon dioxide (CO_2), chlorofluorocarbons (CFCs), and methane (CH_4). Carbon dioxide, the gas that contributes most to greenhouse warming (55%), has increased more than 10% since the Industrial Revolution (see Figure 6). As a result, over the last 100 years, it is esti-

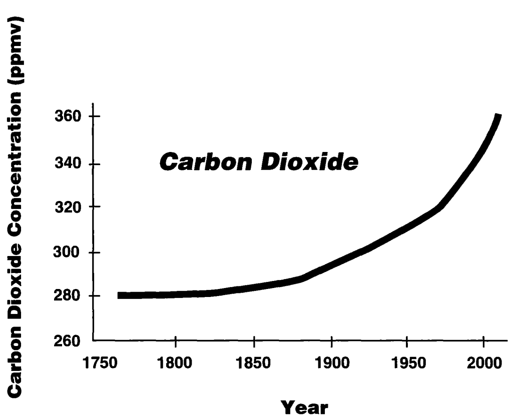

Figure 6. *Global atmospheric carbon dioxide concentrations (Pickering & Owen, 1994, p. 79).*

mated that the average global temperature has risen between one-half and one degree Centigrade and, at current projections, could increase by an additional two and one-half degrees Centigrade by the year 2100 (Barney, 1993; Gore, 1992; Wiens, 1993a).

Even if global warming gas abatement measures were to be taken today, predictions are that there would be a 30 to 40 year lag time in which greenhouse gasses (already released) would continue to migrate into the upper atmosphere and contribute to global warming. Such changes in the earth's atmosphere could easily destroy climatic equilibrium, causing wind and rain patterns to change and polar ice caps to melt, thereby raising ocean levels. This, in turn, could lead to widespread flooding of low-lying areas and increased (or shifted) drought patterns. As a result, numerous coastal cities would be destroyed (Gore, 1992; Sarre & Smith, 1991; Wiens, 1993a).

As with ground-level air pollution and acid precipitation, the primary cause of the release of excessive greenhouse gasses, particularly in affluent countries, is the burning of fossil fuels. In the United States, the country with the highest per capita contribution in the world, each person is responsible for the release of an average of 22 metric tons of CO_2 per year. Total carbon dioxide equivalents for the United States and other selected countries/regions of the world are depicted in Figure 7. Another major source of greenhouse gasses, more common in traditional countries, is the widespread practice of burning forests. This practice releases carbon from plant tissues into the atmosphere in the form of CO_2 (Gore, 1992; Pickering & Owen, 1994; Sarre & Smith, 1991). Drawing on archeological evidence, some scientists suggest that warming of the oceans will increase moisture in the air which, in turn, will increase snow fall in the polar regions—thereby leading to a premature ice age (Easterbrook, 1992). The general consensus among scientists is that we are conducting an enormous atmospheric experiment, the outcome of which we cannot predict with any reasonable degree of confidence.

Ozone depletion. Another disturbance of the earth's upper atmosphere that has serious implications for life in the lithosphere and hydrosphere is ozone depletion. Ozone is a form of oxygen containing three atoms (O_3) instead of the more common two. Most ozone is found in the upper atmosphere between 20 and 35 km (12 to 21 miles) above the surface of the earth in what is known as the ozone layer. This concentration of ozone absorbs harmful ultraviolet (UV) radiation from the sun, thus protecting

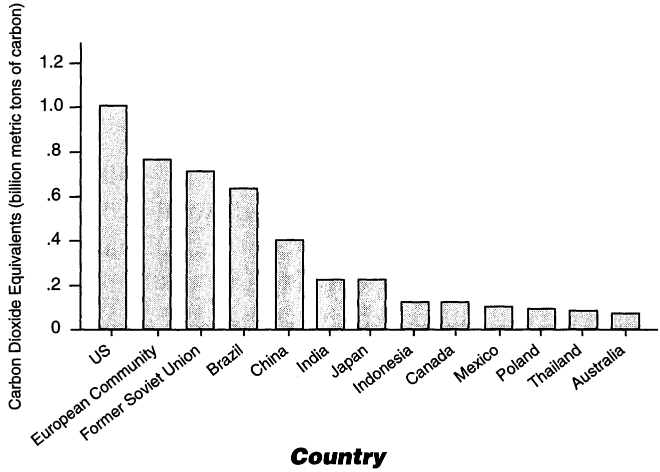

Figure 7. *Carbon dioxide equivalents for selected countries (Pickering & Owen, 1994, p. 79).*

life on the planet. However, chemicals such as CFCs that have been used for such things as refrigerants, aerosol propellants, and plastic foams have been identified as agents that are destroying the ozone layer. When exposed to UV radiation, chlorine atoms that make up the CFC molecules are released. These chlorine atoms then immediately combine with oxygen atoms from ozone. The reaction is potentially cataclysmic—one chlorine atom can break down approximately 100,000 ozone molecules. What's more, another ozone destroying chemical, bromine, is 50 times more destructive than chlorine (Gore, 1992; Lemonick, 1989; Sarre & Smith, 1991; Wiens, 1993a).

Estimates are that atmospheric ozone has been depleted by approximately 10% over the past four decades around the globe and, at times, by as much as 50% over Antarctica. In an effort to correct this problem, international agreements will, as of 1996, have phased out the production and use of the most offensive substances in many countries. Because these substances are destructive long after they have been released into the atmosphere, however, they will continue to deplete the ozone layer for an additional 20 years (Gore, 1992; Shea, 1989).

Although the full extent of the consequences of resultant increased UV radiation are not yet known, it is expected that the hydrosphere may be the most directly threatened. Phytoplankton, one-celled organisms that are at the base of the marine food chain, are extremely sensitive to such radiation. Decreases in their numbers could lead to the decline of numerous other species which, either directly or indirectly, depend upon them. Additionally, plant yields have been found to decrease and the reproduction of amphibians (e.g., frogs) is thought to be inhibited as a result of increased UV radiation. In terms of hazards to human life, for every 1% decrease in ozone, there is a 2% increase in ultraviolet radiation and a corresponding 4% increase in skin cancer. Human exposure to UV is also believed to be responsible for causing an increase in cataracts (an eye disease that causes loss of vision) and depressed immune systems (Lemonick, 1989; Sarre & Smith, 1991; Wiens, 1993a).

The Lithosphere

Although perhaps not readily apparent, the lithosphere serves a vital protective function within the global ecosystem. This component is also experiencing environmental stress as a result of human technological activity in a number of crucial ways including deforestation, desertification, topsoil erosion, species extinction, and waste generation/disposal.

Deforestation and desertification. Forests are extremely important in that they help stabilize global climate patterns and regulate the hydrologic cycle. Deforestation is a global problem that threatens those natural cycles. Forests around the world have been reduced approximately one-third since pre-agricultural times from 6.2 to 4.2 billion hectares (15.5 to 10.5 billion acres). There are a number of factors that contribute to deforestation. In affluent countries, forests are cut for lumber, for paper mill pulp, and, in a few places, for urban expansion. According to José Lutzenberger, Brazil's environmental secretary, the primary reasons for deforestation in traditional countries are to make cropland and cattle grazing land available (quoted in Worcman, 1990). Lutzenberger added, ". . . we noticed that a significant part of the forest devastation was caused by multinational companies and financed by the multinational banks with money from the First World taxpayers" (p. 43). Deforestation also contributes to desertification. Once the hydrologic cycle is disturbed in a region, forests are replaced with arid land. Approximately 1.2 billion hectares (3 billion acres) of land have been affected worldwide, and desertification continues at a rate of 6 million hectares (15 million acres) annually. This affects about 900 million people in over 100 countries in a variety of ways including reductions in productive land, shortages of firewood for heating and cooking, and human starvation (Brown, 1992a; Brown, Flavin, & Wolf, 1990; Chege, 1994; Stone, 1994).

The most dangerous form of deforestation is tropical forest destruction. Equatorial forests serve as the most important sources of biological diversity on the planet and are the most threatened of all forests. Estimates are that approximately 50% of all living species exist only in those forests. Medical science considers the tropical forests an important source of potential medicines, some for currently incurable diseases. Also, destruction of forests contributes to carbon dioxide in the atmosphere and global warming in three ways: (1) while alive, trees consume carbon dioxide when they transpire; (2) the common slash and burn technique of removing forests produces considerable CO_2 from burning; and (3) what is not burned, decays—yet another process that releases CO_2.

For these reasons, many biologists believe that destruction of the world's tropical forests is the single most serious environmental threat occurring today. Half of those forests have already been destroyed, and those remaining are disappearing at an average rate of approximately 30 hectares (75 acres) per minute. If this rate continues, the last area of tropical forest is expected to disappear by the year 2040. Temperate forests (i.e., those located in the middle latitudes) are also in decline in dozens of affluent countries. The cumulative effects of decades of air pollution have damaged approximately 31 million hectares (78 million acres) of temperate forests worldwide (Brown, Flavin, & Wolf, 1990; Denniston, 1993; Gore, 1992; Hayes, 1990).

Topsoil erosion. Under homeostatic forests conditions, the roots of plants draw nutrients from the soil while stabilizing it. This prevents the erosion of land from wind and rain. Thus, deforestation also results in topsoil erosion. Worldwide, approximately 26 billion tons of topsoil are lost annually in excess of new soil formation. The only major food-producing country to respond to the threat of erosion has been the United States, which has reduced the loss of topsoil by more than one-third in recent years. This response has been strongly supported by government programs—as research has shown that alternative farming practices are economically advantageous for farmers (Brown, 1992b; Brown, Flavin, & Wolf, 1990).

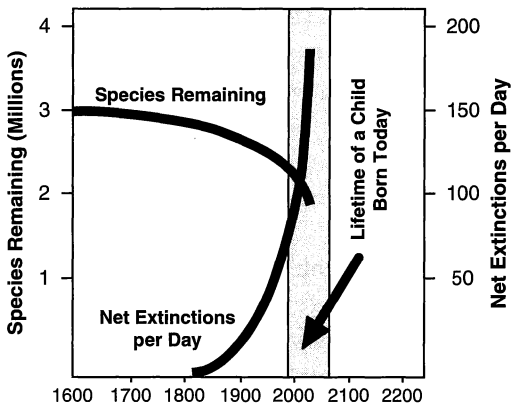

Figure 8. *Species remaining and net extinctions per day (Barney, 1993, p. 26).*

Species extinction. An associated environmental issue is species extinction. Various studies indicate that 40 (or more) species of plants and animals are becoming extinct every day—species that could provide new sources of food, energy, raw materials, industrial chemicals, and/or medicines. The number of species remaining and net extinctions per day are identified in Figure 8, as is the human life span for comparison purposes (Barney, 1993; Prins, 1993; Sarre & Smith, 1991).

Miller (1990) has commented on the importance of biological diversity observing that "every species here today represents stored genetic information that allows the species to adapt to certain changes in environmental conditions. This biodiversity is nature's 'insurance policy' against disasters. It must be preserved and sustained" (p. 139). Hence, the implications of species extinction are extremely serious.

Waste products. Another human technological activity, primarily affecting the lithosphere, is the generation and problems associated with disposal of tremendous amounts of waste products. Most visible are the large amounts of municipal solid waste (MSW) being generated. The situation has expanded to near crisis proportions in some communities as landfills have reached capacity and people have strongly objected to the development of new landfills in their backyards. New York City, for example, ships half of its garbage to Pennsylvania and westward as far as Missouri (*The Kansas City Star*, 1990). Perhaps nothing has demonstrated the solid waste problem as vividly as the voyage of the ill-fated barge, the Mobro. In the summer of 1987, this scow, loaded with 3,000 tons of garbage, left Islip, Long Island, and sailed into America's collective coscience, in search of a place to dump its smelly cargo for a profit. The captain was turned away by six states and three countries—Mexico, the Bahamas, and Belize—before returning to Long Island, 57 days later, to dispose of the load.

In the United States, a country of extremely high consumption, such waste is generated at an average rate of over five pounds per person per day. Various types of hazardous toxic waste and heavy metals are also produced, by conservative estimates, in roughly the same quantities. Furthermore, the more than 80,000 commonly used chemicals that largely comprise that waste are increasing at a staggering rate. More than 7 million chemicals have now been produced, and production is currently doubling in volume every 7 to 8 years. Of those chemicals, many are never tested for possible toxicity before use (Gore, 1992).

Nuclear waste. The most dangerous, and perhaps the most frightening of all waste products is radioactive waste. Ninety-five percent of current amounts has been generated by the civilian use of nuclear power. Radioactive waste now exceeds 100,000 tons worldwide. Approximately 9,500 tons of spent radioactive waste is added to that total every year. Because those substances will remain highly dangerous for hundreds of thousands of years, agreement on appropriate disposal methods has been understandably difficult. In accordance with the 1975 London Dumping Convention, some countries continue to dump their nuclear waste into the oceans legally. Under increasing international pressure, though, many countries (e.g., Britain, France, Germany, Japan and Sweden) have turned to underground repositories. In countries such as the United States, where no national policy has yet been established, most waste remains *temporarily* stored at nuclear reactor sites (Lenssen, 1992; Pickering & Owen, 1994).

The Hydrosphere

According to Gore (1992), there are four major threats to the global water system. These are:

1. the redistribution of fresh water supplies,
2. the rise of sea levels and subsequent loss of low-lying coastal areas,

3. the effect of deforestation on the hydrologic cycle, and

4. the worldwide contamination of water resources.

Water pollution. Environmental stress in the hydrosphere is most readily apparent in inland waterways and lakes, as well as coastal ocean regions. Of those, the effects of human technological activity on inland fresh water resources are most readily noticeable. Although some lakes have been saved, water pollution has resulted in the *biological death* of thousands of others in industrial regions of the world—and thousands more are dying. Groundwater quality has also been compromised by those contaminants. According to information compiled by the Worldwatch Institute, in the United States alone, approximately 50 pesticides contaminate ground water in 32 states (Ayres, 1994). An abundance of degradable pollutants, such as algae and bacteria, as well as non-degradable pollutants, such as toxic heavy metals and chemicals, have contributed to the problem (Brown, Flavin, & Wolf, 1990). The persistence of different pollutants in the hydrosphere is shown in Figure 9.

Water supplies. The use of groundwater at rates that exceed the natural aquifer recharge rate also negatively impacts fresh water resources. Worldwide, per capita water supplies were one-third lower in 1993 than in 1970, largely as a result of increased consumption associated with population growth. Underground water tables are falling in many regions of the world including parts of Africa, China, India, and North America. As a result, the availability of fresh water is rapidly being curtailed, while salinity levels are increasing. One well-known example is the high plains

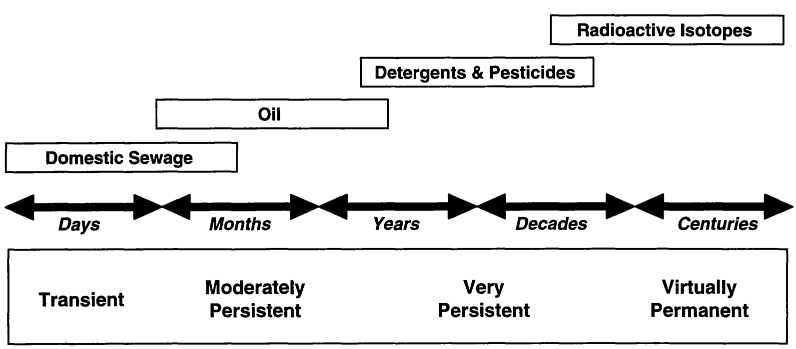

Figure 9. *Persistence of hydrospheric pollutants (Pickering & Owen, 1994, p. 139).*

Ogallala aquifer in the central United States that supplies 30% of the country's groundwater used for irrigation. That aquifer has been undergoing depletion for several decades. In Texas, where the most severe depletion has occurred, as of 1990 there had been a 24% decrease in available water from the aquifer. As a result, some cities that depend on aquifers and rivers for their municipal water supplies are fighting with irrigation farmers for water rights (Brown, Flavin, & Wolf, 1990; Postel, 1993). As water becomes more scarce, irrigation will need to be curtailed, and different seed varieties developed and used. Large investments that have been made in irrigation equipment will be lost, and production will drop. Perhaps more serious, some major irrigation-dependent crop producing areas will become deserts.

Marine life. The earth's marine ecosystem is also showing signs of severe stress. As Weber (1994) commented, "degradation in oceans' biological systems is most immediately visible in the human industries that directly depend on the seas. Marine fishing, which supplies the world with more animal protein than any other source . . . is facing a global crisis" (p. 41). In that regard, the total marine catch in 1994 was at, or above, the projected maximum sustainable yield. As a result, many fisheries have already experienced a decline in fish harvests. Marine mammal populations (e.g., whales, dolphins, and seals) also serve as an indicator of environmental stress in the marine ecosystem. This is due to their position at the top of the food chain. In recent years, many species have declined drastically in population (see Table 1).

Many other problems, contributing to degradation of the oceans, result largely from increasing pressures associated with human populations residing in coastal areas. In fact, nearly three-quarters of the world's population resides on land near the water's edge. Associated threats to the coastal environment include polluted waters and beaches from the release of industrial, municipal, agricultural, and livestock waste, as well as eroded topsoil and damaged coral reefs. Some beaches are no longer fit for human use while nitrogen from human and industrial waste has caused algae to flourish and choke out many fish and other higher forms of aquatic life (Ayres, 1993; National Commission on the Environment, 1993; Union of Concerned Scientists, 1992-93).

Table 1

Changes in Marine Mammal Populations Since Mid-century (Ayres, 1993).

SPECIES	**PAST POPULATION** [1]	**RECENT POPULATION** [2]
Declines		
Sei Whale	200,000	25,000
Fin Whale	470,000	110,000
Blue Whale	200,000	2,000
Humpback Whale	125,000	10,000
Right Whale	200,000	3,000
Bowhead Whale	120,000	6,000
Northern Sea Lion	154,000	66,000
Juan Fernandez Fur Seal	4,000,000	600
Hawaiian Monk Seal	2,500	1,000
Recoveries		
Gray Whale	10,000	21,000
Galapagos Fur Seal	near extinction	30,000
Antarctic Fur Seal	near extinction	1,530,000
Walrus	50,000	280,000
Dugong	30,000	55,000

1 - Late nineteenth to mid-twentieth century
2 - Late eighties to present

The Human Response

All too often, contemporary ecological issues such as those identified here are presented without further discussion. Clearly, there are major challenges facing humanity in regard to degradation of the global ecosystem. These issues are being addressed on a number of fronts: political, technical, and social. Each of these will be discussed in turn.

Political

Historically, humans have relied more on the political system to address environmental degradation than on any other institution or segment of society. This has largely taken the form of environmental legislation. A number of international conferences have been held for this purpose. In June 1972, the first international conference on the state of the environment was held. Sponsored by the United Nations in Stockholm, the conference was attended by 1,200 politicians and officials from 114 nations (Markert, 1989).

A second global environmental conference was held at Versailles, France, in November 1984. One of the nine governing principles adopted at that conference served to summarize the conferees' position: "Mankind must continue diligent efforts to understand the natural environment, especially to anticipate the consequences of industrial and other human activities" (Anderson, 1985, p. 9).

More recently, the Rio de Janiero United Nations Conference on Environment and Development (UNCED), the *Earth Summit*, took place in June 1992. With leaders in attendance from almost every nation, the Earth Summit was a historic event that captivated the true magnitude of the global environmental crisis (Gore, 1992; Prins, 1993).

International conferences such as these have resulted in numerous environmental agreements. This is especially true regarding agreements to limit atmospheric pollutants. Ozone depletion, climate change, and acid precipitation have all been addressed, at least to some degree, by such agreements. Table 2 identifies offending substances; use of those substances; names, dates and targets of agreements; and the number of participatory countries for each of those perturbations.

Table 2

Major International Atmospheric Agreements (Based on information in Pickering & Owen, 1994).

Environmental Issue	Major Offending Substances	Major Use of Substances	Names & Dates of Agreements	Target(s)	No. of Countries Signed
Ozone Depletion	CFC's, HCFC's HBFC's Halons Methyl bromide Methyl chloroform Carbon tetrachloride	Aerosols Refrigerants Plastic foams Solvents	Montreal Protocol (1987) followed up as: London Amendment (1990) Copenhagen Amendment (1992)	75% Reduction by 1994 (E.C. = 85%) Banned in 1996	86
Climate Change	CO_2 CH_4 NO_x	Fossil fuel combustion Forest burning	RIO: U.N. Framework Convention on Climate Change (1992)	Reduction of gasses to 1990 levels by 2000	160
Acid Precipitation	SO_2, NO_x	Fossil fuel combustion	Nordic Proposal Stockholm Convention (1984) Continuing as "Sulfur Protocol" (1993)	30% Reduction in SO_2 over 10 years (Does not address NO_2)	22

Other recent historic international agreements include the Law of the Sea (November 1994) which protects coastal waters from over exploitation from roaming fleets, and the Biodiversity Convention (December 1993) which promotes sustainable uses of biological resources. The banning of hazardous waste shipments from Organization for Economic Cooperation and Development (OECD) countries to non-OECD states is another recent development that is scheduled to take effect December 1997 (Ayres, 1994).

Many environmentalists, however, point to the limitations of such agreements, as well as to lost opportunities at environmental conferences. They contend that although the formation of policy at such meetings should consist of impartial analyses of the nature of technical systems, possible societal gains or losses, and expected environmental impacts that, very often, this is not the case. Many political scientists even go as far to state that legislation is formed more as a result of special interest groups and political action committees (PACs) than it is by informed citizens. Special interest groups have been notorious for influencing legislation through political contributions. This is largely due to the fact that when a political issue involves a technology, the possible economic advantages or disadvantages of that technology inevitably influence the political decision.

The formation of policy is further complicated by the fact that there is no *absolute* safe level of exposure to offending substances—most offending substances have *some* effect on the environment. Nevertheless, policy formation necessitates the establishment of *safe* thresholds of pollutants. As a result, determining acceptable levels of contaminants often remains a value judgment involving trade offs through risk-benefit analyses. This situation is exacerbated by the fact that new chemicals are developed daily. "Some 40,000 to 50,000 industrial chemicals are now in existence, either created as by-products or the result of spent processing materials. Of these chemicals, 80% have not been tested for health hazards" (Misch, 1993, p. 11).

In many ways, today's political establishment appears to be more inclined to seriously address environmental concerns than has been the case in the past. Beginning with the evolution of political parties in Europe known as the *Greens*, ecological issues purport to be of concern to any serious political candidate, at least in more affluent countries. However, the inhibiting factor remains that political survival is perceived as being dependent, either directly or indirectly, upon the tenants of technological and economic growth (Porritt, 1985; Young, 1990).

Such limitations within political systems must be addressed in order to successfully resolve a number of key international global issues that are critical to halt the assault on the global environment. Those issues fall into three major categories: international cooperation; the jurisdiction of common areas (e.g., Antarctica, the open oceans, and space); and assistance to traditional countries burdened with overpopulation, and international debt (Markert, 1989; Porritt, 1985).

Technical

Technical approaches can also be used to combat the many environmental hazards that we now face. One approach is to eliminate the use of technologies and/or substances that are having a detrimental effect on the environment. Some such efforts have been successful—a notable case being the decision to ban the insecticide DDT in the 1970s because of its adverse effects. Nevertheless, that option frequently encounters strong opposition because many accept the apparent dependency of society on such technologies/substances for everything from economic growth to the availability of jobs.

A more moderate suggestion, and one somewhat more readily accepted, is simply to reduce the release of pollutants into the environment. Reducing consumption, increasing product reuse and recycling are all growing responses to that need. Those approaches not only prevent the direct waste of resources, but also indirectly result in decreased energy use and a reduction in associated pollutants. Often, however, preventing the release of pollutants requires the application of ever more complicated technologies to try to reduce or eliminate environmental impacts after the fact. Automotive emission controls are one such example, where approximately $1,000 worth of equipment must be factored into the cost of each new vehicle.

Such application of technology has been a typical societal response to environmental degradation since at least the early days of industrialization. In fact, modern societies appear to be predisposed to the formulation of technological solutions. One might even go as far as to say that society has become intoxicated with the promise of technology to repair ecological damage. Such an approach relies on what might be labeled technological fixes—attempts to remedy the problem without a corresponding change in life-style (Lovins, 1977).

Another approach to improving the condition of the environment involves reducing our dependence on offensive substances and technologies and/or the use of substitutes. Most of the conveniences that we are accustomed to today can be provided by other means. For example, we are not limited to the use of fossil fuels to heat our homes and transport ourselves any more than we are committed to the accumulation of radioactive waste in order to power our appliances. Likewise, it is not a foregone conclusion that the production of goods must entail the release of massive amounts of industrial waste any more that the use of resources requires that waste products be disposed of in landfills or oceans.

Alternative practices are becoming increasingly popular, and innumerable others are constantly being developed and implemented. The use of ever-improving renewable energies such as solar and wind represent one way of providing energy with virtually no environmental effects. The use of more energy-efficient appliances and devices such as low-emissivity windows, increased insulation and fluorescent lighting are another. In the transportation sector, efficiency increases can be augmented by the increased use of electric vehicles and less polluting fuels such as natural gas, ethanol and (ultimately) hydrogen. Alternatives to many common substances/technologies such as freon-based (CFC) appliances and ozone depleting plastic foams are either currently available or, given sufficient resolve, can be developed (*Greenfreeze*, 1995; *Ozone-Friendly Foam*, 1994).

In *Small is Beautiful* (1973), E. F. Schumacher outlined the concept of what has since become known as appropriate technology. His thesis was that countries should adopt technologies that are most suited to the given situation, taking into account the desired goal and identifying the most direct and appropriate means of attaining that goal. Although originally proposed for application in traditional countries, the concepts of labor intensiveness (providing jobs), decentralization (local control), and ecological sustainability (environmentally sound) have application on a global scale. Perhaps the challenge lies with accepting the accompanying social changes that are required to fully implement those concepts.

Social

Societal changes are a final approach to addressing environmental degradation. Although human activities have always had an impact on the environment, citizens have not always been aware of that impact. In other words, environmental awareness has often been lacking, at least in forms capable of mobilizing people in large numbers. As Markert (1989) observed, only relatively recently have environmentalists and ecologists begun to make the general populace more aware of the effects of technologies on our natural resources. In fact, environmental concern has been slowly increasing among the general public worldwide. At least in the United States, this awareness largely began as a result of Rachel Carson's book *Silent Spring* (1962), which caused widespread concern about environmental issues for the first time.

Although many sociologists and politicians predicted a waning of ecological interest in the shadow of other causes, support for environmental programs remains strong. In that regard, Porritt and Winner (1988) concluded that:

> Some historians of the [environmental] movement argue that interest in the environment in modern times has largely been confined to periods of prosperity....Other theorists, however, point out that while this analysis may have held true in the past, we are now in the middle of an entirely new phenomenon, since the present worldwide wave of environmental concern comes at a time of considerable economic uncertainty. The truth is that, underlying the peaks of concern, there has been a quiet but steadily growing awareness of environmental issues. (p. 20)

This increasing environmental concern has begun to be reflected in increased citizen participation in environmental decision making. In many affluent countries (e.g., Australia, England and Germany), this participation has lead to the formation of national *Green* parties. According to Young (1990), the lack of a such a political party in the United States, however, "does not reflect the level of national concern about the environment" (p. 184). In the United States, citizens have instead become more empowered through membership in influential environmental organizations. As of 1990, the 25 most influential national environmentally-related organizations boasted combined memberships of approximately 8 million. Increasing pressure has been focused on the political establishment by these groups, and this has begun to result in environmental improvements. For example, of the 40 birds and subspecies that Rachel Carson (1962) warned were likely to become extinct as a result of the reckless use of synthetic chemicals, 19 have remained stable. This was a direct result of the banning of many highly potent agricultural chemicals such as chlordane, dieldrin, and DDT (Easterbrook, 1994; Gifford, 1990).

On a more personal level, environmental concern is increasingly reflected in individual choices. Brown, Flavin and Postel (1991) concluded as much, commenting that:

> some of the most far-reaching changes are coming from the grass-roots as individuals see their lives and their relationships with nature in a new light. As a result, they are making changes in their lifestyles, and are insisting on changes in public policy. Environmental activism has swept the world in the past decade—from Sweden to Senegal, from Moscow to Manaus. (p. 166)

Despite the fact that attitudes, values and actions are beginning to lessen the effects of human technological activity on the environment, many authors (e.g., Pickering & Owen, 1994; Sarre & Smith, 1991; Young, 1990) acknowledge that further change is imperative. Furthermore, change must occur at all levels of society. Responsibility for environmental degradation lies with every person, regardless of educational training or technical background. In the past, it was largely assumed that politicians, specialists, and experts would make appropriate decisions in the best interest of the general public. Over the years, that blind faith has dwindled. Clearly it is inadequate to suggest that scientific, technological, political, or industrial experts bear sole responsibility. *Every* person, whether accepting the role or not, plays a part in shaping the future condition of the environment. Although it is extremely difficult to change patterns that have governed human action for the past 2000 years, to do less compromises life as we know it on our planet.

Conclusions

Describing human survival in years past, Gordon and Suzuki (1991) pointedly observed that:

> in the earliest years of human evolution our ancestors knew immediately . . . [when] danger was at hand. They read the signs and silences of the natural world, and they noted the absences, and they heard clearly the warning cries of the beasts that were their sentinels for survival. (p. 233)

In the modern world, our sentinels are not as clearly understood, or completely accepted. Our ability to react to mountains of data about the current state of the environment has become inhibiting. Today's environmental crisis is colossal to the individual. To understand, much less act on, that information requires that we completely rethink the value system upon which we were raised. According to Porritt and Winner (1988), this is the most critical step, and perhaps the hardest of all to take in responding constructively to our modern crisis:

> The essential first step is to be prepared to listen to and accept the worrying information we now possess about the irreparable damage the human race is inflicting on the planet, instead of trying to reinterpret the information to make it fit with our existing hopes and expectations. (p. 255)

Education has a profound mission in addressing the degraded condition of the environment. Environmental education is necessary to provide citizens with an understanding of important environmental issues, as well as the political, technological and social influences that contribute to them. By studying those issues in a realistic context, a complete understanding of associated topics that have environmental implications (e.g., resource use and population growth) can be gained.

Such education must provide linkages between disciplines. Whereas education traditionally compartmentalizes different subjects into specific units, departments, or colleges, what is needed is a truly multidisciplinary approach. In order to emphasize that approach, the term socio-cultural/environmental/ technological (SET) education has been proposed (Karian, 1989). Whether informally presented outside of the classroom, integrated into existing topics, or offered as separate units or courses in various fields, SET education has an increasingly important role to play (see Figure 10).

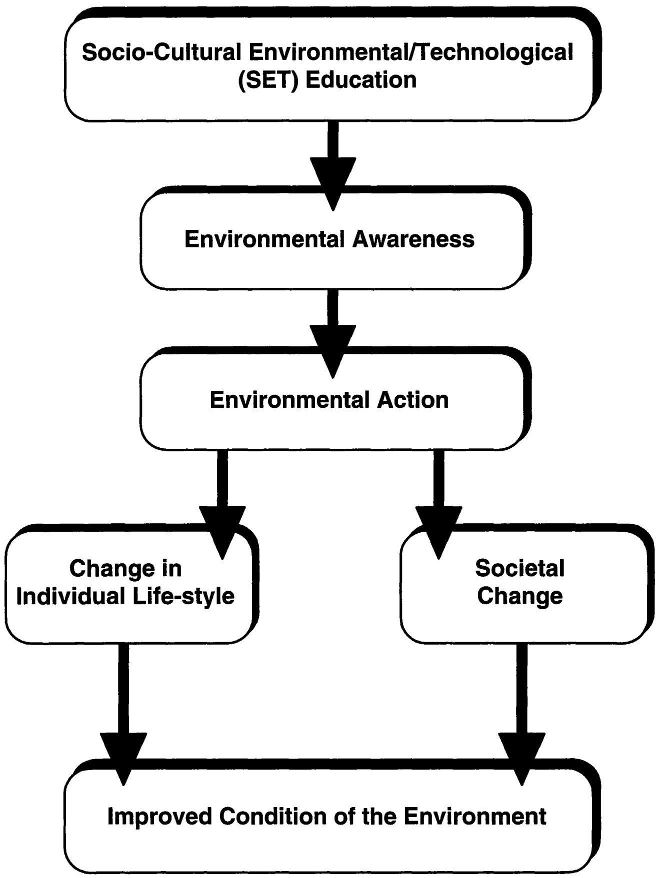

Figure 10. The role of SET education in solving environmental problems.

Only through a holistically educated citizenry can thoughtful decisions be made about global environmental issues in an increasingly technological world. Specifically, students of SET education need to be able to:

1. analyze the impacts of human technological actions on the environment,
2. synthesize the interactions between technological and socio-cultural change, environmental perceptions, and environmental quality,
3. describe categories of technological impacts and major contemporary ecological issues, and
4. analyze human political, technological, and social responses to environmental issues (for further detail, see Karian & Stahl, 1992).

Looking at the current status of education and the environment, one can easily become overwhelmed and apathetic. Nevertheless, it is true that every problem also presents opportunities. The opportunities for change are tremendous. It is critical that the entirety of our educational systems empower our children with a sense of environmental consciousness as well as personal responsibility. Unprecedented societal change is already occurring throughout the world, primarily as a result of grassroots social, educational, and environmental movements. Many new approaches to environmental protection are being implemented. Endangered land is being purchased for preservation, traditional country debt is being swapped for protection agreements, and past international development patterns are being completely rethought. We are witnessing the birth of an increasingly global environmental movement—from the people, for the environment. It is up to every one of us to participate in the process of shaping our future—and the future of the planet.

REFERENCES

Alcorn, P. A. (1986). *Social issues in technology: A format for investigation.* Englewood Cliffs, NJ: Prentice-Hall.

Anderson, R. O. (1985). Does industry have a global environmental conscience? *E.P.A. Journal, 2,* 8-9.

Ayres, E. (1993). Many marine mammal populations declining. In L. Brown, H. Kane, & E. Ayres, *Vital signs 1993* (pp. 110-111). New York: W. W. Norton.

Ayres, E. (1994). Global governance gaining. *World Watch, 7,* 6.

Barney, G. O. (1993). *Global 2000 revisited: What shall we do? The critical issues of the 21st century.* Arlington, VA: Millennium Institute.

Berreby, D. (1990, April). The numbers game. *Discover, 11*(4), 42-43, 46-49.

Brown, L. R. (1992a). Forests shrinking at record rate. In L. Brown, C. Flavin, & H. Kane, *Vital signs 1992* (pp. 94-95). New York: W. W. Norton.

Brown, L. R. (1992b). U.S. soil erosion cut. In L. Brown, C. Flavin, & H. Kane, *Vital signs 1992* (pp. 96-97). New York: W. W. Norton.

Brown, L. R., Flavin, C., & Postel, S. (1991). *Saving the planet: How to shape an environmentally sustainable global economy.* New York: W. W. Norton.

Brown, L. R., Flavin, C., & Wolf, E. C. (1990). Earth's vital signs. In A. Teich (ed.), *Technology and the future* (pp. 139-152). New York: St. Martin's Press.

Carson, R. L. (1962). *Silent spring*. Boston: Houghton Mifflin.

Chege, N. (1994). The treaty on desertification. *World Watch*, *7*, 7-8.

Cowley, G. (1988). The earth is one big system. *Newsweek*, *112*(19), 98-99.

CQ Researcher. (1992, March 20). *Remember the Mobro*, *2*(11), 250, 252.

Denniston, D. (1993). Air pollution damaging forests. In L. Brown, H. Kane, & E. Ayres, *Vital signs 1993* (pp. 108-109). New York: W. W. Norton.

Diamond, J. (1995, August). Easter's end. *Discover, 16*(8), pp. 62-69.

Easterbrook, G. (1994, Nov. 28). Averting a death foretold. *Newsweek*, 72-73.

Easterbrook, G. (1992, Nov. 23). Return of the glaciers. *Newsweek*, 62-63.

Fisher, M. (1990). *Acid rain fact sheet.* Unpublished manuscript.

French, H. F. (1990). Clearing the air. In L. Brown (Ed.), *State of the world 1990* (pp. 98-118). New York: W. W. Norton.

Friday, L., & Laskey, R. (Eds.). (1989). *The fragile environment: New approaches to global problems.* Cambridge, MA: Cambridge University Press.

Garrett, W. E. (1988). Endangered earth. *National Geographic* (Insert—Cartographic Division), 174, n.p.

Gibbons, M., & Neuman, M. (1985/1986). Creating a curriculum for a global future. *Educational Leadership, 43*, 72-75.

Gifford, B. (1990). Inside the environmental groups. *Outside, 15*, 69-84.

Gordon, A., & Suzuki, D. (1991). *It's a matter of survival.* Cambridge, MA: Harvard University Press.

Gore, A. (1992). *Earth in the balance: Ecology and the human spirit.* New York: Plume.

Greenfreeze: The will to change. (1995, January/February/March). *Greenpeace,* p. 2.

Hardin, G. (1968, Dec. 13). The tragedy of the commons. *Science, 162*, 1243-1248.

Hayes, R. (1990). *Tropical rainforests fact sheet.* Unpublished manuscript.

Hold your own earth summit. (1993, April-June). *EPA Journal, 19*, 40-41.

Karian, M. E. (*1991*). Verification of instructional objectives and a sample unit in technology education addressing environmental impacts (Doctoral Dissertation, Arizona State University). *Dissertation Abstracts International, 52*, 11A. (Publication No. 9210390).

Karian, M. E. (*1989*, December). *Socio-technological (SET) literacy for democracy.* Paper presented at the American Vocational Association Convention, Orlando, FL.

Karian, M. E. (*1987*). Technology education and the environment. *Journal of Industrial Technology*, *3*, 14-16.

Karian, M. E., & Stahl, R. J. (1992). Environmental impacts of technology: Instructional outcome objectives for technology education. *The Technology Teacher, 52*, 11-14.

Lemonick, M. D. (1989). Deadly danger in a spray can. *Time, 133*(1), 42.

Lenssen, N. (1992). Nuclear waste accumulating. In L. Brown, C. Flavin, & H. Kane, *Vital signs 1992* (pp. 100-101). New York: W. W. Norton.

Lovins, A. B. (1977). *Soft energy paths: Towards a durable peace.* San Francisco, CA: Friends of the Earth.

Lyman, F. (1989). What Gaia hath wrought: The story of a scientific controversy. *Technology Review, 92*, 54-61.

Makhijani, A., Bickel, A., & Makhijani, A. (1990, May/June). Still working on the ozone hole. *Technology Review, 93*(4), 53-59.

Markert, L. R. (1989). *Contemporary technology.* South Holland, IL: Goodheart-Willcox.

Miller, G. T. (1990). *Resource conservation and management.* Belmont, CA: Wadsworth.

Misch, A. (1993, March-April). Chemical reaction. *World Watch, 6*(2), 10-17.

National Commission on the Environment. (1993). *Choosing a sustainable future*. Washington, DC: Island Press.

Ozone-friendly foam. (1994, January/February). *Solar Today*, p. 32.

Pickering, K. T., & Owen, L. A. (1994). *An introduction to global environmental issues.* New York: Routledge.

Porritt, J. (1985). *Seeing green*. New York: Basil Blackwell.

Porritt, J., & Winner, D. (1988). *The coming of the greens.* Glasgow, England: William Collins.

Portney, P. R., Harrison, D., Jr., Krupnick, A. J., & Dowlatabadi, H. (1989, Summer). To live and breathe in L.A. *Issues in Science and Technology, V*(4), 68-73.

Postel S. (1993). Water scarcity spreading. In L. Brown, H. Kane, & E. Ayres, *Vital signs 1993* (pp. 106-107). New York: W. W. Norton.

Prins, G. (Ed.). (1993). *Threats without enemies.* London: Earthscan.

Pytlik, E. C., Lauda, D. P., & Johnson, D. L. (1985). *Technology, change and society*. Worcester, MA: Davis.

Rowley, J., & Holmberg, J. (1992). Living in a sustainable world. In J. Holmberg (Ed.), *Policies for a small planet* (pp. 321-346). London: Earthscan.

Sarre, P., & Smith, P. (1991). *One world for one earth: Saving the environment*. London: Earthscan.

Schumacher, E. F. (1973). *Small is beautiful: Economics as if people mattered.* New York: Harper & Row.

Shea, C. P. (1989). Protecting the ozone layer. In L. Brown, *State of the World 1989* (pp. 77-96). New York: W. W. Norton.

Stapp, W. B. (1969). The concept of environmental education. *Environmental Education, 1,* 30-31.

Stone, L. (1994). Solar cooking in developing countries. *Solar Today, 8*, 27-30.

The Kansas City Star. East coast's trash spilling into midwest. (July 15, 1990). A-1, A-10.

Todd, R. D. (1985). Technology education: An international perspective. *Technology education: A perspective on implementation.* Reston, VA: International Technology Education Association, 19-24.

Toffler, A. (1980). *The third wave*. New York: Bantam Books.

Union of Concerned Scientists. (1992-93). World scientists' warning to humanity. *Nucleus, 14*(4), 2-3, 12.

Weber, P. (1994). Safeguarding oceans. In L. Brown, *State of the world 1994* (pp. 41-60). New York: W. W. Norton.

Wiens, A. E. (1993a). *Air pollution and climate change*. Unpublished manuscript.

Wiens, A. E. (1993b). Social and environmental consequences of technology usage. *The Technology Teacher, 53*(1), 13-19.

Worcman, N. B. (1990). Brazil's thriving environmental movement. *Technology review, 93*(7), 42-51.

Young, J. (1990). *Sustaining the earth.* Cambridge, MA: Harvard University.

DISCUSSION QUESTIONS

1. Which of the three major factors contributing to environmental degradation have the most impact in your community? Explain.
2. Which of the major contemporary ecological issues discussed is of highest importance? Why?
3. How has the local environment in your area been affected by human technological activity during your lifetime? What were the contributing factors?
4. What is the present role of technology in contemporary ecological issues? What should it be?
5. Can the average person be expected to comprehend the magnitude of major global ecological issues? How might this be facilitated?
6. How can individuals make a difference in helping to solve environmental problems?
7. Is it true that scientific and technological knowledge provides humans with sufficient information to manage the planet?
8. Is it true that technology alone can solve any environmental problem?
9. Debate the question of whether or not there are meaningful physical limits to the human population carrying capacity of the earth?
10. Is it true that environmental legislation is formed more by special interest groups and political action committees than by citizens? If so, which groups are involved?
11. True or False? Environmental problems caused by technology are best solved by technology. Justify your position.
12. Does responsibility for environmental degradation lie with politicians, technical experts, or individual citizens?

DISCUSSION SCENARIOS

Illegal Dumping

You have worked for company X for 25 years and plan to retire five years from now. While in the office one day, you come across documents proving that the company is dumping toxic waste illegally. You have confronted your boss, but he argued that the company cannot afford legal disposal—that if forced to comply, the company will go out of business. Do you report that activity to the authorities at the possible expense of your job? Would your decision be different if your boss indicated that the company would stop the practice? Explain.

Land Rights

You work for the Department of Agriculture in Madagascar and are in charge of licensing farming rights in the country. A poor local farmer has come to you requesting approval to farm an additional two hectares of land because he can no longer sufficiently feed his family of six, and he is expecting another baby soon. You know that approval will cause additional destruction of what little tropical forest remains in the country and that the soil will only sustain agricultural yields for a few years, after which the land will be left desolate and unproductive. You must decide whether or not to grant agricultural privileges to the farmer. What will your decision be? What will your decision be for the next request? The next 20 requests? Upon what will it be based. Justify your position.

Politics as Usual

You are a member of the U.S. House of Representatives. Your party has been putting pressure on you to support an amendment that would reduce the authority of the Environmental Protection Agency to enforce environmental laws. The party argues that if the amendment is passed, it will allow businesses to be more profitable. How would you vote? How do you decide? Which groups of people have the most to gain and which have the most to lose if you vote "yes?" If you vote "no?" Do politicians usually take the long view or the short view? Why do they take that view?

CHAPTER 12

Technology and the Changing Nature of Work

David C. Bjorkquist and Rupert N. Evans

For many adults in the United States, the primary interaction with technology is in their work. Technology is used extensively in the processes of work and many jobs exist to produce, modify, or service one or more forms of technology. Many of the ideas about the relationships between technology and human existence originate from musings over experiences that occur in the workplace. The interaction with technology on-the-job results in outcomes that are real as well as perceived. For example, Zuboff (1988) quotes a paper mill manager, "The fear is that people will become an extension of a machine, and in this way [an extension] of someone else's logic process" (p. 286). Individuals are challenged by the possibilities created by technology. In its least intrusive forms, it results in changes such as new work procedures. At the other extreme, technological interventions in the workplace challenge long-held beliefs and raise questions about the purpose of human life.

The Relationship of Work to Technology

Work and technology are intimately intertwined. In this section, the nature of this interrelationship is examined by considering technology as a product of work, work as a product of technology, and the structure of the relationships between technology and work.

By definition, work is intended to produce benefits for the worker or for the worker and others. In addition, the worker is aware of being at work when so engaged (Hall, 1986). There may be compensation for work in the form of wages, salary, barter, income saving, or other benefits to which an economic value can be attached. Some benefits of work are not typically measured in economics, including protection and improvement of the natural environment and advocacy for human rights. Work may occur in the place of employment, the home, and the community. Most people in the United States receive compensation for a portion of their work for some period of their adult life. There are many who work to save income and do not receive direct compensation, such as those who provide for care of the home and family members.

Technology as a Product of Work

Technology is often created to make work possible and to extend the capability of the worker. The hoe of the farm laborer, the net of the fisher, the stove of the cook, the order pad of the meal server, the automated machine of the manufacturing worker, the paint brush of the artist, the price tag of the retailer, the lesson plan of the teacher, and the planning committee of the executive represent technologies that are the result of the need to accomplish tasks in the work setting. Whether simple or complex, much of technology has been created to change the performance of the job and is integral to accomplishing the purposes of work. The demands of work have been the inspiration for the development of technology.

In its more tangible outcomes, technology is used to make actions of work more efficient. Efficient action together with knowledge of practice are the elements of the definition of technology used by Towers, Lux, and Ray (1966). From the farm laborer's hoe to the executive's planning committee, efficient action is one of the reasons for employing technology at work. Efficiency must also be thought of in terms of the prevention of loss that may result from the exposure of humans to harmful work surroundings. Technologies have been developed to control exposure to radiation and toxins. Losses due to injuries caused by repetitive motion and job stress are addressed by other technologies. In many cases, the technology of work has produced the hazards for which other technological solutions are sought.

Another reason for the development of technology in the workplace has been to extend human control. Roemer (1980) contended that this is the distinguishing feature of technology. Automated machining centers and precision measuring are technologies that can be used to make products more consistent with each other and can extend human control.

According to Feenberg (1991), technology is an instrument of human control in another form, that is, political control. Technology is not neutral and those who plan the procedures and select the mechanization may do so with the intention of controlling the behavior of those who produce the goods and services. There is a resulting social struggle between those who design and select the technology and those who are employed to use it. Feenberg advocates democratization of the workplace and the representation of workers in the early design of technology for work.

As the demands on work have changed, technology has followed. The pressure for more efficient production has shifted the manufacture of goods away from a system based on the multiple skills of individual craftspersons. The development of assembly lines required limited skills of individual workers but used many workers. Newer diverse production systems incorporate mechanical, information, and human inputs that include supplier-vendors, product design, manufacturing processes, distributors, and post-sale servicing. Each step in the evolution of work has produced a new stage of technological development.

Work as a Product of Technology

Technology has created work, altered the ways in which work is performed, and has reduced or eliminated the need for some work. In Western society, it is doubtful that there is any work that has not been changed by technology. The conditions and demands of work are different because technology has resulted in new mechanisms, materials, and processes that alter the conditions of work and demand increased worker knowledge and skill, on one hand, and deskill jobs on the other.

In earlier times, building construction work in Northern climates was not year-round as it is today. Cold weather prevented the proper use of many building materials and construction workers could not dress to keep warm and still work efficiently. Products resulting from the application of several technologies have been effectual. Plastic sheeting has made it feasible to enclose buildings under construction. Portable heaters will raise the temperature above freezing within these enclosures. Some building materials, such as mortar, are formulated to resist freezing and can be used during the winter. Lightweight clothing insulates workers against the cold without hampering their movements. The proper application of these and other mechanisms and materials on-the-job has required new technological understandings and skills of workers. Conversely, technological systems have been used to mechanize repetitive tasks and to divide jobs thus requiring a narrower array of job skills of individual workers, a form of deskilling. As a result of these technological developments, the cycle of work for building construction workers and the demands upon them have been changed significantly.

Technology has eliminated some jobs from the mainstream of employment. For example, large numbers of workers no longer have jobs on manufacturing assembly lines. The demand for customized products, reduced inventories of manufacturing raw materials and finished products, automated machining and fabricating equipment, robots and material moving systems, manufacturing cells, simultaneous design and production engineering, short production runs, decentralized assembly, and many other technologies are moving toward eliminating assembly line work as typified by the early automakers and other manufacturers.

An illustration of a field of work where new jobs have been created by technology is that of electronic communications. Electronic messages have replaced many messages that formerly were transported by mail or courier. As ideas increasingly are beamed from one location to another, electronic communications become the reason for new jobs. Consumer products are designed, manufactured, sold, and serviced. The systems that make the consumer products usable are constructed and maintained creating new jobs in the utilization of transmitting and receiving stations, fiber optics, satellite stations, and computer interfacing. These, and many other jobs in this field, have resulted from technology that was not in existence a generation ago.

The Structure of the Relationships Between Technology and Work

A characteristic of contemporary work is the extent to which technology has been used to give it structure. The organization of industry and business and the structure of occupations found there are products of technology that are used to accomplish work goals.

In part, the nature of work is the result of ways in which firms are organized. A family farm requires a different organization than does a multinational corporation. The jobs of individuals within these two types of enterprises are related to the structure of the organizations and the functions of the units of the organization.

This can be illustrated by considering the responsibility for training within firms. Rosen (1994) observed cases of the decentralization of the training function in firms in which training is moved away from training departments to individual operating departments. Thus, training is not conceptualized as a separate educational function within an organization but is an integral element of the production of a good or service. This structure alters the work of those who do training and those who are considered to be production workers. It can be expected that training conducted within operations departments, by trainers who are department members, will be responsive to the skill and knowledge needs of those who work in the departments. Training is more likely to be *job specific* and evaluated on the basis of its contribution to the productivity of a department. All members of a department are likely to view their work differently (learning is part of the job) and will have their work changed in some ways by the presence of a trainer. More individuals may find that training others is part of their job responsibilities. This micro example of an organizational structure provides insights into the ways in which the technology, used to organize for efficient production, influences the responsibilities of the work itself. Workers, irrespective of job responsibilities, are being involved in organizational technology such as work teams, participative management, and bargaining units.

At a macro level, mergers and acquisitions are common means for organizations to change their thrust. This may mean expanding existing business, eliminating competition, or adding diversity in products and services. Each merger or acquisition results in the accommodation of two or more separate corporate cultures within a new organization. This will often change the work of all those who are employed because the value system within which they work is changed (Bjorkquist, 1992). For example, there may be a corporate value shift from, "we back our products through their entire life" to, "we manufacture products to meet the price competition." Over and above these all-encompassing work changes that result from the technology of organization are the dramatic work changes that occur for a smaller group within the firm. Some workers may have their jobs eliminated and a chief executive officer of an independent firm may become a vice president in a firm that is formed out of a merger. Those who are employed at one firm site may become specialized in one product or service rather than in the diversity produced previously.

Developing and maintaining organizational structure is technological work for some persons, usually managers. Similarly, tool and die designers and makers have work that is the direct result of the need to develop technology to solve problems of production. Those who produce software for computers must develop technological solutions for problems in order to be successful. In some ways the work of persons in management, tooling, and computer software is distinctive and defined, in part, by the application of technological processes to their work.

The Traditional Nature and Role of Work In United States Culture

Carnevale (1984) authored a monograph, *A Society Based on Work*, and thereby identified a defining characteristic of United States culture. Many early immigrants to this nation were zealous about their work and practiced a work ethic that has helped to shape the ways in which we think about work, even today. Numerous Federal Acts were designed to prepare individuals for participation in the workforce and to further the ideal of equality of opportunity in employment. Although never implemented, legislation was enacted to assure all citizens the right to work (Humphrey-Hawkins, 1978). Even though there may be a perception that work is not as important as it used to be, it still is offered as a primary antidote for social ills. Work is proposed as one of the solutions to problems such as welfare dependency, crime, economic noncompetitiveness, and diminished opportunities (Carnevale, Gainer, & Meltzer, 1988). The central position of work in the culture of the United States from colonial times until the present can be traced.

Economics of Work

Economic returns are, and have been, the primary reason for many people to engage in work. These returns from work can be measured as income producing and income saving. The relative value assigned by society in the United States to these two forms of economic endeavor has shifted over time, although each has contributed significantly in every period of time. Income saving was valued highly by the Puritans as an incentive in work that was performed to achieve thrift and frugality (Almen, 1963). But, even the Puritans consumed beyond what they could produce within their own enterprises and for this they needed to produce some form of income. Their practices of thrift and frugality and the richness of their 17th and 18th century New England environment resulted in an accumulation of wealth as they had not intended. Work could no longer be justified only as a means to achieve thrift. Therefore, wealth acquired through industriousness, frugality, perseverance and sobriety was sanctioned within the Puritan religious ethic of work.

Particularly in the period from 1865 to 1915, the capacity of industry in the United States expanded and the primary societal purpose of work became consumption. Efficiencies of production, such as methods of mass production, resulted in more goods than had customarily been consumed and leading figures in business, politics, and religion urged hard work for the purpose of accumulating wealth (Almen, 1963). At the beginning of the Great Depression (about 1929), industrial capacity in the United States was underutilized and could not provide the jobs and prosperity that were expected of it. Ginzberg (1982) stated that "national policy began to look at employment as much from concern to ensure the consumption of goods as from concern to secure their production" (p. 67).

The period of recovery from the Great Depression (from 1933 into the beginning of World War II) saw the initiation of economic policies to make consumption easier. The objectives of President Franklin Roosevelt's administration, which came into office in 1933, were relief, recovery, and reform. Jobs were created through the Federal government to provide services for public benefit. The Social Security Act (1935) provided income for disabled and retired workers, and those who were unable to find work were assisted by the Unemployment Compensation Act (1935). The Federal Housing Administration, created in 1934, provided for reduced down payments for home purchases and lengthened the period of repayment of the loan. Lump sum repayment of mortgages was eliminated as a common practice.

Two significant attitudinal changes about the relationship of work to personal economics found form during the recovery from the Great Depression. The first was that hard work might not protect individuals from economic disaster. There was need for a social *safety net* that provided financial support for those who were disabled or retired and compensation for those who were unable to obtain work. The second change was one that widened the possibility of consuming on the basis of work to be performed in the future. Home mortgages no longer required a lump sum for the loan principal, a concept that has been extended to other large and small purchases. As consumption was made easier and easier, there were some who observed negative consequences. Former presidential candidate Eugene McCarthy observed (Jeter, 1988).

> The dominant word in America today is more. We over-consume food and fuel. We overbuild automobiles. We're over-advertised. Why spend money on education when we spend $100 billion on advertising, which is pretty much designed to keep us from thinking? (p. A7)

Work as a Source of Group and Individual Meaning

Tillich (1959) contends that work is a way in which a society pursues its goals. For example, if there is an egalitarian goal to recognize the importance of all individuals, a society will work to uphold that value in its practices and will expend significant portions of its wealth to support that principle. In the United States, there is a goal to provide equality of educational opportunity for all citizens. Court decisions are made consistent with this goal and many people are engaged directly in the work of affirming this value. Acting on behalf of citizens who commit a portion of the return from their work through tax payments, legislative bodies in the United States have repeatedly appropriated money to support educational programs.

No person is self-sufficient and each society maintains some division of labor, an idea expressed in the writings of Adam Smith. There is a mutual dependence among people that has had its basis in the community. Those within a community have exchanged for the products of each others' work in order to survive or to enhance their life-style. The concept that has changed is that of community. In earliest times of human existence, community was limited to those with whom direct physical contact could be kept. The community may have been as small as family or clan. This can be contrasted with *one* community of today, one that is global and international. Interdependencies exist among people who have never had direct contact in a physical, visual, electronic, or any other sense. A variety of technologies has been developed to make this extension of community possible. Smaller, geographically localized communities exist today; but, in the industrialized world, they are not self-sufficient.

The interdependence of societies gives meaning to the work that is performed there. Work is a way to serve other people and to enrich their lives. More often, perhaps, the people of other societies are seen as potential markets for the products and services of our work (e.g., Eastern Europe) or are considered to be our competitors (e.g., Japan). These views of our work become incentives to make work more efficient and to introduce technologies to increase productivity. Some decisions about work, which would otherwise be irrational, are justified on the basis of serving others, meeting a market need, or beating the competition.

Many of the values that society associates with work also are held by individuals. Foremost, perhaps, work in industrialized societies is identified as a way to earn a living. The increasing sophistication of societal structure has separated the worker from the source of the goods and services to be consumed. This has given value to the currency that is used to negotiate the exchange of work for the necessities and enhancements of life. To those in middle-class occupations, work means something interesting to do, having a chance to accomplish things, and to contribute. Those in working-class occupations are more inclined to view work as activity with the individual oriented toward the effort rather than the product (Parker, 1983). Work does not have the same meaning for all individuals and the relationship of persons to their work is likely to change from time to time.

One of the outcomes of the high value placed on work by society and by individuals is an addiction to work to the extent that a descriptive term, *workaholic*, has been coined. Work is socially acceptable and those who engage in it beyond usual expectations are often praised for their diligence and contribution and may feel rewarded for extending themselves in their work. However, it is also recognized that overwork may be symptomatic of problems of the individual including loneliness, and the desire to escape from other responsibilities.

Societal Expectation for Work

Turnbull (1983) states that work, across many cultures, is doing what you are doing at a particular time in life, as long as it is socially approved. Society does approve and disapprove of various forms of work, although the degree of approval of a given occupation can be changed. For example, prior to the spread of gambling casinos across the United States, fewer persons approved of occupations within the gambling industry. The level of approval has changed to the extent that publicly-supported educational organizations have prepared workers for entry into gambling occupations.

Society also expects a return from the work of its members. Education for work preparation is taken as a societal responsibility. In return, society expects that the economic well-being of the individual and the entire society will be improved. This has been carried out at the state level and is evidenced as national policy in the United States through the programs for occupational preparation that are supported by the federal budget. Some examples are in the Land Grant Acts, the Vocational Education Acts, and the support of the military academies. Each state in the United States supplements the federal educational investment and supports an additional variety of educational institutions.

Another conception of work is as a cornerstone of domestic tranquillity, a way to help society function peaceably. Teachings, from early times forward, have associated idleness with troublemaking and undesirable outcomes. (For example, see the account of the teaching of St. Jerome in Kaiser [1966]). Mahatma Gandhi (Datta, 1953) saw work as an act of self-surrender in order to accomplish the greatest good for all. He advocated that work, requiring some physical exertion, be required of all workers thereby reducing the need for artificial exercise and medicines, to the benefit of the individual and society.

Individuals in modern industrial society seldom work alone because they cannot be self-sufficient. There are organizations and institutions within society that serve to bring together individuals whose productivity can be enhanced by working together, who need to exchange the output of their work for the product of someone else's work, and who want to serve or be served through work. To this, society adds norms to identify socially acceptable work. Technology has contributed by expanding the geographic interrelationships in work, expediting the exchange of products of work, and communicating social expectations for work.

Changing Technological Requirements of Work

As demands to increase the productivity of work have increased, the use of technology in the workplace has multiplied. Technology which is designed to extend human control and capacity is evident in the places where people work. Restauranteurs understand the business benefits of using a salad bar to let customers prepare part of their own meal. Barcodes and barcode readers have replaced price markers and keyboard cash register entry in the grocery business. Driving nails with a muscle-powered hammer largely has been replaced by power nailers. The dentist fills teeth with compounds that have become available within the last few years. New processes, new machines, and new materials have entered into practically every occupation in the industrialized world. As a test of the spread of technology at work, ask a group of friends to name a job that has not been changed in the past decade by the introduction of technology. This section considers technology that is used in work, technology as a means of controlling work and workers, the educational and competency demands placed on workers, and the changing demographics of work in the United States.

Technology Used in Work

Given the centrality of work in industrialized society, the emphasis placed on the productivity of that work, and the concept of technology as a means of extending human capability, it follows that technology, in all of its forms, is represented in the workplace. The technology of the workplace is one of sociotechnical systems that has the purpose of increasing the efficiency of producing goods and services (Kline, 1985). Technology in the workplace can be identified by the mechanisms and social organizations that are used there and by the artifacts of technology which provide much of the record of technology used in work.

The technology represented by mechanical devices, including electronics and lasers, has an easily documented place in work. The computer is often used as a machine that stores and retrieves electronic impulses. The computer may be coupled with other machines that compute, control, inventory, print, weld, machine, paint, and perform other functions formerly dependent on human intervention. As a result, we expect to see computer-controlled machines in most goods and service production industries. Zuboff (1988) describes how the knowledge of individual workers is digitized and entered into computers, thus relegating production and control functions to *smart machines*.

The importance in the workplace of socially-based technologies rivals other technologies that are there. The social organization that can bring the investments of millions of owners together in a corporation is a necessary technology for the existence of many workplaces in industrialized society. The social structure of any enterprise where work is performed provides clues as to how the organization is an entity with its own characteristics and how individuals are linked together to accomplish the purposes of the organization. The demands for product flexibility, for example, have resulted in the development of several social technologies such as self-managed manufacturing teams, cell manufacturing, pull-along assembly, and just-in-time linkages with vendors and distributors. On another level, Lakes (1990) describes the important social skills that are developed through apprenticeship training and the ways in which these skills enhance the ability of workers to function on the shop floor.

Technology is readily evident in the work of the home and community. Utensils, such as spoons, represent technology that has existed for a long time, while electronic devices such as television, programmed thermostats, transmitter/receiver monitors for infants, and microwave ovens represent more recently developed technology. The work of home and community is facilitated by the systems for measuring and delivering utilities (water, gas, and electricity). The time of the householder for providing these services, as compared with gathering fuel and carrying water, is reduced by hours each day thus allowing more leisure, a greater diversity of work within the home, or employment outside of the home. The redistribution of time in the work of the home, community, and employment is further evidence of the impact of technology.

Technology as Control of Work and Workers

Increasingly, attention to the use of technology in the workplace is focused on control of the work and, subsequently, on the worker (Feenberg, 1991). In colonial India, Mahatma Gandhi advocated the production of homespun cloth by citizens as a form of protest against the British policy of purchasing cheap raw Indian cotton and returning expensive cloth to the markets (Datta, 1953). Work in India, in the production of cotton cloth, was largely limited to growing cotton. The placement of technologically-advanced looms outside of India provided this control and reserved the value-added processing for others. Rodney (1983) contends that Europeans intentionally underdeveloped the continent of Africa in order to maintain the control that technology makes possible. On a global scale, the Indian and African cases provide examples of how technology, used as control, influences the work of individuals and large and small groups.

In relationship to the individual workplace, Zuboff (1988) describes two alternative outcomes that result from the introduction of *smart machines* in the workplace. The primary difference in these outcomes is in the way in which technology is a control and who is the controller.

One of the alternatives, according to Zuboff (1988), is to automate by the use of machines. This reduces the number of decisions to be made by humans and increases computerized decision making. Skills that use senses of sight, touch, and smell are replaced by sensing devices that are digitized and placed into computers together with the parameters for decision making. Zuboff gives an example of how the work of pulp makers in a paper mill has changed. Before smart machines, these individuals were responsible for deciding when process stages were completed based on information gathered by squeezing and smelling samples of pulp that were hand-dipped from vats. After automation, sensors placed in the pulping vats relayed data to a computer which displayed icons on a computer screen so the process could be monitored while decisions were made by the computer. Workers were located in a control room several hundred feet away from the floor where the paper pulp was being processed and were not permitted to intervene in the processes now controlled by the computer. Actually, the computer was not the controller. The real control was in the hands of those who determined the parameter limits that would be exercised by the computer.

One of the influences of computer controlled and paced work is that workers can deny responsibility for errors that are made and can blame them on the computer. When this happens, the tendency is to tighten the control of the computer and to further remove the worker from involvement in decisions associated with the work. One of the consequences of this disengagement of the worker is not to use the experience and knowledge of the worker who is best informed about intimate details of the job.

With the introduction of advanced technologies into the workplace, authority for more and more minor decisions tends to concentrate in the hands of those with managerial responsibility (Zuboff, 1988). This runs counter to what some workers consider to be characteristics of a desirable job (e.g., see Karasek & Theorell, 1990; and Northwestern National Life Insurance Company, 1992).

The second alternative that Zuboff (1988) describes is one that she calls to *informate*. To informate is to use the smart machines to provide all individuals working in an organization with the same information base and to encourage workers and work groups to initiate and develop alternative practices for accomplishing a firm's goals. This shifts significant control to those who perform the work. For example, teachers in a school may recognize a need for parents to have more descriptive information about the school progress of their children. With this goal in mind, teachers working in an *informated* school may act to initiate changes in the computerized student records of the school. The direct experience of teachers with parents has caused them to understand the problem and, as informated employees, the teachers have been enabled to act. In this case, technology has been used to introduce elements into the job that are considered by many to make the work more satisfying.

As with other dimensions of life, the impact of technology on work is not unidirectional. Technology has been introduced to make jobs safer, cleaner, less physically demanding, less tiring, more interesting, more efficient, and capable of more consistent quality. It also has made jobs more monotonous, more stressful, dehumanizing, less satisfying, more controllable, demanding of fewer skills, requiring of more diverse skills, and less secure. Markert (1989) states that in living with technology we are weighing tradeoffs and making choices. In many work situations, employees are not given the opportunity to participate in decisions about the introduction of new technology to the job and are left to protest after the decision has been made when it is not to their liking (Feenberg, 1991). Conversely, Lakes (1994) suggests that technology can be used to democratize the workplace and can enable workers to participate in decisions about technology at work in the earliest stages of consideration.

Educational and Competency Demands Placed on Workers

A primary challenge for workers created by the evolution of technology used in the workplace is meeting the real competency demands created by the technology and separating them from what is perceived by those who control and use the technology. A frequently offered solution for meeting these competency requirements is additional education. Sorting out the competencies that are needed and the route to their development from the solutions that are popularly advocated can be a complex task demanding thorough analysis of the work under consideration. Special competencies are required to perform any work effectively. When these competencies are not grounded in a thorough understanding of the work to be performed, they will tend to be overstated and misdirected when translated into educational requirements (Robinson & Robinson, 1989).

This point can be illustrated by the problems experienced by molder operators in a factory making rubber O-rings and other seals. Because variable heat and time requirements are dependent on the rubber compound being used, there were too many unacceptable parts being produced. Observation and questioning of mold operators indicated that, in large part, they had learned molding practices by trial and error. They were not provided with information about the relationships among molding temperatures, time, and particular rubber compounds. The plant manager suggested that the solution to the problem was for molders to complete a course of instruction in rubber chemistry. The molders were experiencing operational problems in producing acceptable parts because of a lack of information about the performance characteristics of the rubber with which they worked. The plant manager wanted a theoretical course that could better inform molders about rubber compounds but would not provide direct assistance in solving the problems of operating molds. The manager's perception of the problem and its solution was not based on an analysis of molder's job but on some other conceptualization.

Many of the competencies required by work in contemporary industrialized society are based on broader, more generalizable skills. For example, the report, *What Work Requires of Schools* (U.S. Department of Labor, 1991), describes a foundation that is advocated as necessary for developing competencies for work. This foundation includes basic skills, thinking skills, and personal qualities. The basic skills are reading, writing, arithmetic and mathematics, speaking, and listening. Thinking creatively, making decisions, solving problems, visualizing, knowing how to learn, and reasoning are the thinking skills. The personal qualities are individual responsibility, self-esteem, sociability, self-management, and integrity.

The proposed competencies that are built on the foundation also are widely generalizable (U.S. Department of Labor, 1991). Effective workers are to be competent in resource allocation, interpersonal skills, information processing, understanding systems, and application of technology.

One of the assumptions is that the foundation of skills and competencies for effective workers (U.S. Department of Labor, 1991) will increase the flexibility of the worker by applying to many work situations. The specific skills required for the work of a particular firm, for a specific occupation, or a given work station can be developed on these skills and competencies. With this preparation, the expectation is that more and more workers will be able to make new applications of their skills and to adapt to changed demands in their work. Many of these adaptations require the transfer of old skills to new situations and the broad skills and competencies. Each change in technology implies additional learning to an extent that makes learning as integral to the work as any other function of the job.

Changing Demographics of Work in the U.S.

The United States Bureau of Labor Statistics classifies jobs in the economy according to goods- or service-producing industries (BLS, 1994). Goods-producing industries include construction; agriculture, forestry, and fishing; manufacturing; and mining. Service-producing industries are transportation, communications, and utilities; retail and wholesale trade; services; government; and finance, insurance, and real estate. Of the estimated 121.1 million persons employed in the U.S. civilian labor force in 1992, 24.8 million were employed in occupations in goods production and 83.5 million were engaged in occupations in service production. Another 12.8 million employees are not accounted for in the two categories of goods and service production. Almost all of the increase in the number of persons employed in the U.S. civilian labor force, to an estimated 147.5 million in the year 2005, is expected to be in service-producing industries (BLS, 1994). These changes in the demography of jobs in the United States have, in large part, been made possible by technology. Goods are produced with fewer workers and more productive machines. For example, about two percent of today's labor force is engaged in farming as compared to about 50 percent at the beginning of the 20th century (BLS, 1994).

According to the BLS (1994), 15 of the 20 fastest growing service-producing industries (as a percentage of the present number employed) are classified as services. Parenthetically, we should mention that there is a category called *services* within the service-producing industries. These include health, business, and educational services. In part, increase in the demand for these three services can be attributed to technology. The application of technology in the health field has extended the average life span of persons living in the United States and has increased the size of the segment of the population needing the most medical care. Medical procedures involving more advanced technologies have improved the patient survival rate and have increased the demand for them. Businesses have used an organizational technology to link vendors with their operations thereby allowing them to reduce the size of their own business service operations. For example, a manufacturer (goods-producing industry) may hire a computer consultant (service-producing industry) rather than have computer programmers on staff where they would be categorized as goods producers by the BLS. The technologies employed by industries to enhance their competitiveness also have increased the amount of service that they require. The increased employment in educational services can often be linked to the use of more advanced technology in the workplace.

Thus, the technology required for contemporary work, the ways in which work is performed and controlled, and the work that actually exists are all influenced by technology.

Technology and the Quality of Work

The quality of work is described by those characteristics that make work and the worker compatible with each other. There are elements of work that are desired by most workers, such as a healthful environment. But some features of work that are desired by workers are not universal. For example, some workers want security in their jobs while others thrive on risk. Technology is tightly intertwined with work and influences or even controls the quality of work. Factors that relate to technology and the quality of work that is available for workers to perform are considered in this section. These are: the internationalization of the workplace, technology as political power, hazards in the contemporary workplace, and technology for the improvement of work.

The Internationalization of the Workplace

The internationalization of the workplace has been extended by the use of technology to a point where workers interact with workers on other continents as though they were in adjacent locations. Computer networks can connect workers in widely-separated sites and treat them in identical ways to workers who are within the same office complex. Computer chips, made in the United States, are air freighted to the Pacific Rim and used in the manufacture of computer components that are assembled in multiple locations before they are shipped to their retail destinations. The products of many manufacturers and service providers are marketed all over the globe and often compete with locally-produced equivalents. The worldwide sales of road building equipment, pharmaceuticals, and training services are evidence of how technology has internationalized the workplace.

The internationalization of the workplace has an impact on the quality of work. As workers in widely differing cultures are brought together via technology to perform the same work, they are set in competition with each other. This may change the conditions of work by increasing employment instability, reducing worker options, increasing employer demands, as well as causing the loss of economic benefits. The media have been replete with reports of firms that have moved their enterprises to places where workers are willing to offer their services for lower wages. One such example is garment manufacturing which has moved, in large part, from the use of cheap labor in the United States to lower-paid workers in other parts of the world. The threat of moving work to locations where workers will produce for less can be used as a lever to break existing work agreements, lower wages, raise production standards, and reduce worker benefits. The organized labor movement in the United States has been weakened by the management option of moving work to off-shore locations rather than negotiating with the representatives of present workers.

The other side of the internationalized workplace is that some workers, particularly in less industrialized nations, are provided with new opportunities for employment. The jobs that move into their communities may offer higher wages and greater benefits than existing work and be attractive to underemployed individuals. It appears that the gains of some workers come at the expense of other workers. It is often higher-paid but low-skilled workers in the United States who are seen as losers to cheaper workers in the Southern Hemisphere, Asia, Africa, or Eastern Europe.

Questions about the fairness of the relocation of work are complex and difficult to answer. One ideal is that all workers, irrespective of where they work, have employment that is compatible with their needs and that they not be subject to injustices and exploitation. However, three essential forms of justice—individual, social, and distributive—are often set against each other (Maguire, 1980). In the case of the internationalization of work, the interests of some *individuals* may be sacrificed for the accomplishment of broader *social* goals. Workers in the United States may lose so other workers in the world can have better jobs. However, one of the suspicions is that the sacrifices of individual workers, intended to result in greater social justice, are not *distributed* equitably and serve to benefit those who own and manage the organizations that provide the employment. Questioning the reasons why workers in some places continue to provide cheap labor further complicates the issues of justice and exploitation.

Long-standing questions of workplace justice and work quality have been extended and intensified by advancing technology. As workers in widely differing circumstances and places are brought into close proximity to each other in their work, they pose questions that were only hypothetical in the past. One of the challenges of technology used to create the global workforce is to maintain the qualities of work that are compatible with the needs of workers. There are opportunities for enriching lives through the increasingly diverse international contacts that workers may have.

Technology as Political Power

Technology is not apolitical. It is a form of power that can be applied by one person or group to exercise control over another. This exercising of control is done in many facets of life, including the workplace. For example, automated machines can be used to set the pace at which work is performed. In addition to controlling processes, machines generate records of actions that have been taken. If this information is shared within the organization, machines permit a shift in decision-making power from supervisors to operators. Conversely, by tallying the time on task and time taken for breaks, machines can provide for a level of control through monitoring that previously was not possible.

Feenberg (1991) contends that a major political factor in the employment of technology is the decision making about where, when, and how to use technology. Those who will use the technology, and who frequently know the most about the work to be performed, may not be included in the decision making. They are considered to be objectives of the technology rather than individuals and partners in the work. In human capital terminology, workers are an investment for the purposes of production much as the technological devices that they operate. Workers who object to the introduction of new technology into their jobs are characterized as obstructionists who oppose progress.

The argument is made that employers have no choice but to use more and more technology for the sake of remaining competitive. It is claimed that there is no alternative to the introduction of more advanced technology even though it may reduce the number of jobs or the quality of some work. Feenberg's (1991) counter is that the workers who will use the technology in their jobs should be brought in early so their knowledge of the work can be used in the decision-making process. The quality of the decisions will be better and there will be less worker alienation related to the introduction of the technology. With technological devices that generate records about work activities and that facilitate communications within organizations, broader representation of workers and managers in decision making is possible. The emphasis in the use of technology can be shifted from political control to work productivity and the enhancement of the quality of work.

Hazards in the Contemporary Workplace

The definition of workplace hazards has been extended by the use of technology. The increased occurrence of repetitive motion syndrome injuries (e.g., carpal tunnel) on the job illustrates this point. Workers who are linked with machines that require that the same or similar body motions be repeated in the performance of a job often are afflicted. Deboners in meat packing plants, clerical workers whose work is done on a computer keyboard, and manufacturing assemblers are some of the workers who have had a high incidence of repetitive motion syndrome injuries.

Employee burnout resulting from job-related stress has been referred to as America's newest epidemic (Northwestern National Life Insurance Company, 1991). Burnout occurs after prolonged periods of high stress. The inability to gain control causes employees to feel an inability to cope with high demands on the job. Burnout is characterized by feelings of hopelessness, thoughts of leaving, and withdrawing from work. Burned-out workers feel demoralized, and work loses meaning for them (Northwestern National Life Insurance Company, 1992).

According to the Northwestern National Life Insurance Company (1991), 13% of all job disability cases were stress-related. Goldberg (1978) estimated that the cost of stress-induced poor health of workers was approximately $75 billion to $90 billion annually through costs such as those for premature death, absenteeism, medical treatment, hospitalization, and recruitment of replacements.

It can be argued that repetitive motion syndrome injuries and stress-induced disabilities have been present but unrecognized in the workplace for a long time and that there is no relationship to the increased use of technology on the job. However, reported injuries and disabilities of these types have been on the increase and some of them almost certainly have been related to demands placed on workers because of the introduction of new technology. One technological device that has resulted in repetitive motion syndrome injuries is the scanners used by checkout clerks to record the prices of items purchased by customers. Beyond that, conditions of work have been shown to have an impact on the general physical condition of workers as in the case of the United States and Swedish air traffic controllers.

There are new hazards in work that may be traced to the introduction of new technology and some dangers of work have been reduced by technology. Once again it is difficult to characterize technology as either an evil or good force but clearly it interacts with other elements at work resulting in the effects that we observe.

Technology for the Improvement of Work

Technology can be used to improve the conditions of work, make the requirements of a job more compatible with the incumbent in the job, and make work possible for a larger portion of the population.

Technology has improved the conditions of work in such ways as reducing worker exposure to physical hazards on the job. Robots have replaced humans in situations of exposure to known or unknown dangers. Robots used to replace rods in nuclear power plants illustrate this point. Airborne toxins cause fewer injuries in such places as paint booths because of changes in the paints and the reduced use of humans to do spray painting. Additionally, ventilation systems, filters, and body coverings have been improved to add protection for the worker. Machine guarding, material moving and storage techniques, and the replacement of some hazardous chemicals have reduced the exposure of workers to hazards. Worker right-to-know laws have been designed to help workers understand the hazards of the materials that they use in their work.

Some distasteful jobs have been made more person-friendly by the use of technology. In many homes in the United States, dishwashers have eliminated what was, for many, the distasteful job of washing dishes in a sink. Pressure-treated lumber has eliminated the sticky, stinging, environmentally dangerous job of applying creosote to wood that would have contact with soil.

Many of the monotonous jobs have been eliminated by the use of technology. The hand posting of entries on ledgers by bookkeepers has been replaced by computer programs that maintain records and complete needed calculations. Twice-a-day milkings required by dairy herds have evolved from hand milking, to moving milking machines to the cows, to moving the cows to milking parlors.

Reductions in muscle power requirements have changed human involvement in much work. Consequently, the employment of humans for muscle power has been replaced, in large part, with hiring humans for their brain power. Ditches, dug by hand in times past, are now dug by skilled backhoe operators. Air or electrical power portable tools have replaced hand tools in many job applications. Hydraulic lifts on the tailgates of trucks and two-wheel dollies make it possible for one person to deliver an appliance, such as a refrigerator, to a home. The power systems incorporated into over-the-road trucks have reduced the physical requirements for those who choose to do this work.

Technology has made it possible for people, who previously were considered to be unqualified, to participate in the labor force. Individuals with physical disabilities or limitations, those who cannot come to an employer's workplace, and those who prefer an atypical workday schedule, can be fully employed with the use of technological enhancements. Elevators, door openers, and electric wheelchairs have enabled many who are physically disabled to gain access to work. Telephones, facsimile copiers, and computers have connected service providers, such as travel agents working in their homes, with clients. Average men and women are able to do the work that once required the strength of a brute because the work has been altered by technology. The reduced psychomotor skill requirements of jobs, such as those of a machinist, have opened that employment to a different array of people. Extending opportunities to be part of the labor force is especially important when the benefits of society are distributed through a system based on work, as contended by Carnevale (1984).

Technology has made some work better because it is less boring and physically demanding and more accommodating of the individuals who do the work. Work also has been improved by technology for those who have been enabled to consider entry into the labor force and who have an array of career choices because their capabilities have been extended.

In developing a model for training research from the worker's perspective, Bjorkquist and Lewis (1994) conducted a literature review through which four major worker agenda items were identified. Worker autonomy, meaning the worker's freedom to perform a job without excessive external control or isolation from other workers and supervision, was one agenda item. Another item was compensation. The concern is with the amount of compensation for work performed and with comparative compensation. Workers want to be compensated fairly as compared to their peers and they are disturbed by executive salaries that are several multiples of their own. Worker health, another agenda item, refers to the emotional climate of the job as well as the physical environment. The fourth agenda item was the fit of the worker with the job. Workers want to have jobs that provide them with satisfaction based on a fulfillment of their needs and the utilization of their capabilities. Adjustments between worker and job should not always be at the expense of the worker; job changes to fit the worker should be routine.

Each of the worker agenda items—autonomy, compensation, health, and worker-job fit—can be influenced by the technology used in the workplace. Technology can be credited with aiding the worker's cause, in many cases, but it has also become the worker's nemesis. The power of workers to determine their own futures has been significantly eroded by technology and the use of technology for the purposes of workers has not been realized as extensively as it could be. Technology is an actor in each of the quality of work issues of this section: internationalization, political power, work hazards, and workplace improvement.

Preparing for the Technological Workplace

The appropriate education for an individual's work in this era of advanced technology is contentious. In one direction, curriculums for work preparation have been challenged to become more relevant to the demands of the work and the needs of employers (e.g., U.S. Department of Labor [1991]; Carnevale, Gainer, & Meltzer [1988]). There are other voices that say that the fluidity of the workplace requires that workers need more than the skills of the job; they also need to know how to look out for their own well-being. Lakes (1994) distinguishes between *functional* and *critical* preparation for work. He contends that work preparation programs have done well in teaching the functions of jobs but have rarely tackled the critical preparation of workers which is concerned with making critical judgments about work, such as the effects of technology. Schools at all levels are challenged to face up to these demands and to prepare graduates who can function and survive in the technological workplace. This section focuses on the frame of reference for training, rather than the content of training, from the perspectives of identifying the content of work preparation, worker assessment of training needs, training to participate in job changes, and preparing for unemployment and new employment.

Identifying Content for Employment Preparation

Actors in employment preparation are comprehensive high schools, secondary school level vocational programs, two-year community and technical colleges, undergraduate colleges and universities, graduate schools, labor organizations, and employers. Some programs are operated solely by one of these entities and others are joint efforts of two or more. The ideology of each type of institution probably is expressed in the approach taken toward work preparation. For example, universities have not been as responsive to needs expressed by employers as have vocational or technical schools. Universities have sought to prepare well-educated citizens in foundational fields of knowledge with majors in broadly identified fields of practice. Vocational and technical schools typically have developed their programs of study based on occupations as described by employers and incumbents in jobs in those occupations.

Primary differences in what constitutes work preparation programs result from the starting point taken in the development of those programs. These differences can be dichotomized as the curriculum approach to work preparation and the business need approach.

The curriculum approach honors the principles of curriculum construction as taught and practiced by educators. The subject matter identification for instruction is based on the discipline to be studied (e.g., the sciences), logically structured sequences of learning, surveys of employers and job incumbents, and even job analyses. However, there is no conscious attempt to address the business needs of a particular firm or segment of enterprise. Examples of programs of this type are those that are designed to integrate vocational and academic subject matter or to meet accreditation standards.

The business need approach begins with an examination of the business goals of an organization as often expressed in a strategic plan. If an organization plans to gain a larger portion of the market share for its products, increase client satisfaction with its services, or improve the quality of work-life ratings by workers, the need *may* be addressed by programs of training.

It is understood that instructional programs will not solve all problems or realize all goals. For example, if the conditions of work are detrimental to workers, instruction on how to perform the job is unlikely to improve quality of work-life ratings. Some other interventions, such as actual changes in work conditions and instruction in how to make changes in jobs, must be considered to bring about the desired change. The crucial characteristics of instruction based on business need are that it is directly derived from strategic goals and it is used only when it is judged to be an appropriate solution.

The curriculum and business need approaches often co-exist and can complement each other. This may be intentional or inadvertent. Both have a place in preparing individuals for working in an atmosphere permeated by technology. Workers need basic skills, identified by a curriculum approach, to understand the principles on which technology operates. They also need the specific skills required to utilize the technology in their workplace, derived from the business need, in order to help achieve the goals of the organization.

Comprehensively-prepared workers will be the product of both curriculum and business-need-derived training. They will have functional understandings of basic principles, such as communication and computational competencies. This is one foundation on which more specific work skills (e.g., an orientation to the employer's firm, products and services, culture, business plan, and work organization) can be built. The preparation of a technology age worker will be capped by specific skills needed to help the organization achieve its strategic goals. The ability to learn job specific skills, as derived from a strategic plan, are often aided by a base of comprehensive learning. Adapting to changes and transferring practiced skills from one work situation to another may depend on application of principles as well as specific, sharply honed skills.

Training to perform the tasks of a job is not sufficient job preparation. Worker skills needed to cope with work, as they encounter it, are critical to maintaining health and productivity. A person can learn to deal with a supervisor's style, even when it is not to the worker's liking. Conflicts between work and family can be better managed if preparation to do so is offered. Processes of advancement in a field of work often are unclear and can be taught and learned. Workers should be prepared to deal with the disruptions of unemployment due to employer organizational changes and worker needs.

Worker Assessment of Training Needs

Based on observations of the present and the past, indicators for the future of work suggest accelerating rates of changes in the skill requirements for workers and in the technology used at work. One of the solutions that is offered is regular, if not constant, training. Some training may be away from the job site, but some work skills will be best learned on the job.

Most learning may be good for the person who engages in it; however, not all of it will be beneficial in performing responsibilities of a particular job. For example, some of the broadly described competencies (e.g., allocating time, money, materials, space, and staff) in the SCANS report (U.S. Department of Labor, 1991) may find their application in the home or in enhanced self-esteem of citizens rather than in the workplace. It also will be found that employers identify training that they consider to be appropriate for a job, but it may be inconsistent with what workers think they need in order to do their jobs better or to advance their career development. Self-determination about job skills and career direction can be expressed in the selection of training. In other words, workers can position themselves to do their jobs better and to take advantage of opportunities that develop. Additionally, each worker is in the best position to assess personal capabilities. These capabilities can be compared with new job demands to identify skills that need to be developed. Work-related learning that is undertaken by the worker should be planned after careful deliberation.

With the projection of rapid changes in technology and the nature of work, career planning and the development of applicable job skills has been complicated. Well-developed career plans have been blindsided by changes (e.g., large scale dismissals of employees) in the employing organization, for example. However, this does not suggest that one should be resigned to career chaos. A career plan is as important as ever, but it needs to allow for the unexpected. This means that one should not base a plan for a lifelong career on employment with a single firm. Career goals should probably be broad in order to allow for changes within a field of work and lateral shifts by workers within that field. Promotions and advancement will not be routine. Personal priorities, such as childcare and attention to elderly parents, may enter into the plans of men and women. Comprehensive career planning that accommodates changing work and personal goals is demanding.

Training to Participate in Job Changes

Some workers are not satisfied to be objects of job changes but want to be part of making job changes happen. Workers can be active in the improvement of working conditions and work productivity. Workers are in possession of knowledge of their jobs as no one else really knows the job. By use of tools of analysis, it is possible for workers to understand their jobs in ways that establish their authority for suggesting improvements in work procedures. Work analysis, based on the identification of opportunities for enhanced productivity, assessment of potential initiatives, and proposals for training and other interventions to facilitate best initiatives can be learned by individual workers.

For significant job changes to occur, it usually requires communicating what changes are needed and then convincing someone else that the changes will produce benefits. In many cases, several workers will collaborate in the development of work changes. There must be orderly development and reporting of proposed changes. This kind of group effort can be facilitated by group process skills. It is often necessary to use technical experts, print, or other media resources. There are skills that are required to utilize information resources.

The technological devices that are available at job sites make it easier for workers to initiate changes in their work. Many of these devices are carriers of information about work operations that can help a worker better understand the context of a job and the kinds of changes that are going to be beneficial. The technology also provides means for implementing and communicating desired changes.

Unemployment and Preparing for New Employment

Unfortunately, the history of many workers also includes periods of unemployment. Unemployment has been destructive in economic, psychological, and social ways. The financial demands of maintaining a customary life-style can deplete resources that have been saved for other purposes, such as the education of younger family members and retirement. Some unemployed workers have guilt feelings because they are not working and they withdraw from their usual activities at home and in the community. Most often these self-accusations are not deserved because the circumstances that brought about the unemployment were outside of the control of the person affected. Personal reports by unemployed persons have indicated that there is not an effective way to prepare for the emotional effect.

Workers can try to stay ahead of the job obsolescence cycle with careful analysis and planning. It is difficult to anticipate work changes and the ways in which they will impact individual workers. Workers need to stay informed about the things that are happening in their own fields and should try to adjust to them. They should be proactive in planning their own careers. The uncertainties of employment urge individuals to consider their own talents, needs, and desires as one of the bases for their planning.

The technology of work is a primary reason for changes in work and it can be a cause for job loss. Technology can also be used to stay current with a field of work, to be informed about changes, and to plan for the future.

Conclusion

The workplace, whether it is the location of employment for compensation or is unpaid in the home or community, is a living laboratory for the study of technology. Technology is developed to make work more productive and it is the reason for some work. With the many culturally derived values that are associated with work, the examination of technology in the context of work (and vice versa) gains added meaning.

The full meaning of technology, as associated with work, is not limited to the extension of productivity made possible by mechanization and social structures. In addition, it can be used to determine what work will be done by workers, where on the globe it will be done, who will do it, and how rapidly it will be done. Technology has added to the potential for control of work and workers by those who possess the technology. Increasingly sophisticated technology, introduced at accelerating rates of change, has increased the skill demands placed on workers but also has added to the value of workers who have these skills to sell.

Within the framework of technology and work change, employment has become less consistent. Workers are expected to become more flexible and they are less likely to be able to tie their employment future to a single employer. One of the choices for workers is to make career planning more responsive to personal needs and less centered in a specific occupation or with a particular employer. Education and training for work should increase present productivity and possible transfer of skills to new work situations.

Workplace technology should renew worker resolve to plan for and take control of their own lives. Technology can be used as a task master but it also can aid in the fulfillment of personal goals. Clearly, technology is not optional in relationship to work. It is a challenge for workers and those who educate them, at all stages, to prepare for the utilization of technology to become more productive and better satisfied workers.

REFERENCES

Almen, L. T. (1963). *Work and vocation in the period of the great depression.* Unpublished doctoral dissertation, State University of Iowa, Iowa City.

Bjorkquist, D. C. (1992). Training needs in corporate takeovers. *Performance Improvement Quarterly, 5*(1), 70-89.

Bjorkquist, D. C., & Lewis, T. (1994). A model for training research from the workers' perspective. *Human Resource Development Quarterly, 5*(2), 111-129.

Bureau of Labor Statistics. (1994, May). *Occupational outlook handbook: 1994-1995 edition.* (Bulletin 2450) Washington, DC: U.S. Government Printing Office.

Carnevale, A. P. (1984). *A society based on work.* Columbus, OH: National Center for Research in Vocational Education.

Carnevale, A. P., Gainer, L., & Meltzer, A. S. (1988). *Workplace basics: The skills employers want.* Washington, DC: The American Society for Training & Development and U.S. Department of Labor.

Datta, D. M. (1953). *The philosophy of Mahatma Gandhi.* Madison: The University of Wisconsin Press.

Feenberg, A. (1991). *A critical theory of technology.* New York: Oxford University Press.

Ginzberg, E. (1982). The mechanization of work. *Scientific American, 247*(3), 67-75.

Goldberg, P. (1978). *Executive health.* New York: McGraw-Hill.

Hall, R. H. (1986). *Dimensions of work.* Beverly Hills: Sage Publications.

Humphrey-Hawkins Act. (1978). P. L. 95-523, 92 Stat (1978).

Jeter, J. (1988, February 25). Democratic presidential candidates aren't up to the task, says Eugene McCarthy. *Minneapolis Star Tribune*, p. 7A.

Kaiser, E. G. (1966). *Theology of work.* Westminster, MD: Newman Press.

Karasek, R., & Theorell, T. (1990). *Healthy work: Stress, productivity, and the reconstruction of working life.* New York: Basic Books.

Kline, S. J. (1985). What is technology? *Bulletin of Science, Technology and Society, 5*(3), 215-218.

Lakes, R. D. (1990). The importance of social skills on the shop floor. *Journal of Industrial Teacher Education, 28*(1), 71-74.

Lakes, R. D. (Ed.). (1994). *Critical education for work: Multidisciplinary approaches.* Norwood, NJ: Ablex Publishing Company.

Maguire, D. C. (1980). *A new American justice.* Garden City, NY: Doubleday & Company.

Markert, L. R. (1989). *Contemporary technology: Innovations, issues, and perspectives.* South Holland, IL: Goodheart-Willcox Company.

Northwestern National Life Insurance Company. (1991). *Employee burnout: America's newest epidemic.* Minneapolis, MN: Northwestern National Life Insurance Company.

Northwestern National Life Insurance Company. (1992). *Employee burnout: Causes and cures.* Minneapolis, MN: Northwestern National Life Insurance Company.

Parker, S. (1983). *Leisure and work.* Boston: George Allen and Unwin.

Robinson, D. G., & Robinson, J. C. (1989). *Training for impact: How to link training to business needs and measure the results.* San Francisco: Jossey-Bass.

Rodney, W. (1983). *How Europe underdeveloped Africa.* Washington, DC: Howard University Press.

Roemer, R. E. (1980). Technological studies and the curriculum in higher education. *Curriculum Inquiry, 10*(3), 294-302.

Rosen, S. (1994). Invited reaction: The necessary ingredient for authentic participation in the planning process for training is a labor union. *Human Resource Development Quarterly, 5*(2), 131-140.

Social Security Act of 1935, 49 Stat. 620, § 301, c. 531, 42 U.S.C. (1982).

Tillich, P. (1959). *Theology of culture*. New York: Oxford University Press.

Towers, E. R., Lux, D. G., & Ray, W. E. (1966). *A rationale and structure for industrial arts subject matter.* Columbus: The Ohio State University. (ERIC Document Reproduction Service No. 013 955)

Turnbull, C. M. (1983). *The human cycle.* New York: Simon and Schuster.

Unemployment Compensation Act of 1935, §3301, 3302 26 U.S.C. (1982).

U.S. Department of Labor. (1991). *What work requires of schools: A SCANS report for America 2000.* Washington, DC: U.S. Government Printing Office.

Zuboff, S. (1988). *In the age of the smart machine: The future of work and power.* New York: Basic Books.

DISCUSSION QUESTIONS

1. Should the primary purpose of technology be to increase human capability for work?
2. Should the economic outcomes of work and of the technology applied to work take precedence over ecological or human justice outcomes?
3. In the United States, should it be more important that we work to be consumers than to be producers?
4. Should persons doing the same work in Mexico, Canada, and the United States be compensated equally?
5. Should workers have equal voice with management in the selection of technological devices to be used on the job?

DISCUSSION SCENARIOS

Balancing Work and Home

You and your spouse have recently acquired responsibilities for child rearing that you prefer to perform for yourselves rather than to purchase child care services. Since both of you are employed in jobs outside of the home, this will require some major adjustments in your work lives.

What are some technological solutions that you can propose to meet your goals? How are your options affected by the form of employment of you and your spouse?

What are some of the primary consequences, positive and negative, of the technological solutions that you consider?

New Technology in the Workplace

Your employer has indicated her interest in the purchase of a new machine that will do the work of four of your co-workers. However, suggestions have been made that business can be expanded so no one will have their job terminated. Your job is not threatened by the proposed machine and you have been asked to provide advice on the purchase of the new machine or some other alternative. You consider your employer to be fair in dealing with employees and you do know that any proposal will be scrutinized on the basis of its potential to add to the productivity of the company.

Whose interests will you try to represent as you formulate your recommendations? Your employer's? Your coworker's? Your own?

What questions will you want to have answered in order to make a recommendation?

What are some of the alternatives to a new machine that you would be willing to consider?

An Investment Decision

You have an opportunity to invest some of your own money in the stock of a company. The choices have been reduced to two. One is a large company that wants to computerize its operations to gain some efficiencies and increase its product output. This company has a reputation of high expectations of its employees and of making consistent profits. The other choice is a small company that has a reputation for intelligent, public-spirited management. The small company plan for newly invested money is to increase the training of employees so they can be more active in problem solving and decision making in the firm.

Where are you going to invest your personal money?

CHAPTER 13

The Impact of Technology on Leisure

Falco de Klerk Wolters and Joseph D. Fridgen

Introduction

People enrich their lives through leisure. Leisure and recreational activities make up a significant portion of the average day for members of the industrial world. Evenings, weekends, holidays and vacations are enjoyed, sought after and appreciated as rights rather than privileges for many around the world. Yet nothing is static; the manner in which people pursue their leisure has changed over time. Of course, the games of those who hunted for survival in times past were certainly different than the pleasures of the aristocrats of the middle ages. Who, even in the recent past, could have imagined that people would be finding pleasure jumping off cliffs and bridges while hang gliding or bungee jumping? Concurrent with these shifts in preferences and leisure pursuits has been the impact of technology. Without advanced technology, many of the most popular recreational activities in the world today would not exist. The adaptation and adoption of new technologies for the pursuit of pleasure have made it possible to experience exciting new leisure pursuits ranging from television viewing, hiking with the best equipment, to hang gliding.

The relationship between leisure and technology is complex. As noted by Harry (1976) "the field of leisure activities is one which is increasingly subject to the effects of technological change and invention" (p. 55). The implication is that technologies may lead the way to new activities—games and sports not available prior to the development of new technology. Technology influences not only the activity but the delivery of the activity as well. Edginton, Hanson, and Edginton (1992) suggest that "the technological changes that occur in society will have a profound effect on the creation and delivery of leisure services" (p. 453). New activities born of technology may require unique facilities and management approaches which, in turn, will influence the delivery of the service by management. Take the case of skateboarding in urban areas; here, new facilities were fashioned to keep up with the evolving technology of the skateboard and the skills of the participants. Urban and city sidewalks were no longer appropriate nor safe for the skater or the pedestrian. Ramps, runways, and formed skateboard courses were built to attract and entertain the modern skateboard enthusiast.

Daily our lives are influenced through the various uses of technology. These technologies are creating whole new leisure activities, recreation equipment and leisure opportunities. Technology has brought TV to the masses as a new activity neither heard of nor engaged in before. In addition, technology improves upon existing activities such as music or hiking. According to Samuel (1993),

> In some cases, the new technology improves an older one (compact discs replacing vinyl discs, color TV replacing black and white) and thus leaves the leisure activity itself unchanged. In intermediary cases, new technologies increase the availability of corresponding leisure and the choices given to users . . . . In the extreme cases, completely new leisure activities are generated by technology. (p. 1)

Indeed, the influences of technology on the leisure lives of millions are complex and far reaching.

The issues to be discussed in this chapter center around the role of technology in shaping leisure and the quality of life. Technology can be instrumental in shaping leisure, the activities engaged in and the creation of new leisure activities; but technology does not necessarily create nor guarantee more leisure or a higher quality of leisure experiences. "Technologies have transformed particular activities. . . . Television not only opened college and professional sport to the masses, but also brought about changes in the rules and presentation of the games themselves" (Kelly & Godbey, 1992, p. 75). Such transformations are ongoing in our leisure lives as the computer, mass communications, and entertainment industries integrate their creative and marketing forces to develop new products and services.

The relationship between technology and leisure offers the person at leisure a host of exciting possibilities, but many questions are posed as well. These are not new questions because society has been asking about the value or the erosion of values that have accompanied technology for hundreds of years. Within the context of art, Mesthene (1971) puts the questions about technology this way:

> My concern . . . is with the artist who sees in technology only a new instrumentality; that is, who sees its artistic possibilities but not its aesthetic potential. . . . If their [philosophers and artists] only response to technology is to explore it for finer tools, they fail in that which we most demand of them; i.e., that they lead us to see—in the Platonic sense of seeing—what it is that technology imports for man: for his aspirations, his values and his gods. (pp. 47-48)

The same concerns can be expressed about leisure—do improved technological products or opportunities created by technology enhance the leisure experience? Do these opportunities enhance the quality of life for citizens? It is unlikely that having yet another recreational product with the latest improvements defines what leisure is really about. Reflection and self-enlightenment as well as the time to recreate are the essence of what leisure should be about for people. Yet, so often it can be argued that most people are in a race to locate, own, and use the latest piece of equipment made possible by the most novel of technological innovations. Have people begun to miss the point of rest and relaxation, as well as sport and recreational activities? Has technology been a partner in fostering this need to own, play, and display with less than full concern for the enjoyment and satisfaction to be gained from the experience itself? Are the leisure seekers of the future lost in the instrumentality of the technology and oblivious to the experience?

Fishing and hiking have essential characteristics that have been enjoyed for years using a vast array of equipment; the question is—have these activities become better or even fundamentally different activities altogether due to the use of new equipment? Surely, the improvements in hiking shoes, fishing gear, and boats have altered these activities, even improved catch rates through the use of sonar fish locators; but is that a true measure of an improved experience?

Kelly and Godbey (1992) have noted that "many futurists believe that we are entering a period of hyperindustrialization in which the creation of new products will increasingly shape all forms of behavior, including our use of leisure" (p. 507). These new products are continuously modifying our life-styles and, vicariously, our behavior. Furthermore, many authors are in accordance with the idea that technology is having an impact on our leisure behavior as well as in the leisure industry in general.

This chapter examines the influences of technological change on leisure behavior and its resultant impact upon quality of life. The interaction of technology and leisure behavior, time, tourism and its effects in our socialization process will be discussed. Attention is also paid to the contribution of technology to leisure, positive and negative. Finally, speculation on the future provides an insight into how further advances in technology will generate more changes in our leisure time, in our leisure behavior, and therefore, in the leisure industry.

Defining Leisure

A certainty surrounding leisure is that many definitions exist and few can agree upon a common definition for research and scholarly endeavors, much less general discussions. Definitions wane philosophical at one extreme and become matters of measured time or activity at the other. Academic as well as pragmatic reasons have fostered a broad range of definitions. Psychologists and sociologists emphasize the personal and social aspects of leisure. Alternatively, an economist might have little concern for the personal and look only to measures of time or activity types away from work in an effort to attach a meaning to the concept of leisure.

There are three common conceptions of leisure that are worthy of summary here. The first is merely a matter of time. As noted by Brightbill (1960), leisure can be seen as a block of time, unoccupied and available for use as the person sees fit. Other current analysts would agree and refer to leisure as a *residual* of time left over after paid hours at work and housework are both complete—the remainder is leisure (Schor, 1991; Martin & Mason, 1994).

A second perspective views leisure as an activity—an activity not work-related. Dumazedier (1967) suggests that leisure is an activity engaged in, which is apart from obligations of work, family, and society. This activity is chosen for either relaxation, diversion, education, or social reasons. Kelly (1990), more recently, offers a similar perspective noting that leisure is an activity chosen for its own sake or worth, suggesting that intrinsic motivation would be involved in the concept.

A third definition, popular within the recreation and leisure research arena, is more philosophical. This conceptualization refers to leisure as a state of mind, a state of being (Pieper, 1963). This approach is characterized as being associated with a sense of freedom, spontaneity, and stimulated by intrinsic motivations. Formally associated with the philosophical thinking of Aristotle, the implication is that leisure is a state of being to be strived for and not easily achieved. The implications of this definition for activity or time usage are not clear nor easy to measure.

Given this range of definitions, a useful approach for this chapter is to consider leisure as activity or action chosen freely for the pleasure, meaning and enjoyment of carrying out the act or for the pleasure that results from the activity or engagement. Not all leisure is positive for the individual or society; yet a person may engage in the activity for personal and hedonistic reasons. An example of this would be debilitating drug abuse. Most often leisure takes place outside of the work setting; yet even at work, pleasurable activities can engage a person and be considered leisure. The line between work and leisure is fuzzy for good reason. If pleasure is the sole criterion used to distinguish leisure from work, then what is to be made of the person who is not enjoying a family picnic or the person who loves work and spends extra time on the job? Another element of work is that it is considered an activity with a productive outcome (e.g., products and services). This is not the case for leisure activity. Related to leisure is the concept of recreation. Recreation is often seen as nonwork activity, organized and carried out for personal and social benefit (Kelly & Godbey, 1992). In these two definitions, activities can be differentiated by levels of organization, implied positive benefits, and a specific reference to nonwork situations. As an example, going on a hike with a friend is a leisure activity. Playing softball in a league on a regular basis is recreation. Softball is socially organized and personally beneficial, and not likely to occur during work. A personal hike is not organized, is spontaneous, and may have positive or negative outcomes depending upon the purpose of the hike.

Defining Technology

Technology

A primitive tool of 8000 years ago can, in retrospect, be seen as a simple physical artifact that created a dramatic impact upon the users of the invention. The technology involved was simple, physical, shaped by humans for their benefit and improved quality of life. This latter example fits the dictionary definition quite well. The dictionary states that technology is "the sum of the ways in which a social group provide themselves with the material objects of their civilization" (The Random House Dictionary, 1966, p. 1458). The ways and means used by a culture have changed over time, from simple tools to complex electronic devices and powerful machinery based upon engines and harnessed energy. The automobile of industrialized society has given new shape and meaning to the lives of the modern person. The home appliances of today have dramatically changed the day-to-day tasks of feeding and caring for a family, changes that most likely could not have been conceived even a few hundred years ago.

Yet, it could be argued that the consequences and impacts of new technological innovations have not diminished. A new tool in prehistoric times might have revolutionized society in social and cultural ways much as powerful engines and the marvels of personal travel in the automobile have shaped our society today. Stone tools, a technology of survival for early peoples, while simple in retrospect, were very complex and far reaching for society at the time of introduction. Today, to use as well as understand the technological workings of the automobile or the computer is beyond most people. To be familiar enough with these technologies to use them is all that most people would hope to accomplish.

Technology is not easily defined in this modern age. The conceptualization of technology has changed with the complexity of the *ways and means* of modern science. Going beyond a technology of hardware, Bell (1973, pp. 29-30) suggests three types of technology. *Machine technology* refers to the tools and machines of society, designed to create new products, experiences or to contribute to productivity. It is a controlled tool. *Social technology* refers to the organization of a production, industrial or decision-making system (e.g., a school system, health system). Finally, Bell suggests that there is an *intellectual technology* which refers to mathematical substitutions of algorithms and formulas for human judgments. Intellectual technology is fostered by the use of another technology; namely, the computer which permits the analysis of large data sets with many variables, a task beyond normal human calculations. These three types of technologies illustrate the breadth and complexity of technologies that merge evolving scientific capabilities such as the computer, communications, and electronics.

A more recent but similar analysis of types of technology is provided by Stipanuk (1993) who argues that there is soft, hard, and a mixture of soft and hard technologies. Hard technologies refer to machines and tools. Soft technologies refer to management and business systems such as franchising or the information that makes up a data base. From Stipanuk's perspective, the computer represents a unique but telling example of a technology that is both *hard* and *soft*. At one level, the personal computer can be thought of as a physical tool; at another level, when using the computer for management, the computer can be considered a soft technology producing information useful for decision making.

De Klerk Wolters and De Vries (1987) outline five general characteristics of technology. They note that first, technology is an inseparable human feature; second, technology is always related to changes in the form and/or place of matter, energy and information; third, there is a mutual influence and inter-relationship between science and technology; fourth, technological skills include the designing, production and productive use of technological products; and fifth, there is a dynamic interaction and mutual influence between society and technology.

The interplay between society and technology mentioned by De Klerk Wolters and De Vries is quite clear in the case of music. Music lovers in the United States were presented choices in how they could purchase their music. One medium, LPs, was being phased out by new types of technologies that could carry music in smaller packages and offer better sound characteristics for the listener. As the technology of recording sounds expanded and grew in sophistication, music was made portable in new ways. Society responded. Note how the sales of LPs fell as they were discontinued, but note the rapid growth of purchases of compact discs and the eventual decline in sales of cassettes (see Table 1). Indeed, this represents a very dynamic exchange between a new technology and society's desires and preferences. The improved portability, durability and sonic features of CDs moved albums off the shelves of music stores and placed records in storage in the homes of Americans.

Table 1
U.S. Sales of Albums, Compact Discs, and Cassettes: 1975 to 1992

	Sales (Thousands)		
Year	Albums-LPS's/EP's	Compact Discs	Cassettes
1975	257,000	(X)	16,200
1976	273,000	(X)	21,800
1977	344,000	(X)	36,900
1978	341,300	(X)	61,300
1979	318,300	(X)	82,800
1980	322,800	(X)	110,200
1981	295,200	(X)	137,000
1982	243,900	(X)	182,300
1983	209,600	800	236,800
1984	204,600	5,800	332,000
1985	167,000	2,600	339,100
1986	125,200	53,000	344,500
1987	107,000	102,100	410,000
1988	72,400	149,700	450,100
1989	34,600	207,200	446,200
1990	11,700	286,500	442,200
1991	4,800	333,300	360,100
1992	2,300	407,500	336,400

X: Not applicable.
Source: U.S. Department of Commerce, Statistical Abstract of the United States, 1994, p. 575, Table 902.

Information Technology

Information technology refers to the integration of electronics, communications, and information management and use. It has been called a "tendency for computing and telecommunications technologies to integrate and converge" (Webster and Robins, 1986, p. 10). Information technology, as it is practiced, includes a broad range of technical equipment such as fax machines, electronic mail, word processors, computers, robotics, computer networks, and advanced office equipment. The management, storage, and use of information are shaped by the evolution of information equipment—information technology.

Leisure Technology

Leisure technology can be thought of as those innovations, inventions, information or entertainment systems, and technical machinery that have a direct or indirect influence on leisure. Leisure technologies may alter the way leisure is conducted or actually generate an entirely new leisure pursuit.

Many innovations in a society are developed for one purpose and then, over time and through experimentation, other uses and needs are met with the developed product. Many leisure products have been modified and adapted from other technological enterprises and developments. In a sense, these are borrowed technologies, modified and used for leisure purposes. Spinoffs from the military and space exploration very often find their highest consumer value in other applications in the open market. Many of these applications have infiltrated the leisure world. For example, lightweight and warm fabrics based upon space exploration needs and military research have been adapted for modern camping and hiking equipment. These adapted leisure products and technologies have reshaped selected leisure and recreation pursuits. As an example, baseball and softball are still played in the same manner in spite of the aluminum bat. Effectiveness, game statistics, and costs of replacement bats have changed; but the game is still pretty much the same. Nonetheless, this borrowed technology has influenced the game.

At another level, an entire leisure industry has emerged to develop new leisure products to satisfy the demand of millions looking for unique ways to enjoy themselves. At this level, new technologies and new products have created entirely new activities. The games industry in general creates new games and entertainment activities each year for consumers' pleasure. Some take advantage of new materials and alloys or nontoxic chemicals to create new lightweight, strong plastics toys or game equipment. Selected individual sports are new and would not be possible without new technologies. Inline skating is an adapted sport in some ways and truly new in other ways. Its availability and evolution would not have been possible without the innovative combination of materials and skate design used in creating the equipment. Hang gliding and bungee jumping are two other activities capturing the extremes of thrill seeking which use the latest products designed for pleasurable pursuits.

Of course in the arena of entertainment, information technologies are pushing in many new directions simultaneously. The captains of the information technology industries, in cooperation with entertainment officials, have reshaped the modern home to include electronic offices and entertainment centers. Cable television and entertainment executives clearly have a growing market in mind as they develop the next generation of pay TV, interactive TV, and new types of general television programming. The dynamic interaction of these new technologies has the capability of generating a host of new types of programming, interactive games and information delivery technologies that most would have difficulty describing today even as we consider our expanding TV options.

Technology and Leisure through History

Pre-Industrial Times

The history of technology starts with the history of people. By definition, technology is tied to human behavior and the quest for quality of life—a quest that begins with humans and human interactions. The prior reference to prehistoric tools reflects the long-standing and inherent urge to create and to better one's situation.

Early technologies were not developed in isolation of leisure. Cave paintings and tools with ornaments and artistic engravings suggest not only an appreciation of pleasurable items and technology, but a desire to use technology for more than mere functional activities. The history of technology is replete with technological advances in how a variety of activities and pleasures were conducted, be they competitive sports, music, or social games. For example, evidence of early games of bowling using stones was found in a tomb in Egypt dating back to 5200 B.C. (Dittrich, 1992). Historically, the uses for technology were multiple and mixed. Early games often were training opportunities for battle. Games of competition with new battle equipment had mixed intentions; namely, training and pleasure. Fortunately, innovations in music instrumentation had more pleasurable overtones for users, participants, and the listeners.

Technological innovation moved in fits and starts with large impressive advances associated with selected societies. Greek, Egyptian, and

Roman civilizations along with those of the eastern world compelled society to face and ponder the development and control of technologies in service of leisure. Music, games, and the social fabric of society were transformed in these civilizations due in part to technologies that emerged concurrently.

The technologies of survival and the military were easily adapted for leisure. The gunpowder of ancient China was the stuff of fireworks that are ancient, traditional elements of current community and family celebrations and festivals. More gruesome were the technological innovations used to amuse the crowds of ancient Rome (Kelly, 1990). The deadly games of the gladiators and the human sacrifice of the Roman coliseum were enhanced and made possible, in part, to technologies of architecture, military, and torture. Sadly, the technologies of leisure do not have to serve only the good; sometimes they are used in sinister or negative ways.

Yet even by the middle ages, the pace of life was still dominated by the seasons for most people living in agricultural societies. Work and leisure blended together and the times for each varied according to the weather, seasons, and religious holidays. The pace of life was measured by religious and community events. People could set work aside for days at a time if religious holidays required church activity, social events, or prayer. The rate of change in society due to technology was slow, moving at a *snail's pace* for the vast majority of rural and urban citizens of the middle ages (Cross, 1990). Although the development of the mechanical clock changed how people viewed time, the full manifestations of this invention would not be fully explored until the onset of industrialization (Cross, 1990; Postman, 1985).

Period of Industrialization

The Industrial Revolution changed everything. Prior views of work, leisure, perceptions of time, and the needs for and uses of technology were drastically altered. The factory metaphor permeated life. Clocks were used to set the work day apart from leisure and nonwork time. Jobs in factories required amassing resources and human capital in urban areas close to transportation routes and avenues of commerce. The technology of mass production would forever change how and when the world would be at leisure.

The Industrial Revolution brought changes in the leisure pursuits of the people. On the one hand, while in the pre-industrial society work was incorporated into everyday life along with leisure, industrialization and urbanization tended to separate leisure from work and the ordinary citizen was left with less time for the pursuit of pleasure (Godbey, 1985). An emphasis on economic progress had increased productivity, but a byproduct was less time for leisure.

Technology was a cornerstone in the foundation undergirding the changes brought about by the Industrial Revolution. New machines, sources of power, and innovation in management practices pushed England, then Europe and America headlong into the industrial age. This revolution did not occur overnight of course, but it was well underway and moving efficiently within a short hundred years marked by the beginning of the 20th century. The new technical machines were the target of protest as they were introduced to workers of England. The protesters, called *Luddites*, were working-class people concerned about their fate and the changes machines were bringing to their lives, their villages, and families (Webster and Robins, 1986). Protesters found guilty of damaging machinery were subject to stiff penalties or even hanging. The Industrial Revolution was not to be sidetracked nor was technology.

Daniel Bell (1973) put the legacies of the Industrial Revolution in perspective. He suggested that modern industrial societies were moving beyond industry-based economies, shifting to service-based economic activity. This transition was based, in part, on the emerging revolution in technology that began in the 1800s and was still generating invention and innovation without pause. Toffler (1980) suggests that we look at human history as having four periods—pre-civilized society, followed by an agricultural revolution, the Industrial Revolution, and the technological revolution (led by information technologies). This later period is still in process with outcomes still unknown.

Information technology is leading this latter revolution and it is being applauded by citizens, governments, and societal institutions alike. Hallmarks of this evolution to new ways of work and leisure in the post-industrial society include the arrival of the telephone and its many variations, television, and computers. Modern living is replete with technology.

Modern Times

The Industrial Revolution spawned many technologies that would change the lives of millions in both work and leisure. Massed-produced products and pervasive consumerism linked the use of free time to the purchase of products to use during time away from work. Kelly and Godbey (1992) suggest that there were two *transforming technologies* that defined the new, bold relationship between leisure and technology. The massed-produced automobile was a powerful transforming technology arriving at the turn of the century. As the auto became a common family product, the resultant impacts on leisure were quite clear (Kelly & Godbey, 1992). The automobile expanded the spatial boundaries of leisure, by giving individuals and families mobility. In addition, transport was now more personal, as were the leisure pursuits associated with the auto (from sightseeing to teenage sexual activity). The auto created an expanded and more personal access to national tourism destinations; a process started in earnest in the middle 1800s by regional and national railroad systems.

Another hallmark technology of the era was the invention of the wireless and other audio and visual transmission mediums. Television, in particular, became, and still is, a transforming technology deeply integrated into the leisure lives of millions around the globe. "If the car dispersed leisure, the other transforming technology brought it back home" (Kelly & Godbey, 1992, p. 81). Television moved the family into the living room for entertainment, right alongside the radio. The TV drastically changed how time was used in the home. The activities of the home began to rotate around the TV, certain popular shows, and their respective time slots. Of course, beyond time usage, television broadened the world of the viewer, bringing pictures with the news and sharing images of cultures from home and abroad.

Related transportation and telecommunication technologies also had dramatic influences on leisure and tourism. From jet planes, luxury recreation vehicles, and modern resorts to computers and the telephone, all had impacts that reinforced the changes wrought by the automobile and television. Choices were expanded; individual choices were made possible by personal mobility and more personal recreation and leisure options. These shifts in leisure mirrored other changes in industrialized society. Nuclear families were becoming smaller; suburbs were filled with single families with parents commuting to work in all directions. Entertainment was now available at home (radio, TV, and entertainment equipment) with the core family members, in the suburban community, or in the core of the nearest major city—all choices individual families could make in unison or individually. Going beyond this, especially after WWII, was the increased growth in personal travel by automobile for vacation and pleasure trips. The technologies of travel and entertainment expanded the options of families and individuals, as well as for entire social groups from all walks of life.

Technology and Time

Through history, time as a concept has gone through a metamorphoses. From a vague concept of continuity and a sense of cyclic seasons in prehistoric times to precisely measured milliseconds, time has been transformed. Time and its conception was modified with social, scientific, and technological discoveries. The clock, the mechanical representation of time, profoundly modified humans' lives. Mumford (1963), clarified the powerful influence that time, measured time, would have on the human race. He points to the religious beginnings of the clock in monasteries that emerged after the fall of the Roman empire. While not the first timepieces, the need for order and regularity within the monastery created a need for a type of clock that was independent of the elements (e.g., sun for sundials, unfrozen water for water clocks, etc.). By the Middle Ages, reliable clocks were available and most often in the church tower making measured time available to all through the regular ringing of church bells.

While the history of the mechanics of time measurement was exciting, what Mumford found most important were the consequences for human living. The clock produced "seconds and minutes: by its essential nature it dissociated time from human events and helped create the belief in an independent world of mathematically measurable sequences: the special world of science" (p. 15). Lives would be regulated by time; the productivity and efficiency of machines and technology would be tested against time. "When one thinks of time, not as a sequence of experiences, but as a collection of hours, minutes, and seconds, the habits of adding time, and saving time come into existence. Time took on the character of an enclosed space: it could be divided, it could be filled up, it could even be expanded by the invention of labor-saving instruments" (Mumford, 1963, p. 17). As the Industrial Revolution came in to being, time changed into an industrial technology. How it was measured, managed and its fusion with industrial activity rearranged the lives of the modern worker drawn into this revolution. In fact, Mumford (1963) poignantly observed that "the clock, not the steam-engine, is the key-machine of the modern industrial age" (p. 14).

Time and technology have implications for leisure in people's lives. Time is a required element in most conceptualizations of leisure. There are convincing arguments, that with the onset of the Industrial Revolution, people lost time for personal use and pleasure. The regimentation referred to by Mumford shattered more traditional time patterns within communities and rural areas. The many holidays of the community, government or the church gave way to the needs of production and the factory. Work time and nonwork time moved people in and out of the factories, communities, and their homes with regularity and exactitude. The new powerful business leaders demanded more of workers and got more. Workers were left with few alternatives, more hours, modest pay, and a life of toil. This extended to women and children as well. As new machines demanded people to care for them, control them and monitor them, hours of work increased—to the point that people were working 12-16 hour days, 6 or 7 days a week (Cross, 1990; Schor, 1991).

An analysis by Schor (1991) suggests that hours of yearly work for the average male in the 1200s in Great Britain was around 1600 hours. Through the 1400s and 1500s, hours of work per year moved to approximately 2300 hours. As noted above, the Industrial Revolution moved people into *forced labor* like conditions with over 3000 hours a year in the United States and Great Britain prior to the Civil War in 1860 (3150 for the U.K. and 3650 for the U.S., respectively). It took until after the turn of the century for hours of work to fall below 2000 a year for most workers.

Schor argues that after a decline of working hours prior to WWII, yearly working hours have been increasing. In her analysis, this increase has been most persistent in recent years and for a majority of Americans, particularly working women. These increases in working hours and subsequent decreases in leisure have occurred in spite of increasing productivity and ever-improving technology. There is similar evidence in Europe, particularly in the Netherlands. Recent analyses suggests that over time, between 1975 and 1990, for those aged 20-50 years old, working time has been increasing while leisure time has diminished (Sociaal en Cultureel Planbureau, 1992). In contrast, the reverse is true for those aged 50-65.

The thrust of Schor's argument is that technology has contributed to productivity but it has not cut working hours nor made more time available to Americans. Rather, business owners and managers along with workers have elected or been induced to work longer to pay for increased consumptions of goods and services in order to pay for a higher and higher standard of living. This work-and-spend cycle has been demanding and somewhat unconscious but nonetheless real in the American workplace. There is no time to play and be at leisure because, at least in part, a majority of Americans are working harder to pay for their escalating standard of living.

It could be argued that technology has produced home labor-saving devices and this, in turn, indirectly has influenced leisure in the United States. But here again, Schor argues that as technology entered the home, it has not reduced the time spent on household chores. Rather, the opposite has occurred. Standards of cleanliness, health and other shifts in expectations have put families to work in their homes doing a better job at cleaning, washing, and cooking—all made possible by new technology. As an example, the addition of the new washing machine increased the number of loads washed, the frequency of washing and escalated the standards of what were truly *clean* clothes. Hence, little timesaving was available for leisure (Schor, 1991).

The reduction of discretionary time has several implications for leisure. First, it means that participation can be reduced. There is just less time to fully enjoy a wide range of leisure and recreation activities on a regular basis. The quality of leisure experiences may suffer. The pace of life causes people to try to do more things simultaneously. This is the practice of *time deepening*, doing more with less time (Godbey, 1985). Through this process, people not only try to do more in less time, but they engage in more than one activity at a time (e.g., reading a good book while having lunch, reading and watching TV at the same time, etc.). Furthermore, according to Godbey, people carry out activities more precisely, knowing exactly how long an activity will take down to the minute. Then they plan to place that activity within an already tight schedule. Under such conditions, it would not seem unusual for people to say they are enjoying their leisure less and less.

Technological Impacts on Leisure

The specific characteristics of the relationship between leisure and technology are complex. As noted by some, both positive and negative impacts are associated with any type of technology (Kelly & Godbey, 1992). It would be unreasonable to imagine that technology brings only positive consequences to peoples' leisure lives. Furthermore, the consequences of technology can be very direct as well as indirect. Technology might improve a machine; but improvement has implications for the users of the machine, the developers, and the environmental situation that surrounds the device. Technological improvements in skateboarding mentioned above clearly illustrate these direct and indirect relationships. Not only are the impacts appreciated by the user, but the builder of facilities is also accounting for some of the impacts as are recreation planners and city officials. The implications and responses of the recreation planners and city officials represent another of the consequences of technology on leisure—institutional and social structural changes and impacts (Mesthene, 1990).

These results are mixed and worthy of review here. Specifically, technological impacts on leisure can be discussed on several fronts. Changes in behavior and equipment are obvious topics worthy of attention. Shifts in behavior have management implications for agencies that are at the interface between the public and leisure activity. Outdoor recreation and sports have been influenced by technology and selected impacts are discussed. Finally, one of the fastest growing economic sectors across the world is tourism and travel. Leisure time and money are both being attracted to major destinations around the world. Tourism, like recreation in general, is constantly being adapted or radically changed by new technology. A look to the future of leisure must also include considerations related to tourism and travel.

Complexity of Choices

One of the most obvious impacts of new technologies on leisure is the proliferation of entertainment and activity choices presented to the consumer. During evenings, weekends, and while on vacations, the average family is presented with a vast array of options, both inside the home and elsewhere. Technological improvements to recreation equipment or the development of new devices have given people many choices about what to do with their leisure and how to carry out their leisure. Cable TV, along with video machines (VCR), provides a staggering number of visually-based entertainment options. The VCR provides for *time shifting*, viewing movies when it is convenient, either by recording broadcasts or renting films (Kelly & Godbey, 1992).

In the United States, as seen in Table 2, a majority of households have TV, cable access, and VCRs. Availability of cable and VCRs in households grew quite rapidly in the 13 years between 1980 and 1993. As fiber optics and interactive mediums become available on cable, it is reasonable to assume that even more households will be connected to cable in the years ahead.

Table 2
Utilization of Selected Media: 1980 to 1993

Year	Television[1] (% of Total Households)	Cable Television[2] (% of TV Households)	VCR[2] (% of TV Households)
1980	97.9	19.9	1.1
1985	98.1	42.8	20.8
1986	98.1	45.6	36.0
1987	98.1	47.7	48.7
1988	98.1	49.4	58.0
1989	98.2	52.8	64.6
1990	98.2	56.4	68.6
1991	98.2	58.9	71.9
1992	98.3	60.2	75.0
1993	98.3	61.4	77.1

[1] As of January of Year shown. Excludes Alaska and Hawaii.
[2] As of February. Excludes Alaska and Hawaii.
Source: U.S. Department of Commerce, Statistical Abstract of the United States, 1994, p. 567, Table 882.

Electronic entertainment equipment sales and ownership are up in many parts of the world. In the Netherlands, between 1986 and 1991, VCR ownership grew from 35% to 50% of the households (Sociaal en Cultureel Planbureau, 1992). Ownership of CD players moved to 50% of all households in the Netherlands in 1992; in contrast, estimates for the United States includes only 21% of households (Mitchell, 1994). Personal computer ownership across households in the Netherlands is estimated to be 25% in 1991; in the United States, the estimate is 20% of all households (Mitchell, 1994; Sociaal en Cultureel Planbureau, 1992). Least it be thought that a vast majority of the households will soon be riding the Internet for fun and games in the near future, recent estimates suggest that in the United States less than 20% of households have both a PC and a modem (Presstime, 1993). More current estimates based upon reviews of recent surveys suggest that only 12 to 14 million people in the United States have access to the Internet services beyond e-mail (Brightman, 1995).

New Leisure Patterns and Management

Leisure technologies alter or enhance sport and recreation equipment, create new behaviors, rearrange the social dimensions of leisure, and allow for shifts in time. These direct influences can be manifested in multiple ways, depending upon the leisure activity. New leisure activities and equipment have been discussed previously. Of course, the changes and impacts resulting from these new behaviors and equipment usage have policy implications for society and leisure, recreation, and natural resource agencies. For example, better hiking and camping equipment means that more people and people with less training are able to penetrate deeper into forest, river, and wilderness settings. Management agencies then must respond to the increased pressure that increased visitation brings to fragile regions and resources. Entirely new activities require new regulations and policies.

The introduction of a new technology and subsequent leisure activity sends ripples of change through an organization such as a national park, urban park, or community. An example includes the U.S. National Park Service developing policy for hang gliding off cliffs in Yosemite National Park in California.

Some of the newest leisure equipment advancements have secluded the individual from others in ways not possible before. With the introduction of the *Walkman*, personal music concerts standing in a crowd are now possible. Constant entertainment, personal and pervasive, is certainly an option today for a person who wants to escape the urban noise and clutter or is not interested in the sounds of nature on the walk across a park or to the neighborhood store. Personal entertainment choices are made possible through a technology that is mobile, compact, and of high quality (Sociaal en Cultureel Planbureau, 1992).

Advanced toys and video games have also permitted children and interested adults to isolate themselves in individualized play and entertainment. There may be an option for including others, but it certainly is not necessary. To be sure, isolated play does not result solely from the onset of advanced toys and games; smaller families are also a significant contributor to this behavior. But, it is still an interesting question for the child development specialist—what are the consequences of such behaviors long term?

Outdoor Recreation and Sports

The impacts of technology on outdoor recreation have been long term and impressive. Name an activity and most likely there has been a noteworthy technical improvement in recent years. The television broadcasting of sporting events has been an obvious informational and technological change. Outdoor recreation and sports safety have been improved dramatically with the advent of new equipment, new fabrics, and devices, not to mention the improvement in sports medicine and medical technology. The list can be extended, but a brief discussion of only a few major impacts follows.

Technology, Access and Gadgets

When John Muir, a wilderness advocate and philosopher, visited Alaska in 1879 he felt it was the most pure wilderness he had ever encountered: raw, sublime, huge, and remote. How could tourists, campers, and hikers find such a place, so remote, cold, and undeveloped? Yet, the Alaskan wilderness was very accessible in only a short time. The sweeping improvements in transportation from rail to airplanes soon opened the Alaska wilderness to outdoor enthusiasts from around the world (Nash, 1982). It was not just transportation technologies but innovations in camp-

Table 3
Recreational Vehicles: Numbers of Shipments: 1970 - 1992

Year	Recreational vehicle shipments (thousands)
1970	380.3
1975	339.6
1980	181.4
1984	396.2
1985	359.2
1986	379.5
1987	400.2
1988	427.3
1989	395.7
1990	354.5
1991	300.5
1992	389.8

Source: U.S. Department of Commerce, Statistical Abstract of the United States, 1994, p. 630, Table 1012.

ing, hunting, sleeping, and food preparation technologies that made Alaska and other remote parts of the world highly accessible. Attendance at national parks and forests is continuing to increase with the ease of getting there improving with each new recreation vehicle, trailer camper, and caravan that comes off the assembly line (Table 3). Easy access and comfort away from home on outdoor vacations are direct by-products of technology.

It is not only recent innovations that have concerned observers of outdoor recreation. Over forty years ago, Aldo Leopold (1949), forester, wildlife manager, and philosopher, offered these concerns about what modern technology was doing to one outdoor activity—hunting.

> Gadgets fill the pockets, they dangle from the neck and belt. The overflow fills the auto-trunk, and also the trailer. Each item of outdoor equipment grows lighter and often better, but the aggregate poundage becomes tonnage. The traffic in gadgets adds up to astronomical sums, which are soberly published as representing 'the eco-

> nomic value of the wildlife.' . . . I have the impression that the American sportsman is puzzled; he doesn't understand what is happening to him. Bigger and better gadgets are good for industry, so why not for outdoor recreation? It has not dawned on him that outdoor recreations are essentially primitive, atavistic; that their value is a contrast-value; that excessive mechanization destroys contrasts by moving the factory to the woods or to the marsh. (pp. 214-216)

Technology and Conflicts

The observations of Leopold (1949) force the question—what is the role of gadgets and what is their relationship to the true experience of the outing? Gadgets may actually obscure the experience or become the end rather than a means to an end. This is a reoccurring theme in the outdoor recreation literature.

Technologies introduced into the outdoors as new devices and conveniences may spawn conflicts as well as a desire to have, use, and display the latest piece of equipment. Growth in sales in a selected sporting goods can be seen in Table 4. The appearance and use of the varied devices and equipment have caused some to question their value and impacts. "Rather than being a place of relaxing tranquillity where the recreationist can enjoy nature, the outdoor recreation scene seems to be an emerging *jungle* of technological, interpersonal, administrative and political conflicts" (Harry, 1976, p. 57). Those in a powerboat have conflicts with those on a jet ski, cross country skiers dislike those on snowmobiles, and downhill skiers wish the youth on snowboards would find another mountain. Years ago, these conflicts did not exist and the agencies and managers had no reason to be developing conflict resolution policies as they do currently.

Recreation Environments

Of course, none of these activities take place without environmental impacts. Here again, technological innovations have threatened the environment in ways not thought of prior to introduction. The mountain bike is a case in point. Bicycling has been a growing activity, but the technology that put the large-tired bike in the forest created a personal vehicle that can move quietly but destructively through fragile environments. Other off-road vehicles have similar destructive effects on the environment, creating erosion, killing vegetation, and disrupting ecological communities.

Table 4
Sporting Goods Sales by Product Category: 1980 to 1993 (Millions of Dollars)

Year	Athletic & Sport Footwear	Walking Shoes	Exercise Equipment	Bicycles & Supplies	Snowmobiles
1980	1,731	(NA)	(NA)	1,233	216
1981	2,610	263	1,216	2,109	162
1986	3,199	368	1,206	2,518	177
1987	3,524	512	1,191	2,272	188
1988	3,772	752	1,452	2,131	273
1989	5,763	1,237	1,748	2,259	301
1990	6,263	1,509	1,824	2,423	322
1991	6,300	1,375	2,106	2,686	362
1992	6,242	1,375	2,050	2,723	376
1993 (proj.)	6,339	1,388	2,071	2,822	389

Source: U.S. Department of Commerce, Statistical Abstract of the United States, 1994, p. 259, Table 407.

Tourism and Travel

A growing and significant use of people's vacation and discretionary funds is travel. Travel, and the associated tourism industry, is a major international industry fashioned with the purpose of satisfying the traveler—the tourist. Just as the three-wheel vehicle has made it possible to get to exciting natural resource attractions in outdoor recreation settings, the technological transformation of travel has put millions of tourists on the rim of the Grand Canyon, in small villages in jungles across the world, and on exotic islands in the Pacific. In 1958, with the introduction of jet airline service along with coach fares, tourism took off and has not stopped since. Today, the countries of the world receive approximately 400 million international arrivals at their borders and airports. In 1960, the United States received approximately 5.6 million international arrivals; by 1991 this number increased to 43 million arrivals (Edgell and Smith, 1993). Vacations, travel, and the tourism industry go together with millions each year taking their vacations on the road.

Transportation has not been the only sector of tourism that has benefited from improvements in technology over the years. Information technology, the computer, and the resultant complex computer reservation systems (CRS) created by the airline industry has revolutionized the way transportation is marketed, priced, and sold. The interactions between tourism, technology, and information management and transmission have been conceptualized by Molwanda and Smith, (1992) (see Figure 1).

As can be seen in Figure 1, the tourism infrastructure which includes transportation, accommodations, the availability of funds for travel, credit for travel, and access to reservations interacts with two other systems. Information systems and information itself are inherent to the tourism infrastructure and support tourism and travel (e.g., timely reservation information in reservation systems, instant credit information available internationally). Interacting with information and the tourism infrastructure is technology. Technology in combination with the information and the needs of tourism and travel make reservation systems possible and profitable along with other conveniences for the traveler internationally. The ability to monitor availability of plane seats or hotel rooms across the globe at a key stroke is a tremendous management tool and an advantage not available prior to the use of information technology. The systems are so large and effective now that special national and international policies

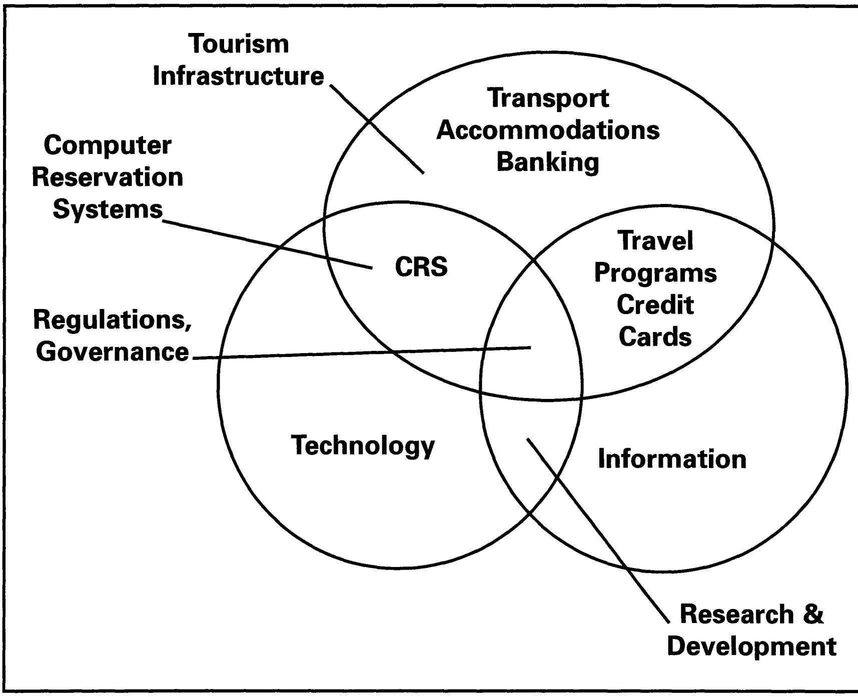

Figure 1. *Technology, information and tourism (Mowlana and Smith, 1992, p. 165).*

must be implemented to address issues of competition (or lack of it) along with negotiated understandings of fairness between and across countries and corporations.

Stipanuk (1993) has summarized the interrelationship between tourism and technology (see Table 5). The influences of technology on tourism are multiple, positive and negative. Selected impacts are directly apparent to the tourist; others have far-reaching but indirect impacts.

Tourism Growth

Stipanuk argues that technology is a stimulant for economic growth that, in turn, fosters the growth in tourism. Beyond this argument of indirect contributions, there are more direct technological contributions. The access to destinations provided by the by-products of technology (e.g., jet

Table 5
Technology's Influence on Tourism

Technology:

A.	Influences tourism growth
B.	Creates tourism experiences
C.	Protects tourism and tourists
D.	Enhances traveler experiences
E.	Becomes the attraction
F.	Acts as a tool within the industry
G.	Destroys the tourism experience

Source: Adapted from Stipanuk (1993, p. 268).

airlines) creates or stimulates a growth in the tourism enterprise and subsequent economic activity.

Tourism Experiences

This is an important contribution to tourism; one that cannot be overestimated. Technology makes certain destinations possible. Disney and the theme parks of the world are only possible due to the direct application of sophisticated technologies. The modern skiing experience along with the luxuries of the superliner cruise ships are technological marvels of efficiencies, communication, safety, and entertainment.

Tourism Protection

Tourists shun destinations and countries that are not safe. Safety is extremely important to the tourism industry. Technology facilitates a host of safety procedures and policies from security checks by computer and X-ray machines at airports to hotel rooms opened by security cards, not keys. Protection takes on other forms as well. Landscape design materials, created to protect a resource or manage crowds, are functions of technology and appropriate design (e.g., special turf grasses, walkway materials, fencing, safety lighting, and computer-assisted directional signage).

Tourism Enhancer

From photos in the album to trinkets on the shelf from the last trip, technology enhances the tourism experience in many different ways. Video films contribute to the experience and create lasting memories that can be refreshed through review. Telecommunications technology makes it easy to stay in touch while traveling and assist with language difficulties and interpretation needs. While in flight, communications are now possible along with a host of in-flight entertainment options (e.g., films, video games, and even possibly in-flight gambling).

Technology as the Attraction

Epcot at Disneyworld; the historical machinery at Greenfield Village Museum in Detroit, Michigan; the airplanes on display at the National Aeronautics and Space Museum in Washington, DC; and the Parc Asterix in France draw their crowds, in part, due to the use of and display of technology. Tourists come to see it, touch it, or use it—technology is the central attraction—the defining characteristics of the destination. Of course, there is a long history of this going back to the first world fairs and expositions. Technology has always had an inherent attraction to people and that has not changed in recent times, given the success of theme parks and museums focusing upon technology.

Technology as a Tool

Here again the gains in tourism brought by the use of technology are apparent. Computer systems and telecommunications systems are inherent to the daily operation of the travel industry. From the hotel kitchen to the direct marketing campaign based upon huge databases, the tourism industry appreciates and uses technological tools very effectively.

Technology as Destroyer

Stipanuk (1993) argues that the relationship between tourism and technology is not always positive. Technology can destroy the tourism experience in a number of ways. A breakdown in a computer reservation system, a chair lift or a theme park ride can spoil a trip or an outing. This creates a very direct impact on the tourist. More subtle problems are suggested when resorts or attractions are so *high tech* that people do not have positive feelings about the destination. Certainly, some tourists are sensitive to the bounds of reality and how these boundaries are stretched in extravagant ways (Thayer, 1994). As noted by Paul Kelly (1994), technology might be able to create a simulated entertainment experience, but even if it offers a great deal of realism, it may not be considered exciting by some tourists (e.g., realistic flight simulators where the realism is overlooked and not appreciated). Philosophically, some ask whether the technologically rich destinations destroy our sense of realism and present narrow, biased views of the world (Spitanuk, 1993).

Value Change and Shifting Norms

The brief review of the relationship between technology and leisure illustrates the far-reaching impacts that result, positive and negative. Yet questions remain. Has life improved due to these technological improvements to leisure? What is the worth of new leisure equipment? What value do people place upon the ever-growing array of leisure and recreation options they face? Is quality of life increasing as people press more activities into fully-scheduled days and nights? In this section these questions are discussed.

The worth of a society is reflected in the values and norms that guide the behavior of its citizens. As standards of living rise and the importance of time increases, the meaning and significance of leisure begins to shift as well. The criteria of what is a good vacation, a quality weekend, and a pleasant evening out escalate. This is not a new trend; with industrialization and mass production in the early 1900s came the *commoditization* of leisure. People wanted more and expected more. Leisure activities and recreation equipment became market products with changing models each year and marketing strategies to entice the person who wanted the best for the precious leisure that was available. This social and marketing process continues today.

Technological equipment changes with the times. Bigger and better travel trailers, boats, and recreation vehicles are always coming on the market. Like car models, there is always something new and better out there ready for the consumer. Once a new technology transforms a leisure activity, the standard of acceptance changes. It is easy to see the evidence of this shift in norms of satisfaction with recreation equipment. Imagine, what percent of computer/video game players would be satisfied with returning to video games of the past with their limited visual clarity and limited interactive capability? Consider the same question for sleeping bags used for camping, sailboat equipment and accessories, downhill skiing equipment, or music entertainment in the home. Standards are set, expectations established and met, and now there is no return to a time when leisure was *simpler*, less complex.

Lost Value in Commoditization

Kelly and Godbey (1992) argue that leisure, for all too many people, is becoming nothing but a commodity to be consumed. Yet, as efficient as the market can be, is that how a society should define leisure—as a product bought and sold? With the aid of technology, it is very easy to commercialize experiences and sell them. They observe that instrumentality of leisure misses important values and experiences that people seek—meaningful involvement and activity along with genuine communication with other people. "The problem with commodified leisure is that it lacks both those elements of satisfaction. It is based on being done to rather than doing, possession rather than sharing, things rather than people, and instrumental behaviors rather than intrinsic meanings" (p. 350). From their perspective, if the tools of leisure become the goal, then significant meaning is lost from the experience.

Commodities are to be bought and sold. Commodities as products are mobile and can be purchased and experienced around the world. Modern media technology and the mass distribution of cultural leisure items such as movies, music, and literature pressure the citizens of diverse cultures to defend their value systems and cultural heritages. As noted by planners in the Netherlands, the leisure products are readily available across cultures permitting the individual to select a personalized style; but one strongly influenced by a common world or United States culture and orientation (Sociaal en Cultureel Planbureau, 1992).

Value Accommodation

From another perspective, it can be argued that technology does play a role in value change, and there are good reasons for such change. Mesthene (1990) argues that technology creates new opportunities, and these new opportunities may create value conflicts not experienced before. He notes that values change by accommodating the new opportunities and challenges brought about by technology. "Specifically, technology can lead to value change either (1) by bringing some previously unattainable goal within the realm of choice or (2) by making some values easier to implement than heretofore; that is, by changing the costs associated with realizing them . . ." (p. 87).

This is more common within leisure than might be obvious. The introduction of snowmobiles and jet skis has presented the outdoor enthusiast with activities and access to settings not possible before. Hence, trails in forests and beaches at waterfronts were open to all; resources were protected by virtue of limited access or access via means with less noise and power. After these machines are introduced, agencies must develop policies that pit conflicting values against each other. The value of open public lands is put up against the need to protect fragile resources not from people per se, but from the results of access by a new technology. These debates, conflicts, and resolutions are the accommodations required of society over time. While not pleasant, accommodation is a necessary process that accompanies change, social preferences, and the lure of new ways of doing things, be it leisure or business.

Socialization, Culture and Media

Part of what concerns many, from educators and parents to cultural censors, is the impact of leisure and media upon learning, socialization, and the development of youth. Not only are they concerned about how TV-based leisure will influence learning, they worry about lost values and shifting norms. Now, of course, broad-based media have focused the issues on an international level. The cultural mores and norms of distant lands appear daily in the homes and movie houses of families around the world through international television and video films. The pervasive voices of CNN and the video music and fantasy of MTV have shaped these issues into a matter of international debate.

Learning and socialization through the developmental years are natural processes but are also specific to every culture. Leisure often is used as a socialization instrument within societies, among peer groups and subcultures. New leisure technologies are an integral part of these processes. Modeling of social behaviors is augmented by TV shows and advertisements. The latest technological variations of popular leisure products disseminate rapidly among young people and other target markets, fostered by images from media.

Complaints about the effects of mass media revolve around the issues of socialization processes and values being mediated by a common, popular entertainment industry rooted in Western culture, specifically U.S. culture. TV, as a babysitter, strikes many as a less than optimal way to parent, nor is it the highest end use of the medium. Yet, millions of families have the TV as the center of family gatherings, entertainment, and child care.

Socialization, gender, and technology interact in important ways. Traditionally, selected leisure technologies have been, and still are, preferred and used somewhat more by one gender over the other. This partly has to do with who designs the products, be it ski equipment, exercise machines and video games—mostly males. For example, the designers and programmers for video games are predominately young males creating products that appeal to other young males. Knowing this, Sega is trying to develop and market more products which will appeal to girls (Johnson and Brown, 1994). Regarding technology in general and the VCR specifically, Gray (1992) clearly states, "Men and women have unequal access to technological knowledge within our society; this is generated through familial socialization, education and work-place experience, and has resulted in an ideology of female-related technical incompetence" (p. 25). Her case study analysis of English women's use, understanding, and appreciation of VCRs in the home was most revealing. Women, in her case study, were less interested in the machine itself, were often not the ones interested in purchasing it, were somewhat concerned with the disruptive influences it might have on their family life, and did not want it to influence their leisure outside of the home.

Quality of Life and Leisure

The implications of technology for the *good life* would seem apparent. It would be difficult to argue that technology has not enhanced the type, diversity, and quantity of leisure choices for almost everyone. Very few would be willing to give up their leisure products and return to a *simpler* time, with fewer technological distractions. This, of course, does not speak directly to the issues of quality of life. An improved piece of recreation equipment does not guarantee a quality experience. As stated previously, for many the leisure experience is lost in the glamour of the equipment or latest device. In such cases, the potential of technology to enhance the lives and life-styles of people is lost.

On the other hand, leisure technologies have created new and exciting activities never seen before, have expanded the range on others, and will continue to bring challenging and worthy experiences to millions with no end in sight. It would seem that a *balance* is what is required of the users of leisure technologies. Society and leisure are being changed due to technology; understanding these changes requires a knowledge of technology, its influences on leisure, and a balanced approach to the use and ownership of leisure technology.

Arguments about the benefits of leisure and recreation (e.g., Driver, Brown & Peterson, 1991) for individuals and society seldom include a thorough analysis of technology. The true meaning of leisure is imbedded in experience, in interactions with other people, in self reflection, and in insights about self, life, and humanity. This does not require CDs, VCRs, rollerblades, computers, or the latest jet ski.

It is important to remember that millions of people still participate in ordinary low technology activities as part of their leisure lives. They visit with others, have picnics, rest in the backyard, and read books. In the United States, volume of books sold continues to increase (U.S. Department of Commerce, 1994); yet in the 20-year period between 1965 and 1985, Americans reported spending less time per week reading (Cutler, 1990). Some of this time is being consumed with TV, cable TV, and other new home-entertainment equipment. The Dutch do not report marked shifts in activities such as reading, TV viewing, or sports between 1975 and 1990 (Table 6, Sociaal en Cultureel Planbureau, 1992). It would seem that the excitement of entertainment technology has not shifted patterns of leisure dramatically, even though readily available. Quality of leisure and quality of life are not necessarily tied to technology. Asked about using interactive TV for paying bills and other chores, most Americans are not interested; but a recent poll found that 77% of adults would be interested in such technology if it allowed them to select their favorite TV program at will (Mitchell, 1994). Discrimination among the services and activities that technology offers a person is important. Quality of life is not made from the random selection of services and uses provided by technology; rather it is built upon choosing options wisely and through the meaningful implementation of technological capabilities.

Leisure Education

As free time increasingly becomes available to people through retirement and vacations, knowing what to do with leisure becomes critical. Retirement and long vacations test individuals' and families' abilities to move between structured work schedules and unstructured leisure settings with agendas that are self-initiated. In the leisure profession, growing services in leisure education are designed to assist people with the challenges of leisure in their lives. In these times, leisure education must

Table 6
Leisure Time per Week for Leisure Activities in the Netherlands

Year				
Activity	1975	1980	1985	1990
	% of Leisure Time per Week			
Social contacts	23	25	21	21
Going out	11	10	11	12
Hobbies/sport	10	13	14	12
TV/radio/audio	25	25	27	27
Reading	12	11	10	10

Source: Sociaal en Cultureel Planbureau, 1992

address the broad range of choices people face as they seek pleasure in their lives (Kelly & Godbey, 1992). This should include choices about leisure technologies, the appropriate uses of these technologies, and what their use means for the individual, family and community. A living room, recreation room and garage full of toys, electronic games, video films, boats, and the latest in transportation for fun does not insure quality of life. Standards of living may rise, but there is no guarantee that the quality of life will improve. Meaning and significance beyond just the possession of *technological toys* must be gained through education. Industrial societies offer their members few places where such ideals and ethics are learned except from within the family, spiritual centers, and in schools. Schools could do more; as part of the debate and instruction about technology, leisure technologies should be studied.

If technological advancements are creating more leisure opportunities, then people are presented with more choices. It is not enough to have increased freedom to choose leisure gadgets; the implications of these choices for the community and personal well-being must be considered (Kelly & Godbey, 1992). Limits must be set. Cultures, communities, and the natural environment cannot flourish nor be maintained if growing populations with increasing discretionary time and money continually infringe upon cultural, social, and environmental thresholds. Aside from coercion, education, and public awareness about choices, the quality of those choices and the impacts of choice would seem to be a viable option for society.

The topic of education for the proper use of spare time is not new. Churches, schools, law enforcement agencies, and social service groups have long understood the need to be concerned with how young people used their free time and pursued leisure. Retirement looms for millions as the baby boomers of the industrialized nations edge toward their "golden years." Constructive and meaningful use of time and resources will be a concern for many.

Education could begin to address these issues in three ways. Leisure education should be a part of the education system in some form. First, technology education must include the leisure technologies. It is not enough to consider the mechanical nature of such technologies; in addition the social and cultural context for these technologies must be addressed at the same time. After the details of a video machine and videotape have been taught, a debate should follow on the social uses of such devices, and the implications of their use in the home, positive and negative. Broad-ranging social and cultural discussions would be expected after an analysis of the internal combustion engine or super sonic transportation (SST) flight—leisure technologies should fare equally as well in technology education classrooms.

Second, leisure education concepts and issues should be a part of the general school curriculum. Topics important to individuals and society through life need to be reviewed and discussed in some manner. Too often the latest entertainment technology is discussed in schools as merely another consumer product discussed in terms of price, functionality, and quality. Little effort goes into placing the product within the context of one's leisure life-style, where choices about technological leisure products have social, environmental, and personal consequences. To the extent that educational institutions are designed to educate well-rounded citizens, it seems appropriate to include concepts that prepare young people for all of life—for the job and for nonwork portions of life (Kelly & Godbey, 1992). Physical recreation education is only part of such an education. Educators have to find opportunities to discuss the choices citizens face in their homes, on weekends, on vacation, and as they prepare for retirement. As noted throughout this chapter, these choices have consequences.

Business classes, social studies, and history courses could include appropriate materials that bring out the interrelationships between technology, leisure pursuits, and cultural impacts. The pervasive nature of the entertainment industries in the lives of millions requires discussion and debate. Sega programming on TV 24 hours a day via cable should stimulate debate in business courses as well as social studies. Technology has made such pleasures possible, but how should consumers balance their freedom to choose, their freedom to indulge, their freedom to ignore other worthy activities—from reading to charitable acts of volunteerism? Educators must be at the cutting edge of this debate.

Third, continuing education is a growing segment of the educational mix today. Leisure and education come together as more and more people choose to take classes for self-improvement and enrichment (Kelly, 1990). Today, one can find courses ranging from how to improve in a particular sport to how to use the Internet. Where appropriate, educators must introduce the leisure technologies as part of these courses. In some ways, it already is occurring. Students may select courses on sailing, backpacking, etc., but the environmental and cultural issues associated with these technologies and activities may not be discussed. However, they should be. Nontraditional educational opportunities represent a way of sharing technological knowledge and concerns with citizens from all walks of life and ages. Citizens are lured constantly to consume, to find amid the wide array of technological *toys*, a few that will truly improve their lives. Businesses of all kinds are emerging to take technology from the drawing board to the leisure world. Billions are at stake and the potential for enormous profits has not gone unnoticed. Major phone, media network, entertainment, sports equipment, and transportation corporations all are looking for the next important opportunity to tie technology to leisure in a profitable way (West, 1994; Mowlana and Smith, 1992; Dawson, 1994). The assault on the consumer will be relentless. As these markets expand, the task for the consumer to make sense of this will be daunting. Continuing education can assist the consumer with courses that focus the questions and stimulate debate around reasonable answers and solutions.

Technological Literacy

Society is challenged by the need for its citizens to understand technology, its meaning and impacts. This is not a new concern, but a growing and more complex concern. "New and more sophisticated technical means have decreased the level of understanding by the general population of the basic and essential technical systems of our global society. The issues of society have become more intertwined with issues of a technological nature. These in turn have become more intertwined with issues related to the life-giving and life-sustaining environment of the Earth" (DeVore, 1992, p. 3). Indeed, individuals' choices about leisure technologies have consequences for human well-being and stewardship of the earth and should not be ignored. Just as it is the responsibility of citizens to acquire general knowledge of technology that is used within society, it is also their responsibility to know and understand the meaning and implications of leisure technologies.

To the extent that child development is shaped by the mass media, it is a responsibility to know and be concerned. To the extent that our precious natural resources are damaged by *high tech* leisure devices used inappropriately, it is a responsibility to know and be concerned. To the extent that social community and social discourse are disrupted or retarded by overly personalized, leisure entertainment technologies, it is a responsibility to know and be concerned. Citizens of today and the future must exercise their technological choices with care and attention to the impacts which can occur in ways not thought possible in previous eras.

Conclusion

To assist citizens in their adjustment to the pace of technological change and the range of choices presented to them, technological education along with leisure education is required. Choice, all too often, is shaped by popularity, media, and ill-advised social influence. In times to come, the errors of choice will become costly—socially, economically or environmentally. Education provides a means of avoiding costly errors in choice. "We have discovered that placing our faith in inappropriate technical solutions is the road to disaster and that technically driven social purposes bring forth un-imagined and unplanned for consequences" (DeVore, 1992, p. 4).

Enjoying the fruits of leisure technologies is a cherished goal for most all of society, but their use and misuse are not without consequences, short- and long-term. Citizens, parents, teachers, and leaders of today and tomorrow must carefully prepare themselves and the youth of society for these pending choices. Philosophers have warned of the dangers that technologies and pleasures might bring to a society. Postman (1985) clarifies the dark visions created in two futuristic worlds created by Huxley (*Brave New World*) and Orwell (*1984*). Central to each was the concern that people would lose their freedom and dignity, but the threats were different. In Orwell's view, Big Brother was the oppressor; technology fostered oppression. In Huxley's view, people were to lose their liberty through their love of pleasure and pleasure-giving technology.

> What Orwell feared were those who would ban books. What Huxley feared was that there would be no reason to ban a book, for there would be no one who wanted to read one. Orwell feared those who would deprive us of information. Huxley feared those who would give us so much that we would be reduced to passivity and egoism. Orwell feared that the truth would be concealed from us. Huxley feared the truth would be drowned in a sea of irrelevance. Orwell feared we would become a captive culture. Huxley feared we would become a trivial culture, preoccupied with some equivalent of the feelies, the orgy porgy, and the centrifugal bumblepuppy. (Postman, 1985, p. *vii*)

Postman is concerned about the world of Huxley, a world where people grew to love their technologies dulling their thinking capacities. This is no idle concern for a citizenry that must choose almost daily from a plethora of entertainment options made possible by technology.

REFERENCES

Bell, D. (1973). *The coming of post-industrial society.* New York: Basic Books.

Brightbill, C. (1960). *The challenges of leisure.* Angled Cliffs, NJ: Prentice Hall.

Brightman, J. (1995). Mystery guests. *American Demographics, 17*(8), 14-16.

Cross, G. (1990). *A social history of leisure since 1600.* State College, PA: Venture Publishing.

Cutler, B. (1990). Where does the free time go? *American Demographics, 12* (11), 36-38.

Dawson, W. (1994). Successful family entertainment centers. In *TILE: Technology in leisure and entertainment: Conference proceedings* (pp. 148-151). Warminster, Wiltshire: Andrich International Limited.

De Klerk Wolters, F., & De Vries, M. J. (1987). Technology in pupil's everyday life. Effects of course material on the pupils' attitude towards technology. In Riquart, K. (ed.), *Science and technology education and the quality of life. Volume 2.* Institute for Science Education Kiel University.

DeVore, P. W. (1992). Introduction to transportation technology. In Wright, J. R. &, Komacek, S. A. (Eds.), *Transportation in technology education-41st yearbook, 1992* (pp. 1-31). Columbus, OH: Glencoe.

Dittrich, D. (1992). Before the games could begin, they had to be invented. *Smithsonian, 23*(3), 96-101.

Driver, B., Brown, P. J., & Peterson, G. (Eds.). (1991). *Benefits of leisure.* State College, PA: Venture Publishing.

Dumazedier, J. (1967). *Toward a society of leisure.* New York: The Free Press.

Edgell, D. L., Sr., & Smith, G. (1993). Tourism milestones for the millennium: Projections and implications of international tourism for the United States through the year 2000. *Journal of Travel Research, 32*(1), 42-47.

Edginton, C., Hanson, C., & Edginton, S. (1992). *Leisure programming: Concepts, trends and professional practice*. Iowa: WCB Publishers.

Godbey, G. (1985). *Leisure in your life*, (2nd ed.). State College, PA: Venture Publishing.

Gray, A. (1992). *Video playtime: The gendering of a leisure technology*. New York: Routledge.

Harry, J. E. (1976, Spring/Summer). Technological change and leisure: the case of outdoor recreation, *Humboldt Journal of Social Relations, 3*(2).

Johnson, S., & Brown, J. (1994). Simulation technology, a market driven approach. In *TILE: Technology in leisure and entertainment: Conference proceedings* (pp. 37-41). Warminster, Wiltshire: Andrich International Limited.

Kelly, J. R. (1990). *Leisure*, (2nd ed.). Angled Cliffs, NJ: Prentice Hall.

Kelly, J. R., & Godbey, G. (1992). *The sociology of leisure*. PA: Venture Publishing.

Kelly, P. (1994). Customers—matching expectation to reality. In *TILE: Technology in leisure and entertainment: Conference proceedings* (pp. 14-19). Warminster, Wiltshire: Andrich International Limited.

Leopold, A. (1949). (1966). *A sand county almanac - with essays on conservation from round river*. New York: Ballintine Books.

Martin, B., & Mason, S. (1994). Current trends leisure: taking account of time. *Leisure Studies, 13*, 133-139.

Mesthene, E. G. (*1990*). The role of technology in society. In Albert H. Teich, A. H. (Ed). *Technology and the future, 5th Ed.* (p.77-99). New York: St. Martin's Press. Originally titled "Some General Implications of the Research of the Harvard University Program on Technology and Society" in *Technology and Culture*, October, 1969.

Mesthene, E. G. (*1971*). Technology and humanistic values. In M. Kaplan and P. Bosserman (Eds.), *Technology, human values and leisure*, pp. 42-57. New York, NY: Abingdon Press.

Mitchell, S. (1994). Technophiles and technophobes. *American Demographics, 16*(2), 36-42.

Mongon, E. (1994). Parc Asterix reengineering—key factors for success. In *TILE: Technology in leisure and entertainment: Conference proceedings* (pp. 143-147). Warminster, Wiltshire: Andrich International Limited.

Mowlana, H., & Smith, G. (1992). Trends in telecommunications and the tourism industry: Coalitions, regionalism, and international welfare systems. In Go, F., & Frechtling, D. (Eds.), *World travel and tourism review: Indicators trends and issues* Vol. 2 1992, (pp. 163-167). Wallingford: CAB International.

Mumford, L. (1963). *Technics and civilization*. New York: Harcourt, Brace & World, Inc.

Nash, R. (1982). *Wilderness and the American mind* (3rd ed.). New Haven: Yale University Press.

Pieper, J. (1963). *Leisure: The basis of culture*. New York: Mentor-Omega.

Postman, N. (1985). *Amusing ourselves to death*. New York: Penguin Book.

Presstime. (1993). Enter the E-paper. August.

Samuel, N. (1993). *Technology and leisure: Leisure research for a world in turmoil.* Paper presented at the World Leisure and Recreation Association Conference, Jaipur, India.

Schor, J. B. (1991). *The overworked American: The unexpected decline of leisure*. New York: Basic Books.

Sociaal en Cultureel Planbureau. (1992). *Sociaal en cultureel rapport* 1992. The Hague: VUGA.

Stipanuk, D. M. (1993, August). Tourism and technology: Interactions and implications. *Tourism Management*, 267-278.

Thayer, R. L., Jr. (1994). *Grey world, green heart: Technology, nature and the sustainable landscape*. New York: Wiley.

The Random House dictionary of the English language: The unabridged edition. (1966). New York: Random House.

Toffler, A. (1980). *The third wave*. New York: Morrow.

U.S. Department of Commerce. (1994). *Statistical abstract of the United States*. (p. 253, Table 396). Washington, DC: Author.

Webster, F. & Robins, K. (1986). *Information technology: A Luddite analysis*. Norwood, NJ: Ablex Publishing Corporation.

West, I. (1994). MGM Movieworld: the first theme park in Las Vegas. In *TILE: Technology in leisure and entertainment: Conference proceedings* (pp. 143-147). Warminster, Wiltshire: Andrich International Limited.

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DISCUSSION QUESTIONS

1. Looking to the future, will technology be able to substitute simulated leisure experiences for the real event or experience?
2. Over the course of history, technology has changed the shape and appearance of our toys that we use in play. In spite of this, has playfulness and the enjoyment of play changed? Is a modern doll with the technology to cry out loud a better doll than the dolls of 50 years ago?
3. Education about technology and technological literacy help people, especially young people, be aware of the promises as well as the limitations of technology, particularly in their leisure lives. Pick a single leisure activity that is dependent upon technology, such as video games, and discuss your reasons and rationale for why a young person should not spend all of his or her time engaged in this activity.

DISCUSSION SCENARIOS

Christmas Day Disappointment

Christmas - 1999. Young John is excited; Christmas has finally arrived and he is full of expectations. He and his friends had asked their parents for a Nintendo computer game called *Destruction Force I.* His parents are teachers in high school; his Dad is a technology education teacher. They did not seem to like this game. But John really wanted it. It was Christmas. He was older this year, and he felt certain that he would get *Destruction Force I* this Christmas. On Christmas night, John was again bitterly disappointed; he did not get the game. He got a book and a wood-kit for building musical instruments. He hid his dismay, but saw little pleasure or value in the other gifts he received. Why does John feel this way and are these reasonable emotions? What reasons could be used to explain the actions of the parents? Why will they not give John the Nintendo game? What is wrong with a computer game, the latest in entertainment technology?

Summer Vacation

Planning a summer vacation with the family has always been fun, an experience that builds excitement from the time the date is set on the calendar. Everybody comes up with ideas about where to go, what to do, and how long to stay where. Ideas and plans are discussed and somehow, in the end, as a family, a democratic decision is made and off they go. This year it went badly—the travel agent working on the plans went out of business. The 16-year-old son said, “No problem; I’ll get on the computer, select some options, and reserve the tickets.” He had access to reservation systems through Internet which he accessed at his school. He told his family about the destination selected, the availability of tickets, and said that brochures would be sent the next day in the mail. His family appreciated his efforts, but the joy and excitement was not there. It did not seem the same as when they all went down to the travel agent and made the plans together in the travel agent’s office. What went wrong? Technology pulled this family out of a bad situation; yet they had some feeling of disappointment. How could this be? What went wrong; what is missing?

CHAPTER 14

Technology, Consumerism, and Consumption

Peter Wright

We talk of technology as the servant of man, but it is a servant that now dominates the household, too powerful to fire, upon whom everyone is hopelessly dependent. . . . We never ask, do we want this, is it worth it? . . . We laugh at the Luddites . . . but they were the last humans to seriously confront this issue. . . . We try to outdo each other in singing the praises of the oppressor, although in fact the value of technology in terms of human satisfaction remains at best undemonstrated. For when evaluating its effects we always adopt the basic assumptions and perspectives of technology itself and never examine it in terms of the totality of human experience. (Slater, 1970, pp. 44-45)

Hey, Mom, I saw a bunch of products on TV that I didn't know existed, but I desperately need. (Watterson, 1994)

Consumerism

Key Concepts and Overview

Consumerism is an umbrella term which includes the two broad areas of consumer protection and consumer education. Consumer advocates attempt to use regulation and education to ameliorate the negative effects of totally free markets on the purchasers (consumers) of products and services. Consumer advocates document systematic abuses by some sellers and recommend the establishment of ground rules and regulatory structures by central authorities to reduce common abuses. This approach is known as *consumer protection.*

Consumer advocates also seek to educate consumers about how to purchase goods and services. The Consumers Union conducts independent product tests and reports its results in a magazine called *Consumer Reports*. The United States government recently made all of the consumer-oriented literature in its Consumer Information Center available online through the Internet. This approach is called *consumer education.*

The consumerism movement, while it has played a valuable role in creating a fairer marketplace, is ultimately an outgrowth of a social system based on viewing each person first as an individual economic unit (consumer). Other ways of conceiving human beings (spiritual, political, emotional) are not considered as a primary part of the consumerism paradigm.

Thus, consumerism can make sure the deodorant we buy will not blind rabbits, but it cannot address the question of why people are afraid to lift up their arms without having perfume in their armpits. The massive consuming culture represented by advertising is built on waste, insecurity, and mass-anxiety. No amount of government regulation or consumer education can change this fact. Similarly, there is no *producerism* movement, although agencies such as OSHA do enact regulations to protect producers (workers).

Furthermore, the marketplace, both its products and its assumptions, is rapidly changing as new technologies, particularly in the communications and information areas, refashion the nature of various markets and industries in a complex and ongoing fashion. The consumerism movement with its reliance on slow-moving regulatory agencies and consensus building with presumably-stable industry groups is severely challenged by the increasing pace of organizational and technological change.

This chapter will present a brief overview of technological changes followed by a discussion of the consumerism movement as typified by Ralph Nader's pioneering efforts. The benefits and costs of consumerism and its resultant government structures will be traced and weighed. Later in the chapter, the issue of consumption itself will be addressed—which technologies do we really need to develop and whether a blind faith in consumption itself has weakened both the consumerism movement and our society overall. Methods to prove that people control technology for human ends will be discussed. If we can ever consciously channel technological development to meet agreed-on human needs, we will have made great social and spiritual progress—not to mention proving the technological determinists wrong.

The Technological Environment for Consumerism

With each passing year it is clear that technological systems in general are becoming:

- more complex;
- more widespread;
- more powerful per unit of size; and
- more rapidly developed.

These obvious changes are leading to numerous secondary effects on the lives of people and cultures. Because we are in the midst of this ongoing revolution, the exact nature of these changes is difficult for us to predict, or even fully comprehend.

Certain overriding trends in technological systems will probably continue. They include:

- the continuous explosion of knowledge and new technological systems;
- increasing automation and computer interfaces with physical and biological systems;
- the incorporation of more information and less mass and energy into products;
- more integration of technological systems with direct human experience (virtual reality, etc.); and
- the changing nature of human experience based on technological changes.

More powerful technological systems can be a mixed blessing. Most people would agree that an automated leg prosthesis that enables a disabled person to walk again is a very desirable outgrowth of the above technological advances. However, the same trends, leading to devices of reduced size with increased complexity and power, could lead to the widespread production of an easily portable backpack nuclear bomb or chemical weapon system. Very few people feel that these innovations would be desirable. Yet, all of these new products result from the proliferation of smaller, more powerful, and more automated technological systems.

Similarly, these rapid, incremental, and fundamental changes in our world make it increasingly challenging for a cumbersome bureaucracy to provide regulatory laws and structures to protect consumers. Industries, products, and our environments are changing too quickly to be controlled on a slow regulatory cycle. Additionally, as a result of the above and of our belief in consumption itself, we will continue to see increasing pressure to reduce physical waste and to slow down the consumption of non-renewable resources. This issue has been totally outside the scope of consumerism, which is conceptualized as a movement of consumer protection and consumer education.

The key issue in government regulation is a clash between the traditional American values of freedom and of fair play. Our belief in freedom encourages us to let all people produce and sell whatever products they want with the assumption that the good products will survive in the marketplace. Our belief in fair play encourages us to regulate and create rules to protect individual consumers from massive powerful entities which sometimes utilize methods that violate traditional American values—such as deceit, profiteering, and negligence—to increase profits.

Consumerism—A Growing Social Force

"For over half a century the automobile has brought death, injury, and the most inestimable sorrow and deprivation to millions of people" (Nader, 1965, pg. i). With this opening sentence of *Unsafe at Any Speed*, Ralph Nader fired a blast at the American automotive industry which many Americans still remember as the start of the modern consumerism movement.

The first chapter had the catchy title of, "The Sporty Corvair: The 'One-Car' Accident." Nader sharply criticized U.S. car companies for many practices including: denying evidence autos contributed to smog; spending far more on auto styling than safety; and concentrating more on highway safety led than on automobile safety (because the public bears the cost of improving highways). In fact, General Motors research on highway safety led to the design of the first thruways and, ultimately, influenced the design of all limited-access multi-lane highways.

Nader described how the inventor who developed a telescoping safety bumper was ridiculed by the auto industry. He quoted Alex Haynes, Ford Motor Company Executive Engineer in Charge of Safety, as telling the General Services Administration (GSA) in November 1964 that auto bumpers were important stylistically to cars and were not essential "from a safety standpoint" (p. 181).

These arguments seem outdated today because many of the problems that Nader described have been responded to with federal legislation that has contributed to automobile safety through mandatory restraints, impact and bumper crash standards, and smog reduction. In addition, consumers now have a far more serious attitude towards automotive safety than they did in the 1960s. In fact, regulation of new autos is now proceeding in areas Nader's 1965 book hardly considered such as fuel economy, recyclability, and passenger-side airbags.

However, Nader was far from the first American crusader whose publicizing of problems of unchecked capitalist practices of an era resulted in legislation to ameliorate the problems. Upton Sinclair (1906) wrote *The Jungle* as a novel which employed the Midwestern meat packing industry as a metaphor for the entire capitalist system. Many people read his compelling novel of dangerous, unsanitary and destructive practices and skipped his essay at the end about how socialism is the solution to these practices he had reported.

President Theodore Roosevelt, aware of the national concern and outrage following the appearance of *The Jungle*, pushed for federal government control to insure meat hygiene. The result of *The Jungle* was not the triumph of socialist workers' ownership in the United States as Sinclair had hoped, but rather a comprehensive meat inspection law that was passed in June 1906 within our regulated capitalist system (Miller, 1951).

However, consumer protection regulations regarding meat did not start or end with Upton Sinclair. In fact, the hygiene of meat has been regulated since the Hebrews and Arabs in the Middle East started enforcing remarkably similar religious rules about the proper sanitary way to kill animals for food several thousand years ago.

The meat inspection laws of 1906 did not end this debate in the United States either. Crusades and investigative reporting of meat-packing abuses occur to this day highlighted by carpal tunnel syndrome and the death and illnesses of people eating contaminated hamburgers at fast-food restaurants. It is almost a foregone conclusion that continued government oversight and additional regulations will be promulgated in this area.

Nader has conducted assaults on the practices of many industries since 1965. One book he coauthored is *Winning the Insurance Game: The Complete Consumer's Guide to Saving Money* (Nader & Smith, 1990). This book is largely devoted to advice for consumers on how to purchase insurance wisely. Only in the final chapter, which is devoted to government regulation of the insurance industry, do we find flashes of the original Nader's belief in strong, progressive government regulation. Nader and Smith commented, "It is safe to say the insurance industry is *supposed to be* one of the most regulated industries in America" (p. 428).

Nader and Smith (1990) traced the 1944 Supreme Court case that almost led to the loss of the insurance industry's exemption from both antitrust laws and federal regulation. They critiqued the resulting dependence on state regulation of the insurance industry. As in *Unsafe at Any Speed*, Nader and Smith's final chapter spelled out recommendations for meaningful reform and tightening of government regulations of the insurance industry. Yet, the devotion of 90% of the book to consumer education, rather than the strong recommendations for consumer protection which are so typical of Nader's earlier career, seems to indicate a shift in his focus.

Many corporations and free enterprise advocates have argued that people should be free to buy and produce whatever they want. They believe in the long-term benefits of a free market to ensure the survival of the highest quality and most cost-effective products and services. Consumer spokespersons, like Ralph Nader, argue that some corporations, when given total freedom to maximize profits, will sacrifice product quality, product safety, worker health, and even, honesty. Nader and others believe in effective government regulation to ensure the production and consumption of high-quality products and services within a fair society.

Governmental Regulation

The U.S. government regulates many industries to protect consumers. Major federal agencies in the consumer area are the Consumer Product Safety Commission (CPSC), the Food and Drug Administration (FDA), the Federal Communications Commission (FCC), and others. Agencies such as the Occupational Safety and Health Administration (OSHA) protect producers (workers) in the workplace. But, OSHA, was formed as an outgrowth of the regulatory philosophy of the consumerism movement which believes in using the power of a central government to protect individuals from abuses by private organizations. Similarly, other public agencies regulate banks, other financial institutions, and numerous other industries.

Arguably, the first piece of consumer protection legislation in the United States occurred when the U.S. government acted to stop deceptive selling practices in 1872 by passing a mail-fraud law. The first legislation concerning product safety was the Federal Food and Drug Act of 1906, which forbade the adulteration of food and drugs and the use of false claims. In 1914, the Federal Trade Commission (FTC) was created to control unfair methods of competition. The need to further protect consumers from unfair selling practices was acted on in 1938 in the Wheeler-Lea Amendment to the Federal Trade Commission Act.

In 1938 the Federal Food and Drug Act was updated by the Federal Food, Drug, and Cosmetic Act. Under this act, the Food and Drug Administration (FDA) was required to test new drugs for safety and effectiveness before they could be sold. Highlights of consumer protection legislation from 1950 to 1970 included safety standards for products such as flammable fabrics, household chemicals, toys, and motor vehicles.

Partly as a result of Ralph Nader's work in the 1960s, the Consumer Product Safety Commission (CPSC) was established in 1972 to regulate (more broadly) product safety. In the 1980s, a backlash against the tight regulation of certain industries resulted in the partial or total deregulation of the banking, telephone, trucking, and airline industries. The results of this deregulation are still being hotly debated in a number of forums. In the 1990s, much effort has been expended by corporations and other free market advocates to use various legislative methods to reduce the number and scope of product liability lawsuits.

One clear trend of government regulation is that it always seems to increase. This is logical since no *one* law solves the problems inherent in an industry. As a bill is passed and an agency created to regulate an area, new concerns and abuses are identified and some companies find a way to get around the previous rules. Therefore, the pressure to create new, more precise and detailed rules is ongoing.

One area of consumer protection which most people support is clear food product labelling, which helps consumers know what they are buying and eating. In fact, the Food and Drug Administration (FDA) has established rules on the ingredients a product must contain before it can be called *beef sausage* or *macaroni and cheese.*

Ironically, the government labelling regulations for pet foods are even more stringent than those for human foods. A bag of dry dog food in your supermarket contains a complete nutritional analysis on the label which is required by federal law. Food labelling laws have a flaw that highlights one weakness of the federal government as a protector of consumers. As a political body, the government is susceptible to lobbying from powerful industries. As a rule, foods must display all of their ingredients, but the politically powerful alcohol and cigarette industries are exempt from many of those regulations.

Cigarettes are permitted to contain any of hundreds of chemical additives, but the tobacco companies are not required to list the additives included in a particular cigarette. In fact, the FDA does not regulate cigarettes as foods in the manner of other foods, nor as drugs in the manner of other drugs! By conferring with industry groups to build consensus, all regulatory agencies risk being co-opted and neutralized by powerful industries.

Technology and Consumerism

Liability Law, Research and Development

Consumer protection through federal regulation attempts to protect consumers by regulating products before the point of purchase. With the exception of relatively rare recalls, the government cannot help consumers after they have been cheated or sold defective merchandise. Therefore, liability law is looked upon as the last recourse of consumers who have been injured or otherwise damaged as a result of unsafe products or other negligence by sellers.

Kolb and Ross (1980) in their book, *Product Safety and Liability: A Desk Reference*, provide a guide for corporations on how to manage their design and production processes to create *minimum-hazard products.* Early in the book, they note that efficiency of operation has been the key design criteria for industrial machinery since the Industrial Revolution "almost to the exclusion of other considerations" (p. 1)—such as safety. In their opinion, the rapid shift in the attitude towards product safety in the United States occurred in the mid-sixties. As noted earlier, Nader's *Unsafe at Any Speed* was published in 1965.

Sapolsky (1986) edited a book, *Consuming Fears: The Politics of Product Risks*, in which the politics of six product safety controversies were analyzed. He used cigarettes, dairy and meat products, salt, artificial sweeteners, tampons, and urea-formaldehyde insulation as topics for each of the authors to analyze. One key point he made was: "A central feature in all the controversies is the struggle among interested groups to control governmental agendas" (p. 17).

Sapolsky also noted that sorting out claims of product risk is made difficult not only because the manufacturers have a financial interest in minimizing the risk of their products, but because many of the consumer advocates, liability attorneys, and media have a financial interest in exaggerating the risks and creating as much fear and excitement as possible. The difficult, complex, and slow task of proving and assessing product risks over time is often lost in the din of competing factions.

Huber & Litan (1991) stated that the U.S. liability system funnels $100 billion a year from manufacturers and service providers to lawyers and claimants. Critics state that America's liability system has slowed innovation and hurt its productivity. Defenders assert that the system has enhanced the safety of services and products for all consumers.

Huber & Litan's (1991) book, *The Liability Maze*, focused on five areas where the authors believe that the liability system has had the greatest impacts: the automobile, chemical, general aviation, pharmaceutical industries, and the delivery of medical services. They concluded that general aviation has seen its innovation level drastically curtailed by liability suits and fears, while the chemical industry has experienced little of these negative effects on innovation. While the other three areas have experienced some loss of innovation, some improvement in safety has occurred as a result of liability law and court cases.

Martin (1991) cited a study by the Beech Aircraft Corporation which showed that of the $18 million it spent defending and settling product liability cases between September 1971 and June 1976, only $3 million went to claimants. The rest was absorbed by "attorney's fees, technical investigations, and miscellaneous litigation expenses" (p. 483).

Liability law is a major political issue in the 1990s with the arguments echoing the competing factions identified so clearly by Huber and Litan (1991). The right of people to gain compensation for injuries they have incurred as a fault of someone else must be balanced against the right of producers to sell products in good faith without fear of being unfairly ruined by excessive litigation.

Technological Development, Consumerism, and Economic Progress

The basic conflict between total regulated protection of the consumer and total freedom of choice is reflected in arguments that have become increasingly common with regards to new technological developments. For example in the area of weapons, some producers argue that they should be able to freely produce and sell any weapon that they can create based on a free-market philosophy and the Second Amendment to the Constitution. Others argue that weapons such as machine guns, armor-piercing bullets, and grenade-launching products should be available to government officials but not to the general public. Other weapons are considered by many people as being undesirable for anyone to produce or use. These include biological weapons such as anthrax germs in warheads and certain chemical weapons.

Arguments about whether certain technologies (biological weapons) should be developed with public money or permitted for ownership by the public (armor-piercing bullets) are outside the scope of the consumerism movement. Consumer advocates would just want to make sure the bullets worked as advertised and that they were safe if used in accordance with the manufacturer's instructions (consumer protection) or to educate the public about the dangers and proper use of such weapons (consumer education).

Schmookler (1984) argued that all weapons will be continuously developed and used because people who live peacefully and mind their own business will eventually be dominated by neurotic groups that are more hungry for power. He stated that such power-hungry groups are continuously working to upgrade their technical arsenals in order to attack others. Certain pastoral and hunter-gatherer tribes destroyed by outside logging and mining operations might agree with Schmookler's thesis. Unfortunately, this well-argued book offered no obvious solution to this general problem of human behavior and technology.

Schmookler postulated power-driven evolutions towards larger societies, more complex societies, and more effective central control. Ultimately, he envisioned all people as living in a state of chronic emergency in an adrenalin society or in being decimated by those who are. Obviously, the exponential growth of technological systems, particularly in the areas of weapons, and of technologies which facilitate central monitoring and control, dovetails well with Schmookler's vision. Similarly the increasingly anxiety-ridden and frenetic quality of many American's lives supports his view.

In his concluding chapter entitled, *Conclusion: Therefore Choose Life*, Schmookler states, "The question is whether we shall discover within ourselves the understanding and the will to contain the rule of power" (p. 331). When the quest for power is combined with an environment that seems to become more friendly to developing technology every year, we can predict that the technology-based rationales of efficiency, flexibility, and the bottom line will lead inevitably to the development of ever more powerful, miniaturized, destructive, and easy-to-use weapons. Consumerism, as presently conceptualized, is not equipped to deal with these trends.

However, within the United States, consumer protection laws do serve to protect honest producers, at least to some degree, against competitors who are willing to use illegal and unethical means in order to succeed at any cost. Ironically, extending consistent government regulation worldwide would extend central control over all people in the world just as Schmookler predicts, but it might also help protect honest producers in every country to some degree from whatever competitive practices the authorities define as unfair.

The Other Consumerism—Beyond Conspicuous Consumption

Regulation-oriented consumer advocates often fall into the trap of viewing people as innocent trusting *consumers* who need to be protected from every danger that might exist. If consumers are injured, they assume that they should be awarded (often large) damages through the legal system. In all of this, the consumer is regarded as someone whose role it is to blindly consume. The consumer advocate's job is to make the world safe for blind consumption.

However, as indicated above, product-safety consumerism is incapable of dealing with philosophical issues related to whether or not a certain product or technology is needed at all. Consumerism traditionally has not grappled with the issue of whether all of our consumption provides us with a higher quality of life. In short, consumerism has implicitly been based on the assumption that increasing consumption of safe and effective products is the main goal of all people. In this way, consumer advocates generally are locked into the cycle of blindly accepting the need for any new technical means or products.

Consumption, Technology, and Human Needs

Conspicuous Consumption

The traditional thinking of most consumer advocates rarely identifies situations in which less technology and less consumption may better serve human needs than more technology. Consumerism tends to focus on the buying and consuming process while rarely questioning the social and environmental costs of increasing consumption itself. In many ways, the costs of massive consumption are more damaging to society than the occasional improper product label.

The phrase *conspicuous consumption* was coined by Thorstein Veblen in his famous book, *The Theory of the Leisure Class* (1899). He described a process by which humans moved from a more collective, tribal society to a more materialistic and individualistic society. As this occurred, the possession of certain amounts of wealth (however acquired) became a badge of honor and, ultimately, a prerequisite for respectability. However, owning wealth was not sufficient to be viewed as respectable; one had to display it. Thus, consuming things in public for no practical reason became a way of asserting one's wealth and social acceptability. In other words, being able to waste objects of obvious value, or spend extravagantly, not only became socially acceptable, but also extremely desirable.

Veblen went so far as to note that the children of the rich often studied subjects of no practical value in college as another form of conspicuous consumption. He included art history, ancient literature, and dead languages in that category. In truth, as Veblen noted, such subjects (along with the more practical math, science, and writing) have formed the basis of a *classical* education for hundreds of years.

Historically, only the rich could afford such an education. In fact, it is not too great a leap to connect this kind of social logic with the disdain with which practical studies and trades often are viewed by many of the affluent. Ironically, the advance of technology has caused the value of technical skills to increase in the marketplace and these old attitudes are changing slowly in the United States.

The fact that people are still driven to conspicuously consume can be seen in numerous celebrity weddings, demolition derbies, certain expensive sports (e.g., polo and yacht racing), and people bragging about the expensive (useless) presents they received for Christmas, anniversaries, or birthdays. Consider that 75% of the annual sales in the $4.4 billion United States perfume industry is made to men during the Christmas season (McCartney & Ortega, 1994).

Obviously some of these purchases reflect conspicuous consumption. Similarly, how many men who pay more for a premium beer can tell the difference in a blind taste test between that and the same company's cheapest beer. Many of them are paying more so that their friends can see they spent more money (for no obvious practical benefit).

The trend of conspicuous consumption is embedded in American history through such icons as cowboy mythology. The vast resources of the American continent combined with the strength and ambition of the people who crossed the ocean to settle here, lead to both our great wealth as well as to our tradition of consumption, and even waste. The slaughter of most of the native buffalo on the central American plains is one symbol of both our efficiency and our lack of judgment in using those talents.

Certain Americans have resisted our blind consumption of resources for a long time. In fact, a strong movement for greater simplicity and less consumption began at the start of the 20th century. David Shi (1985) devoted an entire book to the history of the voluntary simplicity movement in American history. He detailed the Quaker ideals, those of the Puritans, and those of the later secular republicans. In one telling section, he described how many people with deep religious and moral beliefs in favor of simple living were convinced to support World War I on the grounds that the discipline of a wartime economy would cause Americans to reject the extravagance of the 1890s era of seemingly unlimited technological advancement and consumption.

These same self-labelled progressives were crushed when, after the promotion of restraint and victory gardens during WWI, the captains of industry and President Wilson preached unrestricted consumption as a patriotic duty within months of the war's end. The American people responded and started the technology-and-consumption-driven boom which we recall today as the *Roaring 20s*.

To this day, Americans consume more of the world's energy and resources per capita than any other country. The Environmental Protection Agency of the U.S. Government stated (in 1989) that in 1988, the United States produced 1.8 kilograms of solid waste per person per day and that this was the world's highest figure (Young, 1991).

In fact, we measure our economic success on the basis of our Gross National Product (GNP) and we rejoice when it rises. However, GNP is a measure of all economic activity whether positive or negative. For example, if someone has a serious car accident and spends two months in the hospital in traction and subsequently purchases a new car, the GNP is increased. If the person avoids the accident, the GNP is lower. If the stress of our society leads to drug use which costs us billions of dollars in police and mental health costs, that increases our GNP. If we lowered our collective stress level, GNP surely would fall and some pundits would bemoan our lack of economic progress. Obviously, GNP does not directly reflect the total quality of life.

A combination of our abundant natural resources, hard work, and bottom-line attitudes has resulted in the largest economy on earth. The variety and amount of media, recreational opportunities, economic opportunities, military power, and food production that the United States has created with hard work and technological means is staggering and the envy of many people in the world.

It is easy for our pride in these evident accomplishments and superior technology to blind us to the downside of excessive and conspicuous consumption. There is much to be proud of, and many people in other countries still view the United States as the promised land. However, we should be alert to the social, personal, and environmental costs of excessive consumption.

Promoting Conspicuous Consumption

Vance Packard was an early, forceful, and articulate critic of the social tendency in the United States to encourage people to consume and waste. In his seminal books *The Hidden Persuaders* (1957) and *The Wastemakers* (1960), he documented the growth of advertising for waste, planned product obsolescence, and the use of psychology to make people who did not consume every new product feel insecure and inadequate. He considered the wastemakers to be "those who are seeking to make their fellow citizens more prodigal in their daily lives" (1960, p. 7).

Packard (1960) blamed advertisers and their corporate sponsors, but he also noted the complicity of consumers, workers, and government in tolerating waste. He made the connection with technological progress by stating that all forms of American wastefulness tended to be caused largely by the fantastic productivity of automated "offices, factories and farms" which caused businesses to promote "ever higher levels of private consumption and a philosophy of waste" (p. 8). While Packard did not blame technology itself, he concluded that our technological means permitted us more easily and efficiently to waste more of the world's resources.

Packard (1960) analyzed how this crisis of overproduction led to political exhortations to buy (anything), prompted producers to design products to break after a certain amount of use, and spawned the growth of meaningless *features* and *improvements* on all types of products. He also noted the spiritual impoverishment, resource waste, and pollution resulting from the disturbing technology-and-profit-driven pressures for greater and greater consumption.

Advertising has changed little from that portrayed in Packard's 30-year-old analysis. Television commercials still use sex to sell nonsexual products and still attempt to make people feel anxious and insecure in ways that can only be relieved by purchasing certain products. Advertising states that we cannot safely raise our arms without the protection of a certain brand of deodorant. Advertising also implies that we will have no love life if we do not purchase any number of artificial aids, from hair color to beer. State governments have even advertised that we will never be rich unless we buy lottery tickets.

Obviously the pressures to conspicuously consume are still with us. In fact, our government forcefully negotiates to convince other countries to admit American advertising so that now American soft-drink and cigarette advertising can be seen in the majority of countries on earth. A typical soft drink is made with the crowning glory of American production technology; yet it usually consists of water, sugar, coloring, phosphoric acid, and possibly, caffeine. The international marketing of a dangerous, addictive, and legalized drug—nicotine in cigarettes—is also one of America's contributions to the world's consumption. Somehow, Packard would not be surprised that his *wastemakers* still are hard at work.

The Costs of Conspicuous and Excessive Consumption

Obviously, being able to consume products is a goal people work very hard to achieve and Americans have been quite successful in this endeavor. Access to skilled medical care, a personal car, and a home television with numerous channels is a benefit that many Americans take for granted and others in the world dream of. However, as affluent as the United States is, the downside of our consumption rarely is discussed by major media organs. After all, their main economic role is to promote the consumption of selected products.

Conspicuous and excessive consumption of products and resources has many major costs for our society. This brief summary will concentrate on environmental costs, our relationship with nature, and the loss of authenticity and meaning in people's lives.

Environmental Costs

Environmental costs are primarily related to the materials consumed and the physical waste produced. The debates about toxic waste disposal, chemical weapons incineration, the greenhouse effect, ozone depletion, the landfill crisis, and so on, show that the environment has been altered permanently by human technological activity. As Young (1991) pointed out, "the devastation wrought by economic production is closely related to the amount of materials consumed" (p. 6).

The per capita consumption of raw materials continued rising in industrialized countries into the 1970s when it leveled off (Young, 1991). The leveling off largely resulted from (a) the disappearance of the most easily extracted and consumed resources, (b) the resulting rise in resource acquisition costs, and (c) the rising costs of waste disposal. The problem of what to do with all of the waste—airborne, waterborne, and solid (or landborne)—cannot be underestimated as a factor in this leveling off. Of course, total resource use continued rising due to increases in population.

The danger in using materials is not so much that we will run out but rather the damage that extraction, processing and disposal do to the environment. In 1988, the United States produced 662 kilograms of solid waste per person (Young, 1991). Until recently with the advent of recycling legislation, the government's response to the solid waste crisis was to *manage* rather than *reduce* the weight. The incineration of solid and hazardous waste was touted for years as the solution to this problem with the claim that energy would be produced as a side effect of waste generation.

It is evident that excessive and conspicuous consumption is promoted by an entire consuming/advertising faction in the United States who stand to profit from increased consumption, whether of useful or useless products. It is equally evident that massive consumption results in direct damage to the environment. Every useless product, unnecessarily large plastic package, and disposable razor adds to the problems of resource depletion and pollution. Recycling of products helps with resource depletion but the initial energy and materials used to make a useless product or package are irreplaceable.

Many Americans, particularly those who have traveled abroad, intuitively know these facts. Why have we done so little about them? One explanation for our failure to react is that we deny this unpleasant reality because we do not wish to restrict our consumption. Other people claim it is because of people's distorted relationship with the so-called natural world. Others claim that people cannot fight technological logic. Still others view the world as a struggle between powerful exploiters and helpless consuming citizens. Another claim is that individually and/or collectively we can control our own uses of technological systems and that we are currently making the necessary adjustments.

Distorted Relations to Nature

Distorted relations to nature have been a part of our history at least since, during the Industrial Revolution, the Europeans began to believe that humans could control and dominate the natural world. After all, the major philosophy guiding the development of industrial societies since the 18th century has been one elaborated by Bacon and Descartes—that the goal of humans is to increase their power through the domination of nature by rational objective means. The results of this philosophy can be seen both in our tremendous technological progress and resource consumption, and also in the deterioration of our air, water, food, and overall natural environment.

Gorz (1980) noted that, "The total domination of nature inevitably entails the domination of people by the techniques of domination" (p. 18). He pointed out that ecology is just the realization that human activity has natural limits that cannot be changed. Many corporate leaders and other societal elites have come to realize that we are bumping up against these limits. However, the tools to dominate people through databases, information control, sensory deprivation prison units, and economic means continue to develop despite environmental limits.

Slater (1970) stated:

> Human beings evolved as organisms geared to the mastery of the natural environment. Within the past few thousand years we have managed to perform this function so well that the natural environment poses very little threat to civilized peoples. Our dangers are self-made ones—subtle, insidious, and meaningless. We die from our own machines, our own poisons, our own weapons, our own despair. (p. 17)

Certainly, the wealth and technology of the United States have not protected citizens from social problems. In 1977, this author was asked by one of his African students, "Isn't it great to live in a country as rich as the United States where there is no crime?" While aware of the overwhelming problems of poorer nations, people often fail to realize that the United States of America has many social problems, such as drive-by shootings, that are only minor problems in less developed countries. In fact, Zaïre has been devastated by AIDS and poverty, but our technology and wealth have not protected us entirely from these diseases either.

In this sense, Slater's quarter century old analysis still rings true. If the excessive waste of our life-styles is damaging our natural environment and plundering our resources and we are still not happy, there is definitely something wrong with our relationship with nature.

Authenticity

Authenticity seems to be missing from many Americans' lives. Children act as if video games are real and the real world is a nuisance.

Adults discuss celebrity trials and football games incessantly and fail to talk with their neighbors about real problems outside their doors. Most Americans who eat meat refuse to butcher an animal for food. Soldiers find it easier to press a button on a tank or airplane video screen (which unleashes explosives killing many civilians) than to bayonet one soldier in person.

As Slater (1970) said:

> We interact largely with extensions of our own egos. There is an uneasy, anesthetized feeling about this kind of life—like being trapped forever inside an air-conditioned car with power steering and power brakes and a telephone to talk to. Our world is only a mirror and our efforts mere shadowboxing—yet shadowboxing in which we frequently manage to hurt ourselves. (p. 18)

Ironically, many Americans have lost the feeling of security implied in Slater's analysis. Technology-led changes in the economy have decimated such formerly secure middle class jobs as union manufacturing and middle management. The purchasing power of the minimum wage continues to drop and the real incomes of all American workers peaked in the mid-1970s. Social problems, violence, and incarceration rates have all risen as well. We seem to have lost some of the secure feeling Slater mentions without losing the uneasiness or the unreal feeling in many people's lives.

People often stay home watching television and playing electronic games instead of going outside. The word for this behavior is *cocooning.* We also notice the hunger for authenticity in the amount of times *real* and *natural* are used to advertise products. The growth in packaged wilderness experiences and travel also reflects our quest for exposure to something authentic combined with our desire for the security we desire.

With the growth of videogames and Virtual Reality (VR) technology, many people already have started spending more time with better and better imitations of real and imagined worlds rather than with the physical realities outside their compounds. The continued loss of true authenticity and real community is a real danger unless we consciously decide not to let this happen. Furthermore, who will write the fantasies that people will vicariously live out? Will it be the same corporate media titans who have encouraged us to increase our consumption for so many years?

When people sue the government because they fell over a cliff in a wilderness area, we know there is some confusion about technology, liability and consumerism. When major cities in the United States have dangerously polluted air and massive amounts of garbage, we know that slowing consumption is a necessity.

Why does so much waste continue to occur when it is costing us so much? Explanations range from a consumer culture to advertising, distorted relations with nature, and basic human character weakness. Economically speaking, however, there are hidden subsidies and promoters of waste. These concerns will be discussed in the section that follows.

Hidden Economic Subsidies for Mass Consumption and Waste

Young (1991) pointed out that *source reduction* is everyone's favorite waste-reduction strategy except when reality occurs. Then it is called unrealistic. He cited three main economic reasons why manufacturers waste so many materials: (a) there are artificially low prices for virgin materials; (b) the public pays for the disposal of packaging, not the manufacturer; and (c) profit is often maximized with wasteful packaging through additional sales.

The reason that raw materials prices are artificially low is that the extractor of the materials rarely pays the true costs of returning the area to its pre-extraction condition. In other words, a great deal of value is extracted from the soil itself which is never included in the prices of the materials. Young (1991) estimated that in the United States alone, current and abandoned metal and coal mines cover an area of over 22 million acres—the size of Hungary.

Similarly, the costs of disposing of products are paid by society as a whole and not by the producers of products. Thus, the true cost of increasing packaging sizes and complexity is not borne by the product producer and so producers are more likely to use additional packaging. Lately, consumer education has led to many companies increasing the use of recycled and recyclable materials in their products. This is one example of how consumerism (through consumer education) has helped reduce excessive consumption. Unfortunately, many products have undergone only minor cosmetic changes, but they still bear new *green* labels.

Profit is often maximized through excessive packaging. Large compact disk cases provide more space to promote sales of a particular recording. Boxes of loose products often appear half full when opened. Did the product settle during shipping and handling or was the manufacturer using excess packaging to increase sales? Consumer education apparently has helped progress in this area, but it is still a major problem.

The factors Young (1991) described could be addressed through government regulation. However, this is a tricky area to regulate. It takes many pages to define the proper criteria for macaroni and cheese and that is a far simpler concept than excess packaging or paying true raw materials costs. Consumers' purchasing decisions may be a stronger influence (or vote) in areas such as excessive packaging than a vote for a pro-regulation candidate.

Technology for What?—The Arms Race and the Consumption Race

The arms race and the consumption race are flip sides of the same coin. Excessive consumption, attempts to dominate nature, and a quest for ultimate weapons and human control are all parts of the same social and technological patterns.

While humans have not been able to control or dominate nature, humans and their technological systems certainly have shown their ability to permanently alter such natural systems as the world climate, the survival of species, and the levels of solar radiation reaching earth. As discussed earlier, Schmookler (1984) described the quest for domination and control that has inspired the more powerful societies on earth and Gorz (1980) explained that the effort to dominate nature inevitably leads to the domination of humans.

Slater (1970) probably exaggerated when he said that Americans have become so accustomed to their 1,000 to 1 firepower odds that they have come to feel that it is their inherent right to kill people without retaliation. However, our massive invasions of tiny countries like Panama and Grenada and our unwillingness to send our troops anywhere that people shoot back hardly refutes Slater's contention. In fact, our massive consumption of nonrenewable petroleum led directly to our massive military intervention in Kuwait and Iraq.

Our stress on control and exploitation has led to a serious imbalance in our natural and psychic worlds. As one example, the mandatory school system in the United States is organized around rigid control of students' time, space, motion, and expression. School emphasizes logic, control, and performance while denigrating creativity, emotion, and spontaneity. Standardized multiple-choice college entrance exams are rapidly becoming the focus of many school systems at the expense of any broader definitions of education (Gatto, 1993).

Public schools provide a carefully designed technology of acculturation in all societies. Our school systems force children to adapt to powerlessness, no private time, no self-scheduling or true initiative, and a fact-and-test-oriented curriculum. People who are obedient and memorize facts can become good technicians, but they are not being educated to question the world around them or their role in it (Gatto, 1993). Now, they can even watch commercials on *Channel One* in many classrooms every day.

People acknowledge that public education is a political system, but they deny that technology is inherently political. Of course, all technological systems have political implications. No technological system has ever been a neutral tool as some technocrats and engineers have claimed. A factory for the production of Mercedes Benzes only is possible where many people work to produce goods for a minority with far greater wealth.

A nuclear power plant requires a quasi-military organization of centrally-controlled power to finance, control, and protect the massive electrical output and hazards of such an undertaking. In fact, nuclear power was developed in secrecy by a powerful elite with massive, secret government financing. Due to the power, complexity, and dangers of nuclear systems, it is not sane to develop them outside of such a rigid, secret setting.

Individual solar installations on private homes imply different political choices. Photovoltaic panels are not the cheapest form of power system (nor is nuclear power), but they do imply decentralization and less secrecy than more massive systems. It is hard for most people to even imagine massive secret government financing of residential solar panel development.

The selection of technological systems is inherently political. The real question in any society is, Who controls the decisions and the systems? No one voted to develop nuclear power systems, nor to implement them once developed.

Of course, some people (e.g., the technological determinists) feel that ultimately people are not in control of their technological systems and that the only choice individuals have is whether to ally themselves with power-based technological systems or to futilely resist them. This viewpoint will be explored in the next section.

Technology's Path—Are We Along for the Ride?

Ellul (1964) viewed the characteristics of technology as rationality, artificiality, automatic, self-augmentation, universalism, and technological autonomy. He argued that technology is leading people and that techniques of human control eventually will be used to reshape our lives, views of time and space, and so on to a technology-based logic. In other words, Ellul argued that human worldviews increasingly would be shaped by the *technological logic* of rationality, artificiality, automatic, self-augmentation, universalism, and technological autonomy. He also predicted that technocrats would end up dominating a rather controlled society. In Ellul's view, people can fight technology or relax and enjoy the ride, but they basically have no choice as to the overall evolution of technological systems. His views form a rather typical expression of technological determinism.

Many people consider Ellul's views unrealistic. Florman (1976), an engineer, devoted much of his book, *The Existential Pleasures of Engineering*, to refuting the views of people he called the *anti-technologists*. He included Nader and Ellul in this group. While minimizing problems associated with technological changes, he clearly argued the prevailing view of technical experts, that technology is essentially a tool which humans use for their own ends. He attributed the few problems he saw with technological systems and their uses to human error and character weakness only.

Florman (1976) argued that technology has served to reduce exploitation by providing individuals with more tools that make it harder for central authorities to control them. He stated that the anti-technological views of Ellul, Dubos, Mumford, Reich, and Roszak represent an irrational response to societal and technological complexity and to problems with democracy. He added that people *choose* to live in cities, take factory jobs, and buy advertised products.

Nevertheless, the argument of technological determinism persists as does Schmookler's (1984) concept of the powerful inevitably using their power-based technologies to dominate the less ambitious and less fortunate. While these arguments have different bases, they predict the same type of future direction.

For example, consider the situation of a resident of a village in Ghana whose ancestors have lived in the same place for hundreds of years. While they have not known this, their village rests twenty miles from a large bauxite deposit. Without modern technology, that deposit never affected the villagers' lives. The raw material needs of the modern industrial production conglomerates, combined with the advanced information and sensing technologies necessary to find these raw materials, have permitted the identification (or discovery) of this major bauxite deposit in Ghana. However, bauxite requires massive amounts of energy to convert it into alumina for making aluminum. Again, modern technology provides a method.

A large corporation convinces the Ghanaian government to build a large dam to provide hydroelectric power. Most of this power will be guaranteed for the use of the aluminum-smelting factory. In this way, the bauxite deposit can be utilized economically and many high-paying jobs can be created in Ghana.

However, consider the deeper implications for the village. Building the dam eliminates the land on which their village has stood for generations. Proponents of this type of economic development call this village's loss *the price of progress*. Obviously, people can argue endlessly about whether this dam should have been built and this bauxite developed. In fact, the author met a Ghanaian recently who told me that the smelting factory is a model employer that provides the best jobs in the country. The resources of most developing countries are extracted directly and processed elsewhere, but due to its hydroelectric potential and the high electricity requirements of aluminum smelting, Ghana has been lucky to reap some of the benefits of the processing of its material resources.

However, the most relevant question is, Could the extraction of the bauxite have been stopped (for more than a few years)? Given the logic of modern industrial powers and the attractiveness of the large easily-extractable metal ore deposit, it is hard to see how the extraction of the bauxite could have been prevented. Thus, what choices did the villagers really have, even though they had lived there hundreds of years without even knowing of the bauxite deposit. The advance of massive modern technological systems had a logic of its own which overwhelmed any wishes or decisions of people living in a less technologically-developed village.

It is easier for us to see how the logic of technological systems has overturned (for better or worse) the lives of Ghanaians than to see how the logic of technological systems may have overturned our own lives. For one thing, we are much more accustomed to the logic of technological systems than the Ghanaian villagers and so we are more habituated to its effects. Entire books have been written about how technology has influenced our culture and sense of reality. Entire movements in art and literature have been inspired by the technologically-based changes in our society. While it is rather easy to question the views of technological determinists, it would be more satisfying to point to (or create) some events which prove them wrong.

Vested Interests in Technology

There can be little debate that technological changes are rapidly shaping our lives including many of the more personal aspects. Our lives are becoming so integrated with massive technological systems that it is hard to imagine life apart from such technologies as telecommunications and the automobile.

Developments in communications, production, and other technological systems have deeply affected Americans. The role of chemical and other human-created toxins as a cause of cancer is difficult to prove or disprove due to the infinite variables and long time frames of such research efforts. However, the parallel growth of our chemical industry, our processed food diet, and the dramatic increase in some types of cancer is well known. But, studies to prove these links are difficult and are rarely funded, while millions of dollars are poured into developing new technologies to try to cure, or at least mitigate, types of cancer. Why is this?

Basically, many people have a vested interest in serving the needs of technology's evolution. The builders, operators, and medical establishment all have a vested interest in profiting from more and more complex and powerful technical solutions. They would not directly profit if all of the people became healthier due to a reduction in chemical toxins in our society. Thus, it is clear that many technical elites have a vested interest in the development of power-based technological systems and little interest in solutions that require less consumption and less technology. There is little profit in prevention.

In fact, all people have some vested interest in the development of technology for it has provided many of the world's more affluent citizens with clearly better health care, greater personal mobility, and countless other benefits. However, we should not let our interest in technological development turn us into blind believers in a *technological fix* for every problem. It is quite possible that human needs in the case of cancer would be served better by *less* man-made technology (toxins, electromagnetic fields, etc.) rather than by more technology (larger and more sophisticated hospital machines).

Why are so many Americans unwilling to weigh objectively whether or not we need every new device that humans can conceive and build? This dependence limits people's ability to recognize that there are some situations in which less technology (or less complex technology) may better serve human needs than more technology. A decrease in the death rate from cancer is one of those situations.

Alvin Toffler's (1970) seminal book *Future Shock* argued that change is occurring in the world faster than people can adapt to it. With this theory, he explained the rising disorientation, addiction, and violence in advanced or rapidly changing societies. After all, people adapt slowly and painfully to change and it is reasonable to think that too much change could be harmful to people's psychological health. Combine this idea with the reality of the explosion in scientific and technological knowledge, innovation, and complexity and one finds a recipe for trouble.

The overwhelming growth of complex technological systems has had numerous profound effects, both positive and negative. In an effort to avoid the loss of meaning in some people's lives and the deterioration of our natural environment, people have considered ways to better manage technological systems. If people wish to reject the idea that technology controls us, then we should be able to make sensible choices about technology.

Two methods which have been developed in an attempt to help us better manage technological decision-making are technology assessment and community-based appropriate technology. These will be discussed in the next section.

The Search for Alternatives

If we accept that the greater and greater consumption of resources, both physical and human, cannot continue indefinitely without greater and greater costs, then what are our alternatives? If we accept that technological growth has a certain logic of its own and that we are, in some ways, unwittingly in its path like the villagers in Ghana, then what can we do to seize control of our human destiny? If we accept the notion that a limited conception of regulatory consumerism is helpless in the face of larger social and environmental trends, then how can the interests of people be protected from others who ally themselves with the logic of seeking and developing ever more powerful methods of control, domination, comfort, and convenience?

Some people believe that assessing technologies with planned methodologies will eventually permit us to guide the development of our future technological developments using the central control which our current systems provide. This reform movement can be called Technology Assessment and it is typified by required Environmental Impact Reports for major projects and the federal *Office of Technology Assessment (OTA)*.

Another school of thought, typified by Gorz (1980), has less faith in central control, particularly as a tool to limit the development of greater central control. This group's (Gorz, Mumford, Schumacker, etc.) response to the problems of excessive consumption and domination is based on the development of small, locally-controlled technological systems to provide sustainable methods of meeting basic human needs that prevent excessive outside control—either technological or human. This is the basis of the Appropriate Technology/Sustainable Development movements.

These movements will be discussed below, but a critical question must be addressed first. If conspicuous consumption and evolving technological systems truly are subverting human goals, then what are these human goals that people might strive to achieve? In other words, if we accept that there are many social, philosophical, and environmental problems with our society's current course, then which ideals should we strive for?

Desired Human Goals?

Packard (1960) in *The Wastemakers* recommends restoring pride in prudence and in quality, restoring a balance between population and the supporting environment, and achieving an enduring style of life. In many ways, he was ahead of his time as these ideas have been heard more frequently over the past 35 years. In fact, achieving an enduring style of life is another way of saying that people must act in a way which can continue safely for many generations. This is the basis of the commonly heard pleas for *sustainability* in our use of resources and technologies.

Sustainability refers to the ability of a technological system to continue operating indefinitely due to its use of renewable resources and its provision of socially-useful products. Drinking rainwater is sustainable while drilling water wells 50 feet deeper every 5 years in parts of the Southwest is not. Recycling aluminum is sustainable while throwing away used cans only to dig and smelt more bauxite is not. Obviously, sustainability should be a major concern in all of our decision-making.

In general, a truly sustainable life-style requires the use of less resources than Americans currently consume. As other developing countries seek to emulate the consumption-based American life-style, they are starting to consume greater and greater amounts of material and energy while producing truly alarming pollution. How can Americans conduct *consumer education* overseas to promote a sustainable future for the world if this society is unwilling to move in that direction?

Sustainability implies a simpler life based more on community and local control of the resources to meet basic human needs such as food, shelter, energy, and health care wherever possible. Obviously, the use of renewable energy sources also is sustainable while mining and consuming fossil fuels must eventually be greatly reduced in amount and impact. Sustainability and a conspicuous consumption culture are diametrically opposed.

If people are going to make decisions about their uses of technologies and become less dependent on central control and central programming, they must start forming more true communities. The alternative is to remain as the atomized consuming units so beloved by marketers. Many Americans are living alone indoors with ever more powerful consumption-oriented electronic devices as illustrated by the phenomenal growth of televised and electronic shopping. Only by forming truer communities can it be possible for people to make their own decisions about technology.

If people are to achieve a sustainable future and also prove the technological determinists wrong, they must find ways to avoid being enslaved by technologies of human control and domination. They may succeed in this quest and be able to make their own choices with regard to human needs, technological implementations and environmental costs. Clearly, no one would reject or abandon many of the wondrous advances of technology. Efforts to carefully weigh these types of choices have begun both through the Technology Assessment and the Community-Based Appropriate Technology models.

Technology Assessment

One approach to retaining the positive benefits of advancing technology while mitigating the negative ones has been through *Technology Assessment.* Technology Assessment involves studying a particular technological project or process to determine its impacts—both positive and negative.

During the process of creating the U.S. Office of Technology Assessment, Representative Daddario described technology assessment as follows:

> It identifies policy issues, assesses the impact of alternative courses of action and presents findings. It is a method of analysis that systematically appraises the nature, significance, status, and merit of a technological program. . . It is designed to uncover three types of consequences—desirable, undesirable, and uncertain. (OTA, 1973, 10-11)

Carpenter (1973) provided the definition of technology assessment used by the Congressional Research Service. It follows:

> Technology assessment is the process of taking a purposeful look at the consequences of technological change. It includes the primary cost/benefit balance of short-term localized marketplace economics, but particularly goes beyond these to identify affected parties and *unanticipated* impacts in as broad and long range fashion as is possible. It is neutral and objective. (p. 357)

Technology assessment represents an organized attempt to evaluate the many primary and secondary impacts of the introduction of technological systems into areas where they have not been before. Careful assessment of the intended and unintended results of the use of a new technology can provide a framework for decision making about the advisability of implementing the technology.

In fact, Environmental Impact Statements (EIS) are a form of technology assessment that is required in the United States before large projects can be constructed. These statements have been instrumental in preventing and modifying the construction of projects that were deemed to have more negative than positive impacts. The Office of Technology Assessment (OTA) studies and reports on larger technological issues, although its reports are merely advisory. The OTA has no regulatory or enforcement powers.

Technology assessment methodologies have never stopped the implementation of entire technological directions. To have a central authority ban a technology before implementation would go against traditional American beliefs in freedom. Also, profit opportunities would be lost. However, the development of certain technological areas has been slowed and regulated as a result of assessments. Biotechnology has been carefully regulated, largely due to fears about man-made bacteria and genetic material escaping into the surrounding, (unprepared) environment.

However, there is little evidence that this method can address issues such as excessive consumption, misoriented spending in the fight to reduce human cancer deaths, or the need for sustainability. Additionally, it is hard to argue with Gorz's (1980) view that a centrally-controlled planning process can never help people choose to have less external centralized control of their lives and thoughts. If people wish to effectively influence their relationships with technological systems, they must make these choices as individuals and/or in small communities.

Appropriate Technology and Community Control

The concept of *Appropriate Technology* involves the belief that, since the technologies we use shape our lives, we must choose technological systems to meet our basic human needs that are sustainable and amenable to local human control. Proponents of Appropriate Technology do not believe that technology is a passive tool of human wants, but rather that any technological system inevitably expresses social and political realities.

In practice, efforts at implementing Appropriate Technology programs have involved attempts to develop locally-controlled systems to meet basic needs for food, shelter, clothing, employment, etc., in a manner that does not destroy the local social or ecological environments. As with any utopian ideal, the implementation of these ideas has yielded growing successes, romantic failures, and much debate. However, the ideas of simplicity, low-cost, local control and the use of local materials have spread to a number of national and international development organizations.

Todd and Todd (1984) proposed that all design should "follow, not oppose, the laws of life" (p. 22). In their work at the New Alchemy Institute, they produced multi-purpose structures called Arks that can provide enough energy to produce fish and vegetable crops, heat themselves, and shelter people. Not surprisingly, the New Alchemy Institute has not received serious funding from the government or from any groups which the determinists might view as centralized technical elites. Despite its real successes, the New Alchemy Institute recently failed financially.

A parallel (albeit far more expensive and private) effort to develop sustainable systems is represented by the well-publicized Biosphere II Project. This project attempts to integrate buildings with human and food-production systems. Obviously, these types of structures are complicated and time-consuming to manage in their present forms, but they provide a guide to how people may wish to better integrate residential, production, and living systems in the future to enable us to live less destructively in our environments.

The most appropriate technical systems involve technology that is understood, implemented, controlled, and maintained by those using it to meet their basic needs—the effects of which have been weighed in advance by those affected to have minimal negative impacts on the local society, culture, and the environment. Using solar stoves; building with earth, used tires, and hay bales; and low-cost grain storage structures are examples of community-based Appropriate Technology efforts.

It is evident that this definition places great emphasis on the idea of local control. The need for local control implies simplicity; low-cost; the use of local materials and labor; and the use of renewable energy sources. Appropriate technology also has to function in a technical sense—to meet the needs for which it is implemented.

In fact, technology assessment methodologies need not be only for the large government agencies. Communities could conduct their own assessments of whether new technical means would be appropriate for their use under whatever criteria they choose. For example, local groups could assess how the implementation of certain technologies would affect the local economy, social life, and environment.

A technology assessment model for use in community-scale development projects could help people to assess how well the proposed technological system meets the criteria for an appropriate technology. Therefore, a community-based technology assessment model should be oriented to helping the local people assess the degree to which they can control and maintain the proposed technical system to meet their needs.

Conclusion

The consumerism movement has had many successes in protecting people from dangerous products and practices promoted by some business interests through its promotion of consumer protection laws and consumer education. However, it is a limited movement as currently conceptualized which is not capable of fully addressing larger problems of resource depletion, pollution, and excessive consumption.

Conspicuous consumption has been a major part of the Western industrialized experience, particularly since the Industrial Revolution. While people can no longer afford to waste as many resources, there are still powerful economic interests promoting debt, consumption, and waste.

Rapid technological change is being used both to improve aspects of humans' lives as well to control and dominate less technologically-sophisticated individuals. As throughout human history, various elites continue to profit.

If the views of the technological determinists are to be contested, then we must find some ways to make choices about the development, or at least about the implementation, of technical means. In the determinists view, sustainability and community are two ideals which seem to be in the interests of people but which run counter to the domination of technological logic over human needs. Even people who reject technological determinism can see the necessity of keeping the benefits of our technological advances while promoting some of the sustainability and community which have been lost over the past two hundred years.

Technology assessment is being practiced by various government bodies and it is a technique available to anyone. Communities have the opportunity and ability to weigh technological systems before their local implementations. Sustainability is a goal which people have an opportunity to strive for before the nonsustainability of many current American practices is more dramatically and painfully shown.

Ultimately, people must accept personal responsibility for the technologies they employ and the products they consume. Students and teachers of technology have a particularly important role to play for two reasons. First, we must educate people as well as we can about the nature and workings of technical systems so that they can understand the great benefits and serious dangers of rapid technological change. Second, we must set an example and model certain roles by our own uses of tools and techniques. We must make every effort to model sustainable and non-exploitative uses of technological systems.

The logic of the technological determinists suggests that we will be forced to watch, support, or futilely resist while technical elites use their many tools to tell people how they will be allowed to run their lives. In this way, the elites (of which some individuals can choose to be a part) will be able to protect their own control in the face of absolute ecological limits. Technological determinists suggest that this process is ongoing and inevitable.

It is ultimately only individuals and communities who can ensure we will deal with ecological limits by making our own decisions about technologies to freely meet our own needs. Teachers of technology must ensure that students learn to ask questions about technological systems, power, and societal directions as a whole. People with technical skills may serve their communities in ways which are valuable economically and socially. Their abilities need not be used solely to aggrandize their own power as Ellul (1964), Gorz (1980), and Schmookler (1984) fear. Hopefully, students can be made sensitive to these issues and given the skills to live sustainably by producing wisely at least as much as they consume. Then they can go forth and make their own decisions.

REFERENCES

Carpenter, R. A. (1973). The scope and limits of technology assessment. In M. J. Cetron, & B. Bartocha, (Eds.), *Technology assessment in a dynamic environment* (pp. 357-370). New York: Gordon and Breach.

Ellul, J. (1964). *The technological society*. (Trans. from French by Wilkinson, J.). New York: Vintage.

Florman, S. C. (1976). *The existential pleasures of engineering*. New York: St. Martins Press.

Gatto, J. T. (1993). *Dumbing us down: The hidden curriculum of compulsory schooling*. Philadelphia: New Society Publishing.

Gorz, A. (1980). *Ecology as politics*. (Trans. from French by Cloud, J. & Vigderman, P.). Boston: South End Press.

Hoyt, E. E. (1938). *Consumption in our society*. New York: McGraw-Hill.

Huber, P. W., & Litan, R. E. (Eds.). (1991) *The liability maze: The impact of liability law on safety and innovation*. Washington, DC: The Brookings Institution.

Kolb, J., & Ross, S. S. (1980). *Product safety and liability: A desk reference*. New York: McGraw-Hill.

Martin, R. (1991). General aviation manufacturing: An industry under siege. In P. W. Huber & R. E. Litan (Eds.), *The liability maze: The impact of liability law on safety and innovation* (pp. 478-500). Washington, DC: The Brookings Institution.

McCartney, S., & Ortega, B. (1994, December 16). Noboby knows your darling wife like a perfume clerk. *The Wall Street Journal*. (pp. A1, A12).

Miller, A. R. (1951). *Meat hygiene*. Philadelphia: Lea and Febiger.

Nader, R. (1965). *Unsafe at any speed: The designed-in dangers of the American automobile*. New York: Grossman.

Nader, R., & Smith, W. J. (1990). *Winning the insurance game: The complete consumer's guide to saving money*. New York: Knightsbridge.

Packard, V. (1960). *The wastemakers*. New York: Van Rees Press.

Packard, V. (1957). *The hidden persuaders*. New York: David McKay.

Sapolsky, H. M. (Ed.). (1986). *Consuming fears: The politics of product risks*. New York: Basic Books.

Schmookler, A. B. (1984). *The parable of the tribes: The problem of power in social evolution*. Berkeley, CA: University of California Press.

Shi, D. E. (1985). *The simple life: Plain living and high thinking in American culture*. New York: Oxford University Press.

Sinclair, U. (1906). *The jungle*. New York: New American Library.

Slater, P. E. (1970). *The pursuit of loneliness*. Boston: Beacon Press.

Todd, J., & Todd, N. J. (1984). *Bioshelters, ocean arks, and city farming: Ecology as the basis of design*. San Francisco: Sierra Club.

Toffler, A. (1970). *Future shock*. New York: Random House.

U.S. Department of Commerce. Office of Technology Assessment and Firecasting. (1973, May). *Initial Publication*. Washington DC.

Veblen, T. (1899). *The theory of the leisure class*. New York: Vanguard Press.

Watterson. (1994, March 20). Calvin and Hobbes. *Terre Haute Tribune Star*. Universal Press Syndicate.

Young, J. E. (1991, January). *Discarding the throwaway society*. (Worldwatch Paper 101). Washington DC: Worldwatch Institute.

DISCUSSION QUESTIONS

1. Discuss whether you feel personally in control of the technological systems in your life. Obviously, you may not feel in control of the monstrous IRS or credit history databases with your name in them, but do you feel in control of the technological devices in your home? Let's get serious. Could you go 24 hours without looking at a computer or a television screen? If your answer is yes, try to do it and discuss the results in class.
2. Find a person over 60 years old and discuss with them the technological systems used when they were young to get food, build houses, obtain health care, and travel. Discuss their views of the strength of communities they have lived in in the past and currently. Discuss in class the advantages and disadvantages of our modern means. Compare the role of community and the sustainability of the previous systems as well.
3. Debate whether our world is changing too quickly for people to adjust (the Future Shock argument). Give evidence both ways.
4. Discuss the concepts of Appropriate Technology and Technology Assessment. Can either of these concepts help us to better employ technological means? If so, how can they? If not, why not?
5. Discuss your favorite and least favorite aspects of modern technological systems. What future technological developments do you desire or fear?
6. Technology creates many ethical problems that are difficult to address. In fact, we often avoid them. Discuss in class if it is ethical to:
    - build a toxic waste incinerator if we know it will emit both heavy metals and dioxin which will cause 10 cancer deaths a year 10 years after firing up if it also creates 50 permanent jobs?
    - sell a legal addictive drug delivery system (cigarettes)? If so, is it ethical to mix chemicals into the cigarette papers so that they will not extinguish once lit?

- spend $500,000 of public money to keep an 80-year-old cancer patient alive with elaborate machines for six more months? Is it ethical to let her die six months earlier to save society this money?

DISCUSSION SCENARIOS

Denial of Death

Why do we in the United States spend innumerable dollars and utilize vast numbers of complex devices to extend the life of an elderly person whose lungs, heart, and internal organs have given out? Many cultures believe that the elderly should die at home when their bodies cannot function on their own to support life. Roleplay the doctor, the wife and the sister of an 80-year-old comatose man whose organs are failing irretrievably and who is in pain. The doctor is worried about being sued if he lets the man die by disconnecting him from the complex medical technologies which breathe for him and pump his blood. The sister wants to keep him alive for personal philosophical reasons and the wife wishes to let him die in peace.

Have the three people hold a discussion for 5-10 minutes. Then let the class discuss the questions and also the fact that people in earlier times did not have these machines and so did not face these choices. In the 19th century the man would have died sooner (probably much sooner) at home.

Trying To Be Like U.S.

Until this decade, the Chinese system managed to feed and house all members of a population of over a billion people. Now, in their zeal for higher productivity and consumption it appears the Chinese may back off from the government commitment to feed and house every person? It is obvious which choice we have made on this issue. Is our hardheaded decision a result of, or a cause of, our *superior technology*? Or are the two unrelated? Why do you think the Chinese are changing to a system more like ours? Is it possible to have rising societal affluence and productivity while still providing every person with food and housing?

Supermarket Shopping

Critically visit an American supermarket and perform any or all of the following investigations.

- Estimate how many of the products are unprocessed. Compare the price of wheat and corn with the price per weight unit of breakfast cereals.
- Study the use of packaging.
- Ask the store manager why is it you cannot buy a 50-pound bag of oats or raw wheat when there are thousands of other food products. Ask how much local produce is sold in the supermarket during local vegetable harvest times.
- Study the product labels on dry dog food and compare the information given to that on human-packaged food items. Now compare this to a package of cigarettes and to a can of beer.

Write down the results of your investigations and relate your results to arguments about technology, regulation, consumption, and modern lifestyles. Conduct follow-up library research where necessary to determine facts.

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Rodney L. Custer has earned bachelors degrees in Psychology (McPherson College) and Industrial Education (Fort Hays State University), masters degrees in Industrial Education (Fort Hays State University) and Theology (Bethany Theological Seminary), and a Ph.D. in Industrial Education (with a major emphasis in Industrial Engineering) from the University of Missouri-Columbia. Prior to his current position as assistant professor at the University of Missouri-Columbia, he was on the Industrial Education faculty at McPherson College, KS. He is currently on leave from the University of Missouri-Columbia, serving as a Program Officer for the National Science Foundation in Washington, D.C. He is the incoming editor for the *Journal of Industrial Teacher Education* and is on the editorial board for the *Journal of Vocational Education Research.* Dr. Custer's research interests and publications focus include the philosophy of technology, workforce skills, and problem solving.

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Marvis L. Custer is a Registered Nurse, nationally certified in general pediatrics with a Masters Degree in Nursing [Medical/Surgical] with an Administration, and Education, emphasis. She works as an advanced practice nurse in Developmental Pediatrics in the University of Missouri-Columbia (UMC) School of Medicine, Child Health Department, and Children's Hospital and is adjunct faculty for the School of Nursing at UMC. She also is the Program Coordinator for a federally funded Maternal and Child Health grant with the primary focus of educating interdisciplinary leaders from ten disciplines in the area of children with special needs. She has been a nurse for over 20 years, spoken nationally, submitted grant proposals accepted for funding, and has worked in a variety of advanced practice nursing positions which include Director and faculty of the McPherson School of Practical Nursing. Ms. Custer has also served as President and Grant Director of the Pediatric Endocrine Nursing Society.

Dr. Michael Daugherty

Michael Daugherty received the bachelors, masters, and doctoral degrees from Oklahoma State University. He has taught at the junior and senior high school levels and is currently associate professor at Illinois State University with major responsibility for technology teacher education. He is active in ITEA, CTTE, and TECA as well as providing leadership to state professional organizations. He was awarded the Outstanding Young Educator Award by the Oklahoma Vocational Association and Teacher of the Year awards in two separate secondary schools. His research, writing and presentation agendas include Technology Education curriculum content and activities, teacher recruitment, and Tech Prep. In addition to teaching professional Technology Education and manufacturing courses, Dr. Daugherty teaches a popular general education course in technology which deals with the technology/society interface.

Dr. Rupert Evans

Rupert Evans received a bachelors degree in Social Studies and Industrial Arts from Indiana State Teachers College, a masters in Trade and Industrial Education from Purdue University, a Ph.D. in Industrial Psychology, and has been awarded four honorary doctorates. Dr. Evans has served as Professor of Vocational and Technical Education and Dean of the College of Education at the University of Illinois. Included among his numerous professional leadership activities are chair of the Mississippi Valley Industrial Teacher Education Conference, membership on the National Council on Employment Policy Board, historian for NAITTE and chair of the Advisory Council for the Industrial Arts Curriculum Project. In addition to his numerous professional presentations, Dr. Evans has published eight books and more than 50 articles.

Dr. Britta Fischer

Britta Fischer, a professor of sociology and coordinator of interdisciplinary studies at Emmanuel College in Boston, was born and raised in Germany. She received her B.A. from Barnard College and a Ph.D. from Washington University. In recent years she obtained two grants to design courses that bring awareness of technology to liberal arts students. In the resulting courses, *The City* and *Women in a Technological World*, students are taught by multidisciplinary teams and conduct technology-related projects. These courses are part of a junior core requirement. Dr. Fischer has published numerous articles on the engineering profession and on the unemployment experience of air-traffic controllers. Her experience in teaching urban and technological issues to liberal arts students has been presented to many professional groups as well as published in the *Bulletin of Science, Technology, and Society*. Currently she is engaged in research on architecture and technology in colonial Brazil.

Dr. W. Tad Foster

W. Tad Foster received the bachelors, masters, and doctoral degrees from University of Illinois—Champaign. He has taught in the U.S. Air Force and at the high school and community college levels. He is currently Associate Professor and Chair of Technology Education at Central Connecticut State University. In addition to his duties as chair, Dr. Foster, teaches courses in materials and processes, production systems, and technological enterprise as well as graduate courses. His research and publication interests include change in educational institutions, educational technology, instructional design, and the integration of educational disciplines. Dr. Foster is very active in the ITEA and CTTE. In addition, he regularly serves on the editorial boards for the *Journal of Technology Education, The Technology Teacher,* and the *Journal of Industrial Teacher Education.* He was awarded the Outstanding Young Teacher Educator award from the ITEA in 1993. Dr. Foster also regularly consults with business and industry in the areas of team building and various aspects of total quality management. He also serves as Director of Adult Education at his local church in Connecticut.

Dr. Joe Fridgen

Joseph Fridgen is a Professor and Chair of the Department of Park, Recreation and Tourism Resources at Michigan State University. His undergraduate degree in psychology is from the University of Minnesota, Morris, and he has his masters and Ph.D. degrees in psychology from the University of California, Davis. He has been a faculty member at Michigan State for the last 16 years with a research focus upon recreation, travel and tourism behavior. University courses he offers integrate environmental issues and social issues within the context of peoples' leisure and travel life-styles. He works with students from around the world on varied research projects. Recent research includes marketing studies for park systems, analysis of international visitors to the U.S., and a textbook on the social science dimensions of travel and tourism.

Dr. Jean Lichty Hendricks

Jean Lichty Hendricks is the Director for Ministry Training in the Church of the Brethren denomination (headquarters in Elgin, Illinois). In that position, she supervises two nondegree educational programs for individuals entering into the ministry. She is an ordained minister who has served churches in Iowa and Kansas. Jean received her Bachelors of Arts in 1969 from McPherson College (McPherson, Kansas), her Masters of Divinity in 1978 from Bethany Theological Seminary (Richmond, Indiana), and her Doctor of Philosophy in American Studies in 1994 from the University of Kansas. She was a Merril Fellow at Harvard Divinity School in 1985. Jean's professional and academic interests center on U.S. women's history and women in today's social structures, with particular interest and emphasis on speech and roles of contemporary clergywomen.

Dr. Daryl Hobbs

Daryl Hobbs is Professor of Rural Sociology at the University of Missouri and Director of the UM Office of Social and Economic Data Analysis. A native of rural Iowa, Hobbs has been on the faculty of the University of Missouri since 1964. He received B.S., M.S. and Ph.D. degrees from Iowa State University. Hobbs' teaching, research and public service has focused on social change, rural community and rural development with an emphasis on delivery of health, education and other services. The Office of Social and Economic Data Analysis which he organized and heads was created to supply Missouri communities, organizations and policy makers with current economic, demographic and other data to facilitate planning and policy formation and analysis. He is author of more than 100 articles and book chapters on various rural topics. He is a past president of the Rural Sociological Society and recipient of that Society's Distinguished Rural Sociologist and Excellence in Public Service Awards. He is also recipient of University of Missouri Alumni Faculty Achievement Award. He has served as visiting professor at several universities and has worked on rural development projects in six foreign countries.

Dr. Stewart M. Hoover

Stewart Hoover is an associate professor in the School of Journalism and Mass Communications at the University of Colorado. After completing the bachelors degree at McPherson College and two masters degrees (one in ethics from the Pacific School of Religion in Berkeley and a second in communications from the Annenberg School of Communications at the University of Pennsylvania), Dr. Hoover completed the Ph.D. in communications (also from the Annenberg School of Communications at the University of Pennsylvania). The focus of his teaching and publications has been on the social implications and ethical dimensions of the media and mass communications on culture. The author of three books and numerous articles, Dr. Hoover is in high demand, both nationally and internationally, as a lecturer and consultant. Research awards in the areas of ethics and communications include those funded by a Fulbright Grant, the Lilly Foundation, UNESCO, and the Gallup Organization.

Dr. Michael E. Karian

Michael Karian grew up in California, Thailand, Nigeria, Kenya, and Jordan, and has traveled extensively in other regions of the world. His undergraduate and masters degrees are from California State University, Long Beach in Industrial Education and Sociology and he holds a doctorate from Arizona State University in Education, Technology, and Sociology. He has conducted research identifying outcomes and developing instructional materials in Technology Education addressing environmental impacts of technology and has delivered numerous presentations focusing on technology and society and written a number of articles in the area of technology and environment. Currently an assistant professor in the College of Science and Technology at St. Cloud State University in Minnesota, Dr. Karian presently teaches and is developing curricula in those topic areas in general, and transportation and energy (especially renewable energies) in particular. He is also active at the international level in appropriate technology and sustainable development.

JoAnne Kirk

JoAnne Kirk is a Registered Nurse, nationally certified in pediatrics, with a Masters Degree in Pediatric Nursing. Ms. Kirk works as an advanced practice nurse in Pediatric Neurosurgery at the Children's Hospital at University of Missouri-Columbia. JoAnne has managed a general pediatric and has taught in an Associate Degree in Nursing (ADN) program and a Registered Nursing school (RN). She has also served as Director of Nursing for the International Cranio-facial Center located at and participated in a mission to the Philippine Islands (in 1995) for purpose of providing complex nursing care to cranio-facial patients. She also holds a position as adjunct faculty at the School of Nursing at the University of Missouri-Columbia and the multidisciplinary Pediatric Neurological Injury Program in collaboration with Rusk Rehabilitation Hospital.

Dr. John Prince

Dr. John Prince completed a masters program in physics and a doctorate in radiation biology from Oregon State University. He has worked at the Health Sciences Center and University Hospitals of the University of Oklahoma since 1982. A Professor of Radiation Sciences, he currently serves as Scientific Director for the Magnetic Resonance Center of Oklahoma which is part of the University Hospitals in Oklahoma City. His research and professional writing have been related to radiation applications and magnetic resonance for diagnosis of disease. His special interest is in assessment of radiological image quality.

Dr. Mark Sanders

Mark Sanders is associate professor of Technology Education at Virginia Polytechnic Institute & State University in Blacksburg, VA. He received the bachelors in Industrial Arts and Technology from State University of New York at Oswego, the masters in Industrial Technology from Illinois State University, and the Ph.D. in Industrial Education from the University of Maryland. Research and development work have concentrated in the areas of integrated academics, multimedia research & development, interactive video/hypercard, and communication technology. Dr. Sanders is widely published in the area of communication technology and is actively involved in providing leadership to numerous professional organizations. His research has been funded by the National Science Foundation, the Virginia State Department of Education, the Graphic Arts Education & Research Council, and the Compugraphic Corporation.

Dr. Gene Stephens

Gene Stephens is a professor in the College of Criminal Justice at the University of South Carolina. He is the South Carolina coordinator of the World Future Society and contributing editor of *The Futurist*. He has also been a consultant/speaker/workshop coordinator for over 100 organizations, including such diverse organizations as the FBI Academy, the U.S. Congress Office of Technology Assessment, the Canadian Police College, the American Bar Association, and the U.S. Occupational Safety and Health Administration.

Dr. Robert Wicklein

Robert Wicklein joined the Department of Occupational Studies at The University of Georgia in 1991 after previously serving as a faculty member at Oklahoma State University. Dr. Wicklein received his Ed.D. from Virginia Polytechnic Institute and State University in 1986 and his M.A. from the University of Alabama at Birmingham in 1979. He has published frequently in scholarly journals and regularly presents at professional meetings. Dr. Wicklein received the Technology Education Division Research Award of the American Vocational Association in 1992, 1993, and 1994; the Outstanding Service Award from the Technology Education Division of the American Vocational Association in 1989; the Outstanding Young Technology Teacher in 1992; the Distinguished Technology Educator Award in 1995; and the Outstanding Faculty Advisor in 1995 from the International Technology Education Association. Dr. Wicklein also serves as the Chair of the Editorial review Board of The Technology Teacher Journal.

Kenton Scott Wiens

Kenton Wiens earned a bachelors degree in Sociology from Bethel College (KS), and an all-but-thesis masters in Political-Economics from the University of Kansas. After several years with the Kansas Corporation Commission as Coordinator of Development for a federally-funded technical assistance program and a short time as Coordinator of Branch Operations for an international engineering/consulting firm, he attended Pratt Institute (Brooklyn) where he was assistant to the Chair of Industrial Design while he earned a masters degree in industrial design. As a freelance designer in New York City, he currently designs furniture, fixtures, and tableware, is a model and prototype builder, and teaches part-time at Parsons Institute. In addition to the aesthetic challenges of furniture and tabletop design, he continues to be interested in philosophical issues such as the contrast between vernacular and professional design, and the degree to which design acts as a causal agent in the human experience.

Dr. Falco de Klerk Wolters

Falco de Klerk Wolters is research coordinator of the Institute for Service Management at the Christelijke Hogeschool Noord-Nederland (CHN) in Leeuwarden, the Netherlands. Dr. de Klerk Wolters completed a masters in Geography and Planning and a Ph.D. in Technology Education. He provided research support to a major elementary Technology thrust in the Netherlands, most directly through AEOLUS (a government funded education center for elementary Technology Education). The CHN research institute services a broad range of clients with diverse research needs from around the country and Europe. A central theme has centered on tourism and recreation. Dr. de Klerk Wolters has traveled extensively around the world, has worked as a visiting professor at the University of Missouri-Columbia, and served as student exchange liaison between the University of Missouri-Columbia's Parks and Recreation department and CHN.

Dr. Peter Wright

Peter Wright is currently an Associate Professor at Indiana State University where he teaches courses in Technology Education and Human Resource Development. His Ed.D. and Masters in Technology Education were both earned at West Virginia University. His B.A. is from Yale University in Group and Organizational Psychology. He has also worked as Coordinator of the UMTA/WVU Transportation Education Project producing educational modules from UMTA field research projects. He served in the Peace Corps in Zaire and worked in Peace Corps/Washington as a Placement Officer and as a Writer/Editor in the Director's Office. His academic publications relate to aspects of Construction and of Social Impacts in the Technology Education area and to Cultural Diversity in the HRD area. He spent the fall of 1994 in Dalian, China investigating the technical education system. Currently, he is reading cyberpunk science fiction and relating it to his intellectual interests.

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