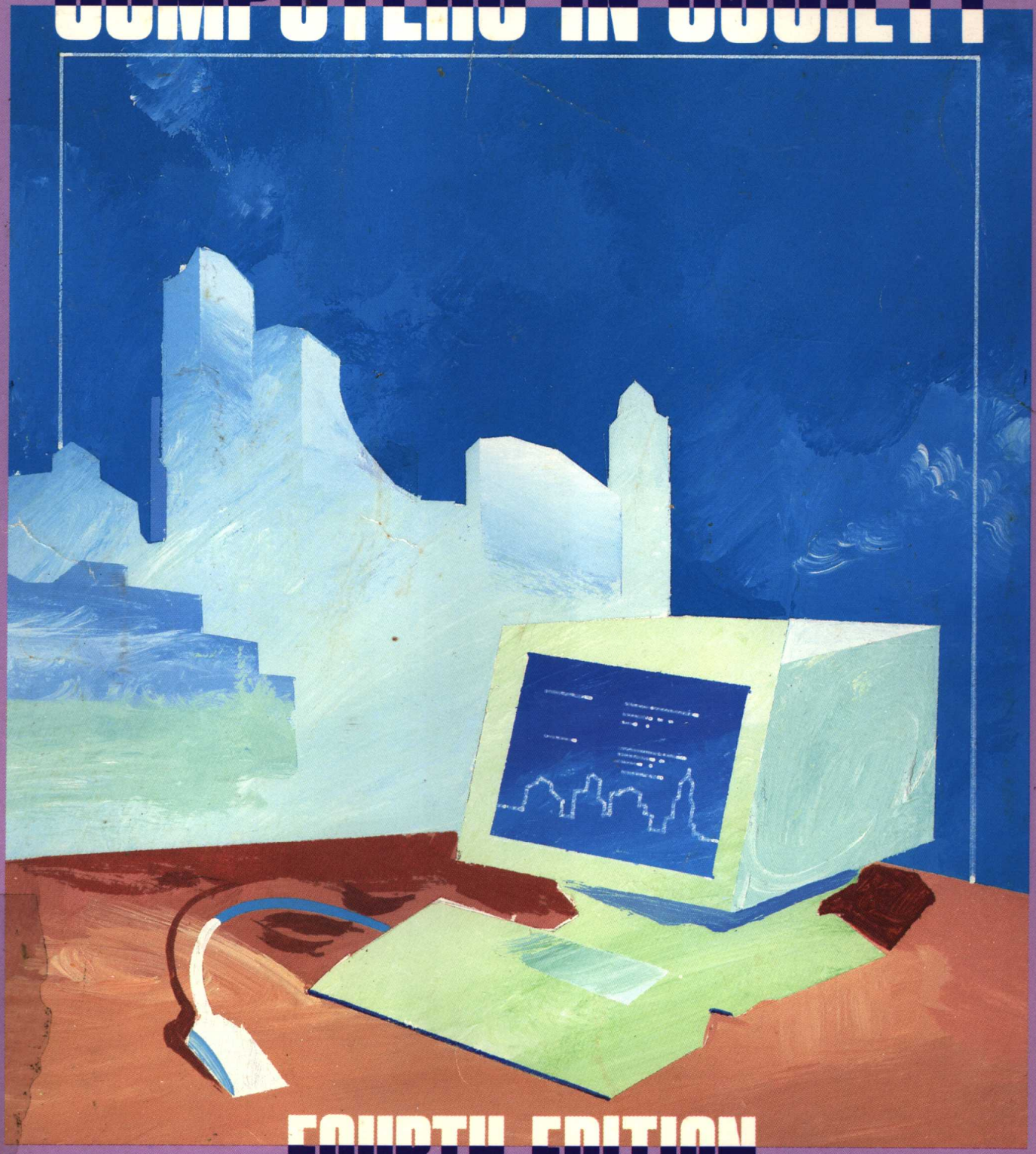
COMPUTER STUDIES

COMPUTERS IN SOCIETY



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Fourth Edition

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Editors/ Advisory Board

Members of the Advisory Board are instrumental in the final selection of articles for each edition of Annual Editions. Their review of articles for content, level, currentness, and appropriateness provides critical direction to the editor and staff. We think you'll find their careful consideration well reflected in this volume.

To the Reader

In publishing ANNUAL EDITIONS we recognize the enormous role played by the magazines, newspapers, and journals of the *public press* in providing current, first-rate educational information in a broad spectrum of interest areas. Within the articles, the best scientists, practitioners, researchers, and commentators draw issues into new perspective as accepted theories and viewpoints are called into account by new events, recent discoveries change old facts, and fresh debate breaks out over important controversies.

Many of the articles resulting from this enormous editorial effort are appropriate for students, researchers, and professionals seeking accurate, current material to help bridge the gap between principles and theories and the real world. These articles, however, become more useful for study when those of lasting value are carefully *collected, organized, indexed,* and *reproduced* in a *low-cost format*, which provides easy and permanent access when the material is needed. That is the role played by *Annual Editions*. Under the direction of each volume's *Editor*, who is an expert in the subject area, and with the guidance of an *Advisory Board*, we seek each year to provide in each *ANNUAL EDITION* a current, well-balanced, carefully selected collection of the best of the public press for your study and enjoyment. We think you'll find this volume useful, and we hope you'll take a moment to let us know what you think.

We can only guess at how the ever increasing power, diversity, and pervasiveness of computers and other information technologies might affect the patterns of our individual and social lives. However, it is hoped that *Computers in Society* will complement students' technical understanding of computers by acquainting them with the philosophical, economic, political, social, and psychological dimensions of the so-called computer revolution.

Contributors to the fourth edition come from a highly diverse range of backgrounds. Their collective writings highlight a wide spectrum of issues and views about how the information age will or ought to unfold. For the most part, their writing styles are very understandable and require no special training in "computerese"—the unintelligible technical jargon that can be a barrier to becoming informed on computer issues. A glossary is included, however, for the few terms that may be unfamiliar.

Because of its social focus, this book is organized to reflect the major dimensions of society rather than various aspects of computing. The major themes of the book are economy, community, and conflict. Many of these themes are also examined in an international context. The final section looks at some of the philosophical challenges posed by emerging technologies.

Each reading has been selected for its informational value, but "informative" does not, in this case, necessarily imply correctness or validity. In fact, some articles are included simply because they offer an opposing view to that argued by another. *Computers in Society* is meant to generate rather than answer questions on how computers will affect society. Hopefully, such queries will serve to clarify issues, broaden perspectives, provoke curiosity, and stimulate informed discussion of and participation in the computer age.

Readers can have input into the next edition by completing and returning the article rating form in the back of the book.

Kathryn Schellenberg
Editor

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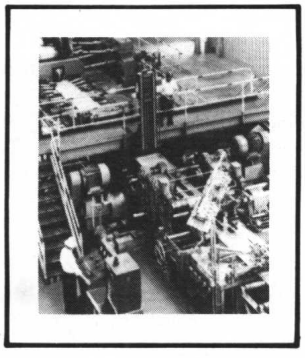
1. **Science and the American Experiment,** John Patrick Diggins, *The Sciences,* November/December 1987. 5
   Professor John Diggins, a historian, relates how Newton's law of physics influenced ***thinking about human nature***, social conflict, and power at the time of the American Revolution. Diggins argues that principles of Newtonian physics thus helped shape the United States Constitution.
2. **Borderline Cases,** Lynn Payer, *The Sciences,* July/August 1990. 8
   Western medicine has traditionally been viewed as an international science, with clear norms applied consistently. However, as Lynn Payer shows, medical practice reflects the national cultures of Western Europe and North America.

Introduction



Unit 1

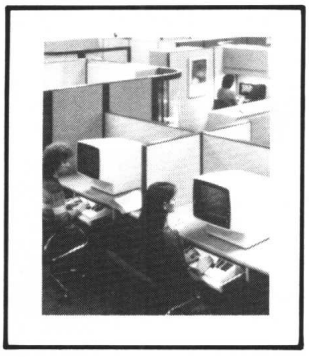
The Changing Economy

Five articles examine issues related to developments in robotics, computer networking, the globalization of the economy, the rise of the service and information sectors, and the decline of North American manufacturing.

Overview 12

3. **Why Japan Loves Robots and We Don't,** Andrew Tanzer and Ruth Simon, *Forbes,* April 16, 1990. 14
   The United States lags far behind Japan in the use of ***robots to solve practical problems***. In this article, the authors discuss economic, cultural, and demographic factors underlying the growing "robot gap."
4. **Taming the Wild Network,** *Business Week,* October 8, 1990. 18
   Communications networks are an indispensable component of modern business, but they also pose immense technical and management problems. This article describes some of these problems and the competition to supply "solutions" for taming wild networks.
5. **Does Corporate Nationality Matter?** Robert B. Reich, *Issues in Science and Technology,* Winter 1990-91. 23
   In today's global economy, money, technology, and state-of-the-art factories and equipment move almost effortlessly across international borders. In light of this reality, Robert B. Reich offers some policy suggestions concerning ***the new global corporation***.
6. **The Myth of a Post-Industrial Economy,** Stephen S. Cohen and John Zysman, *Technology Review,* February/March 1987. 28
   Stephen Cohen and John Zysman challenge the perception that the U.S. manufacturing sector should be displaced by a ***"post-industrial" (service/high-tech) economy***. They contend that to follow such a course would "risk the wealth and power of the United States."
7. **Tying One On,** Alan Morantz, *enRoute,* June 1989. 33
   Office automation in Canada is taking off. Advances in network integration, groupware, facsimile transmission, and telecommunications are redesigning office work. Not all changes are smooth or positive. Office automation can be expensive, resisted by workers, or poorly planned. It also raises concerns about "big brother" and the electronic monitoring of workers.

The concepts in bold italics are developed in the article. For further expansion please refer to the Topic Guide, the Index, and the Glossary.



Unit 2

Employment and the Workplace

Four articles examine the changing skill requirements of the work force, the electronic surveillance of workers, telecommuting, and the "do it yourself" trend.

Overview 40

8. **The Skilling of America,** Jack Gordon, *Training,* March 1991. 42

   The popular belief that jobs are becoming more complex and skilled is challenged by Jack Gordon. He claims that ***jobs are actually being deskilled*** in too many cases. Suggestions on how and why work should be "skilled up" are presented.

9. **Invasion of the Service Robots,** Gene Bylinsky, *Fortune,* September 14, 1987. 48

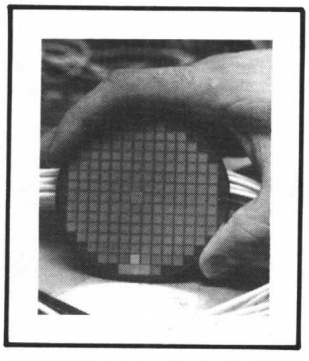
   Robots are moving beyond the factory and into "service" jobs that are too dangerous or boring for people. Some current and future applications described by the author include robots working in radioactive environments, working on the ocean floor, and assisting handicapped persons.

10. **Telecommuters Bring the Office Home,** Stuart Newman, *Management Review,* December 1989. 52

    Telecommuting to work has provided a wealth of opportunities for many people, but for others it has been a failed experiment. In this article, Stuart Newman discusses the benefits and pitfalls of telecommuting for workers and employers.

11. **Do It Yourself,** Brian Hayes, *The Sciences,* March/April 1991. 55

    Modern society is becoming increasingly ***"self-service."*** In this article, Brian Hayes speculates on some of the trend's potential effects in the workplace and other areas of society.



Unit 3

Social Interaction and Participation in the Information Age

Seven articles examine present and future implications of computing and other technologies for participation in social, economic, and political life.

Overview 58

12. **Challenging the Myth of Disability,** Alan Brightman, *Educom Review,* Winter 1989. 60

    There are close to 40 million disabled people in the United States. In this article, Alan Brightman describes the problems and needs of persons with disabilities, and argues that "when ***disabled children and adults are given access to computers***, it becomes clear how these machines can, indeed, change lives."

13. **Hey You! Make Way for My Technology!** David Lyon, *Technology Review,* August/September 1987. 66

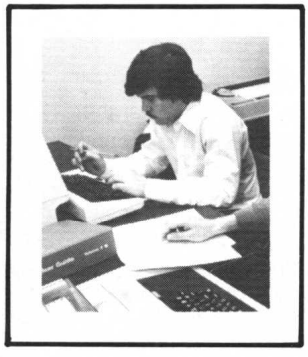
    Civilized behavior is predicated upon ***human interaction***, not on a human interacting with an electronic extension of another person. According to David Lyon, rudeness is on the rise, and ***consumer technology*** is partly to blame for this decline in civilization as we know it.

14. **The Doctor Is On,** Lisa Davis, *In Health,* September/October 1990. 68

    "Seek help from a psychotherapist these days and you could well end up baring your soul to a computer." Lisa Davis discusses some pros and cons to the rise of ***computer therapy***.

15. **Virtual Reality,** Robert Wright, *The Sciences,* November/December 1987. 71

    Researchers are developing technologies that will allow us to explore ***fabricated "realities"*** in the future. In this essay, Robert Wright contemplates the advantages and potential drawbacks of being able to escape to ***fantasy worlds*** of our own creation.



Unit 4

Ethical and Legal Issues

Seven articles look at various ethical and legal computing issues including information distortion, intellectual property rights, computer viruses, and the civil liberties of persons under investigation for alleged computer crimes.

16. **America's Ignorance of Science and Technology Poses a Threat to the Democratic Process Itself,** Paul E. Gray, *Chronicle of Higher Education,* May 18, 1988. 74
A former president of the Massachusetts Institute of Technology argues that because many important social, economic, and political issues center around science and technology, ***illiteracy*** in these areas is a barrier to informed participation in a democratic society.

17. **The Lesson Every Child Need Not Learn,** Morris Shamos, *The Sciences,* July/August 1988. 76
Morris Shamos argues that widespread ***scientific literacy*** is an ambiguous and empty goal. He contends that it is impossible to achieve and is not necessary to equip people for life in a scientific/technological society.

18. **Debunking Computer Literacy,** Ronni Rosenberg, *Technology Review,* January 1991. 80
The goals of "computer literacy" include preparing students for future jobs, developing mental discipline, and creating informed citizens. Ronni Rosenberg argues that ***current computer literacy programs*** fail to meet these objectives, and suggestions are offered about what "true" computer literacy would teach students.

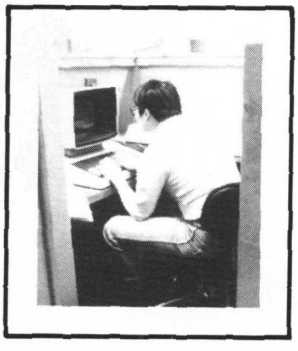
Overview 86

19. **Photographs That Lie: The Ethical Dilemma of Digital Retouching,** J. D. Lasica, *Washington Journalism Review,* June 1989. 88
J. D. Lasica discusses ***journalistic ethics*** in light of digital photography, which now allows for much greater creativity as well as distortion of visual information.

20. **Warning: Here Come the Software Police,** Janet Mason, *Across the Board,* October 1990. 91
A good deal of "illegal" ***copying of commercial software*** takes place in the corporate world. And as Janet Mason points out, even firms that have policies against piracy are facing lawsuits and audits if their employees are caught with unauthorized copies of software.

21. **Software Patents,** The League for Programming Freedom, *Dr. Dobb's Journal,* November 1990. 96
In this position paper, the authors argue strongly that, in most cases, software should not be patentable. They claim ***software patents*** offer little benefit to society and could put an end to the creativity that has driven the computer revolution.

22. **Programs to the People,** Simson L. Garfinkel, *Technology Review,* February/March 1991. 102
Richard Stallman, president of Free Software Foundation (FSF), believes that companies that sell computer programs give their customers the choice of being criminals or bad neighbors, and he is determined to ***make software free***. In this article, Simson Garfinkel discusses Stallman's goals and successes thus far.



Unit 5

Individual Privacy in the Information Age

Six articles discuss threats to individual privacy, especially those posed by the existence of large electronic data bases. Some legal and technical means of protecting privacy are also reviewed.

23. **Legally Speaking: Can Hackers Be Sued for Damages Caused by Computer Viruses?** Pamela Samuelson, and **Viruses and Criminal Law,** Michael Gemignani, *Communications of the ACM,* June 1989. **109**
Two legal scholars discuss potential benefits and problems in bringing civil and criminal action against those who plant ***viruses in computer systems***. In both cases the law is highly ambiguous and has not kept pace with technological developments.

24. **Time Bomb: Inside the Texas Virus Trial,** Edward J. Joyce, *Computer Decisions,* December 1988. **115**
This article outlines the civil and criminal action against a disgruntled employee who planted ***a virus in his workplace computer system***.

25. **Closing the Net,** *Greg Costikyan, Reason, January* 1991. **120**
In this article, Greg Costikyan argues that some investigations of supposedly "illegal" **uses of electronic bulletin boards** have been overzealous and raise concerns that the freedom of the press may be in jeopardy.

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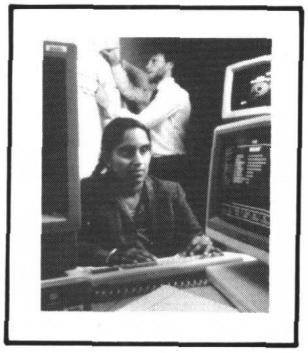
26. **Is Nothing Private?** *Business Week,* September 4, 1989. **128**
Computers hold a great deal of data on individuals and much of it *is largely unprotected by rules, laws, or codes of ethics. This* article explains what ***types of computer data*** exist and why there are so many loopholes in the "right to privacy."

27. **Read This!!!!!!!** Jill Smolowe, *Time,* November 26, 1990. **134**
Direct-mail marketers are compiling and swapping computerized customer lists that they are using to flood consumers with junk mail. Because the lists provide increasingly detailed information about individual consumers, the practice is raising ***citizen concerns about privacy.***

28. **Prepare for E-Mail Attack,** David Churbuck, *Forbes,* January 23, 1989. **139**
Cheap communications are leading to ***information overload***—much of it is unwelcome and highly intrusive. But there are also new products to block uninvited intruders.

29. **Absolutely Not Confidential,** Clark Norton, *Hippocrates,* March/April 1989. **142**
Medical records contain information that could damage reputations or result in the denial of employment or other benefits if *inappropriately used.* Yet, as the author clearly demonstrates, there are serious flaws in protecting the confidentiality of medical records.

30. **Our Chip Has Come In,** *The New Republic,* June 12, 1989. **148**
Russia and China are current examples of how ***information technology***, specifically television and the ***personal computer***, encourages democracy. However, the author cautions, democracy seems to work easily only in select environments.



Unit 6

Computer System Reliability and Safety

Five articles examine potential dangers posed by electromagnetic fields and the implications of society's reliance on computer systems. Difficulties in producing reliable software are reviewed with emphasis on commercial, military, and medical applications. Recommendations for improving safety and reliability are also offered.

31. **Caller Identification: More Privacy or Less?** Jeff Johnson, *The CPSR Newsletter,* Winter/Spring 1990. **150**
In this article, Jeff Johnson reviews ***the pros and cons of Caller ID***. Among other things, the service displays the phone number of incoming calls. While this may aid consumers by reducing unwanted calls, critics claim the main benefits will go to large organizations and that individual privacy may suffer.

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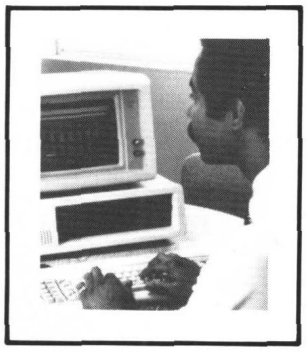
32. **The Magnetic-Field Menace,** Paul Brodeur, *MacWorld,* July 1990. **156**
Paul Brodeur discusses concerns over health ***hazards of electromagnetic emissions from computer display monitors***. He claims the issue has been shrouded by "denial" and addressed with "incompetence." Nevertheless, he concludes that the "monitors may pose a very real threat," and reviews efforts to study and deal with the problem.

33. **Premature Alarm Over Electromagnetic Fields,** C. Andrew L. Bassett, *Issues in Science and Technology,* Spring 1990. **163**
Recent publicity has focused on potential hazards while ignoring the ***benefits of electromagnetic fields***. This article adds balance to the debate by describing some therapeutic uses of such fields. The author also argues that "before we start regulating, we need better information on which to base policy."

34. **A System On Overload,** Evelyn Richards, *The Washington Post National Weekly Edition,* December 31, 1990–January 6, 1991. **166**
Many sectors of society, such as the economy and the military, depend on the reliable operation of computer systems. However, Evelyn Richards describes a number of problems that are related to meeting ***the demand for the highly complex software*** needed to control vital systems.

35. **Programmed for Disaster,** Jonathan Jacky, *The Sciences,* September/October 1989. **171**
Software errors can imperil lives. In this article, Jonathan Jacky describes some of the more serious ***programming errors*** and offers suggestions on how complex, critical software could be made more reliable and safer.

36. **Robowar,** Gregg Easterbrook, *The New Republic,* February 11, 1991. **175**
Gregg Easterbrook offers a brief history of ***high-tech conventional warfare*** from World War II to Operation Desert Storm. He also offers an explanation of why the initial U.N. attacks on Iraq were so technologically successful.



Unit 7

Issues From the International Scene

Five articles examine issues related to computing in several nations, the technological and information gap between rich and poor nations, international competitiveness, and the global economy.

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37. Personal Computers and the World Software Market, Larry Press, *Communications of the ACM*, February 1991. 180

The production and ***consumption of software*** is becoming increasingly global in scope. Larry Press describes recent developments in Latin America, Ireland, India, Eastern Europe, and the Far East.

38. Academic Computing: The Los Andes Strategy, Ivan Trujillo, *Educom Review,* Summer 1989. 186

Scientific and technological advances in wealthy countries can bring economic problems to less developed countries. Ivan Trujillo describes the efforts of one university in Colombia to bridge ***the technological and information gap*** between rich and developing nations.

39. New Dimensions in Creativity, Geri Smith, *Américas,* Vol. 41(1), 1989. 191

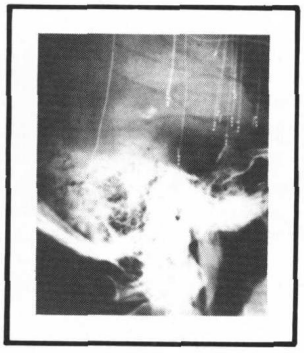
In describing the visual effects achievement of ***Brazil's Globo Television network***, Geri Smith claims that, "nowhere in the world are television spectators treated to as much computer wizardry as they are in Brazil."

40. Space Age Shamans: The Videotape, Geri Smith, *Américas,* Vol. 41, No. 2, 1989. 194

Geri Smith explains how and why a new generation of Latin American Indians is using ***electronic documentation*** to preserve age-old traditions and to protect its lands.

41. Tough Search for Talent, Osman Tseng, *Free China Review,* December 1990. 197

The Republic of China on Taiwan is striving to become a fully industrialized country. It has made dramatic progress toward that aim, but a limited pool of ***scientific and technical manpower*** could stall Taiwan's development.



Unit 8

Philosophical Frontiers

Seven articles consider how new moral and philosophical challenges may arise at the cutting edge of technological achievements. The unit also examines a variety of ways computers might affect the way we perceive human nature.

Overview 200

42. Why Transplants Don't Happen, Joel L. Swerdlow and Fred H. Cate, *The Atlantic,* October 1990. 202

There is an acute ***shortage of transplant organs*** and tissues. The authors discuss some of the cultural, political, and economic reasons underlying this dilemma and argue that, among other things, a better (computerized) system of coordinating supply and demand is needed.

43. Last Rights, Kathleen Stein, *Omni*, September 1987. 206

Due to advanced ***life-support technologies***, the classical definitions of death are no longer adequate. These developments, writes Kathleen Stein, are giving rise to major social, legal, and moral issues and questions about "what it means to be alive, to be a person, to have a mind."

44. Designing Computers That Think the Way We Do, William F. Allman, *Technology Review,* May/June 1987. 212

Researchers are attempting to build ***machines*** that mimic the architecture of the ***human brain***. This represents a radical shift in computer design and, according to the article, "might even change the way we think about thinking."

45. **Is the Brain's Mind a Computer Program?** John R. Searle, *Scientific American,* January 1990. 217
*"**Can a machine think?**"* According to philosopher John R. Searle, the answer is "No. A program merely manipulates symbols, whereas a brain attaches ***meaning*** to them."

46. **Could a Machine Think?** Paul M. Churchland and Patricia Smith Churchland, *Scientific American,* January 1990. 222
Paul M. Churchland and Patricia Smith Churchland present the thesis that the neural network computers currently under development mimic the architecture of the brain and may be ***capable of developing consciousness*** in the future.

47. **Is Thinking Computable?** Peter J. Denning, *American Scientist,* March/April 1990. 229
Peter J. Denning discusses the debate regarding thinking computers and reviews physicist Roger Penrose's book on ***artificial intelligence***. Denning concludes that Penrose and philosophers John R. Searle and Paul and Patricia Smith Churchland, have, for now at least, "bolstered our confidence in the belief that we [humans] are more than mechanical devices."

48. **Love Among the Robots,** Melvin Konner, *The Sciences,* March/April 1987. 232
Developments in ***artificial intelligence*** are shrinking the intellectual turf separating animals and machines. In this article, Melvin Konner reviews arguments about whether computers will ever think or fulfill human emotional needs.

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The concepts in bold italics are developed in the article. For further expansion please refer to the Topic Guide, the Index, and the Glossary.

COMPUTERS IN SOCIETY

FOURTH EDITION

Editor

Kathryn Schellenberg
University of Guelph

Kathryn Schellenberg received her Ph.D. in sociology from the University of Utah and is presently assistant professor of sociology at the University of Guelph in Ontario, Canada. One of her areas of scholarly interest is the social impact of technology, especially computing, and she has taught several sociology courses dealing with this subject. Ms. Schellenberg has also conducted several studies on computer-related topics, and her current research centers on organizational and labor implications of very complex industrial automation systems.

Cover illustration by Mike Eagle

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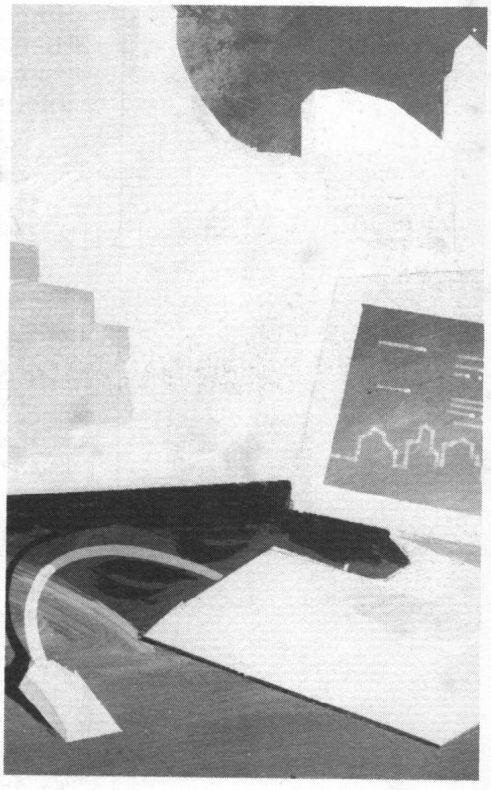

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Topic Guide

This topic guide suggests how the selections in this book relate to topics of traditional concern to students and professionals involved with computers in society. It can be very useful in locating articles that relate to each other for reading and research. The guide is arranged alphabetically according to topic. Articles may, of course, treat topics that do not appear in the topic guide. In turn, entries in the topic guide do not necessarily constitute a comprehensive listing of all the contents of each selection.

TOPIC AREA	TREATED IN:
Artificial Intelligence	44. Designing Computers 45. Is the Brain's Mind a Computer Program? 46. Could a Machine Think? 47. Is Thinking Computable? 48. Love Among the Robots
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Introduction

Computer "revolution" is a widely used term these days. It implies that society is undergoing a radical transformation. This was the view of the late British computer expert, Christopher Evans of Britain. In his thought-provoking book, *The Micro Millenium*, Evans argued that the societal impacts of computers in general, and personal computers in particular, would rival the effects of the Industrial Revolution that:

> brought about immense shifts in all aspects of society, affecting the individual, his family, his neighbors, his domestic and working environment, his clothes, his food, his leisure time, his political and religious ideals, his education, his social attitudes, his life-span, even the manner of his birth and death. (1979:ix)

Moreover, Evans claimed the future is not one of our choosing. He stated that as we began to apply these powerful new tools to the tasks of bettering our lives, we set in motion a process that takes on an independent, unstoppable momentum. The best we may hope for is that we have enough time to anticipate and prepare for the future that will be thrust upon us.

There are those who disagree that a social revolution is underway. And even if there is a revolution, we, the people, will be pretty much in control of it. For example, in his book, *The Personal Computer Book*, poet Peter A. McWilliams argues that computers will no doubt have a dramatic impact on our lives and on society. But he also suggests that we are in command of our own fate when he states:

> For the most part, personal computers will prove their worth to the extent that they fit into your daily life, not to the degree that you adapt your life to be more in step with The Computer Age. (1984:15)

Contradictory predictions about the implications of computing are hardly surprising since people operate from many different premises about society and human nature. We need to keep this in mind when we try to make sense of competing claims about the future. This is not easy since many of us are not even aware of our own assumptions about social life, or how they might differ from other people's views. Most of us take certain things for granted—we believe them so strongly we simply assume other reasonable and intelligent people see things the same way.

This disagreement between Evans and McWilliams basically reflects the difference between how idealists and materialists look at the world. Those who feel that idealism and free will govern societies are uncomfortable with the kind of claims made by Evans—that cultural, political, and religious ideals can be influenced by technical innovation. They would argue that the ideals come first and are the foundation of society. Technical innovations are accepted or rejected according to whether they are in harmony with basic values. This assumption is implied in McWilliams's argument that computers are mere tools that people are free to use or avoid. Materialists on the other hand, insist that new technologies need not support any basic belief system. They maintain that if a technology can provide real material benefits such as greater wealth or longer life expectancy to society or to a powerful minority, it will be adopted. If some aspect of technology clashes with society's values and ideals, then the values, not the technology will be modified or abandoned. Clearly, Christopher Evans is in the materialist camp.

Social theorists and philosophers have debated for centuries over which of the competing social assumptions are valid. Like the rest of us, they continue to disagree about where the truth lies. For the past few centuries, there has been a growing tendency to look to "science" to settle these disputes. The first reading in this collection gives us some insight into how new scientific discoveries about physical nature shaped eighteenth-century views of social order and human nature. In "Science and the American Experiment," historian John Patrick Diggins describes the factionalism of post-revolution America and how Newton's laws of physics helped forge some ideological unity among the framers of the U.S. Constitution.

As Diggins' discussion also shows, scientific "truths" are subject to ongoing debate and revision. Moreover, science itself is, to the surprise of many people, very much shaped by social factors. A good example of this is modern Western medicine that is generally thought to be based on widely accepted scientific principles. However, as Lynn Payer illustrates in "Borderline Cases," medical practice in Western Europe and North America reflects differences in national cultures to a considerable degree.

Looking Ahead: Challenge Questions

Since medical practice varies from culture to culture, what kinds of problems (or benefits) could arise from the use of expert systems developed in other cultures?

If society has a choice about which technologies are developed and how they are used, then who should participate in making those choices? Should those with political power, wealth, or technical expertise assume the responsibilities of shaping our society? If everyone should have a say, how might we provide the opportunity for all to have their views and concerns taken into account?

SCIENCE AND THE AMERICAN EXPERIMENT

How Newton's Laws Shaped the Constitution

JOHN PATRICK DIGGINS

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IN THE WINTER OF 1786, only ten years after declaring independence from England and four years after concluding the war that underscored that declaration, America was falling apart. The single thing the thirteen former colonies seemed to have in common was a penchant for squabbling among themselves. Religious differences separated the Calvinists of New England from the Baptists of the South. The economic interests of northern merchants clashed with those of southern slave owners. Border disputes were common and periodically led to skirmishes. Atlantic states such as South Carolina envied their landlocked neighbors' proximity to the public lands of the Northwest Territorities, and states such as New Jersey, with no seaports, were unhappy about paying import tariffs to New York and Philadelphia, whose harbors were well suited for shipping.

To make matters worse, the Articles of Confederation, ratified in 1781, had placed most of the nation's power with the states. Consequently, Congress was too weak to address broad domestic problems, the most troubling of which was a public debt of sixty million dollars, a legacy of the War of Independence. Small farmers, whose financial problems were especially acute, pressed state legislatures to issue paper money with which to pay their creditors. Though it undermined the value of hard currency, several states complied with the farmers' demands out of fear. And with good reason: when the Massachusetts legislature refused, armed bands forced a number of courts to halt foreclosures and imprisonment for debt. Though the rebels were soon subdued by state militia, their brief uprising, along with the other troubles brewing throughout the colonies, awakened leaders to the growing crisis: the confederation was on the verge of collapse.

At first, discussion about how to restore unity seemed destined to degenerate into bitter disputes, as well. A handful of former loyalists, who had opposed the war, and representatives of New England's upper classes called for a return to monarchy. Desperate and disgruntled, members of the military thought they could put the country back on course by installing themselves as its new rulers. But the most fundamental and far-reaching disagreement existed between the federalists, who desired a strong central government, and the antifederalists, who were reluctant to relinquish even a fraction of state autonomy. Nevertheless, the gravity of the situation was sufficient to persuade the various factions to set aside their differences; Congress and every state save Rhode Island accepted the federalists' invitation to a general convention to revise the Articles of Confederation.

The fifty-five individuals who gathered in Philadelphia in May of 1787 constituted the most outstanding group of American statesmen ever to have assembled in one room. Representing Virginia was George Washington, a hero of the war; James Madison, one of the greatest political intellects in the country's history; Edmund Randolph, the state's governor; and George Mason, author of Virginia's bill of rights. From Pennsylvania came Benjamin Franklin, spokesman for the colonies in their debate with Great Britain about self-government, and James Wilson, an exceptionally gifted lawyer. And the New York delegation included Alexander Hamilton, a talented champion of centralized government.

The group proved to be as bold as it was brilliant. Scarcely had the delegates cleared their throats when Randolph presented fifteen specific resolutions (almost certainly authored by Madison), whose scope greatly exceeded the charter of the convention: included was a proposal to create a national authority with sovereignty over the states; rather than fiddle with the Articles of Confederation, they would begin again, to frame a new constitution. And of what would this constitution consist?

Besides freeing the colonies of England's control, the War of Independence had sundered America's ties to the governmental traditions that had dominated England until the eighteenth century. The framers now aligned themselves with the intellectual movement that had recently swept across Europe—the Enlightenment; they rejected the political ideas of the past, turning elsewhere for models after which to pattern government. One of the most important of these models was nature itself, whose laws were viewed as templates for social laws. And the interpretation of nature considered most valid during the Enlightenment was that offered by such men as Isaac Newton, the English physicist. True, the U.S. Constitu-

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tion represented the confluence of several intellectual, social, and political trends, but, of these, one of the most powerful and lasting was the growing popularity of science itself.

IN TURNING TOWARD SCIENCE, the framers spurned two traditions that had shaped political thought before the Enlightenment. The first was Christianity, which defined man's nature in terms of a spiritual destiny that lay beyond history. Whether that destiny was fulfilled by prayer or work, government was considered a divinely ordained institution to be obeyed as much for salvation as for maintaining social order. The second tradition was classical republicanism, a political system with roots in ancient Greece and Rome, as well as in Renaissance Italy. In its purest form, a republican government is one in which power is exercised by elected representatives who are directly responsible to a body of citizens. Classical republicans sought to elevate people into patriots devoted to civic virtue and felt that this could be achieved best when government officials lived close enough to their constituents to exhort them to correct behavior and, in turn, to be accountable to them. Thus, it was presumed that republicanism worked only for small-scale governments, such as those that existed in sixteenth-century Florence, Milan, and Genoa.

To many of the scientifically oriented thinkers of the Enlightenment, these traditions, emphasizing as they did the repression of self-interest in the name of church and state, were unrealistic. The chief architect of this critique was the Scottish philosopher David Hume. Taking Newton's empiricism as his model, Hume held that there can be no knowledge of anything beyond experience. He conceived of philosophy in general, and of political thought in particular, as inductive, experimental sciences. Sound government must be based on the *science* of politics—on the direct observation of human behavior.

Such observation led Hume to conclude that human nature is uniform, that, even in the face of social and economic differences, invariant rules can be drawn from men's actions. The most important of these is that, since reason is a slave to the passions, political thinkers must be all the more scientific because they cannot expect the people to be so. Noting that, for centuries, the condition of the human race remained miserable under religious and classical authority, Hume argued that the aim of government should be not to exhort citizens to attain grace or virtue but to accept man as a pleasure-seeking creature. Rather than leading to political instability, man's pursuit of material gain will induce productive work habits and thereby contribute to the creation of wealth and progress, as long as government is designed to offset opposing passions. This picture of mankind accorded well with the world view of eighteenth-century science, which was based largely on Newton's three laws of motion, in particular, the third: for every action there is an equal and opposite reaction.

Both Hume's ideas about government and Newton's outlook on nature came together in early American political thought. Hamilton, Madison, and the other framers were particularly impressed with Hume's essay "That Politics Be Reduced to a Science." From Hume they learned that if government concerns itself with institutions and political structures, rather than with manners and morals, a rich and powerful republic need not succumb to corruption. The clearest and most forceful articulation of this lesson is found in *A Defence of the Constitutions of Government of the United States of America*, composed in 1787 and 1788 by John Adams, later to become the second president, and in *The Federalist*, a series of eighty-five essays by Hamilton, Madison, and John Jay, then the secretary of foreign affairs, which appeared in New York newspapers, in support of the Constitution, between October of 1787 and August of 1788. It is no accident that these documents, brilliant expositions of the political theory that underlies American government, are studded with the language of natural science.

ADAMS WROTE the *Defence* in response to French political thinkers who had criticized the American states for having governments whose branches were designed to reflect class divisions as a means of controlling them. Because postrevolutionary America had no monarchy, aristocracy, or peasantry, the French felt the country could dispense with its system of checks and balances and simply vest all authority in a single, national assembly.

Adams faulted the French for failing to realize that governmental abuse cannot be eradicated merely by entrusting power to an active citizenry. He argued that a strong executive branch was necessary to mediate between the rich and the poor, the powerful and the weak. Whereas the French believed that class differences could be abolished along with the executive branch, which remained for them a symbol of monarchal tyranny, Adams, like the skeptic Hume, was convinced that potentially explosive divisions of one kind or another would always exist in society and that democracy must be controlled to prevent the tyranny of any particular faction.

"All nations, from the beginning, have been agitated by the same passions," Adams observed. To him, there was only one solution to political power conceived as a force that expands until met by a counterforce: "Orders of men, watching and balancing each other, are the only security; power must be opposed to power, and interest to interest." Proof for the idea came from the classical mechanics of Newton (for every action, a reaction).

The laws of physics, as well as the maxims of geometry, were also used to support the political ideas in *The Federalist*. In number thirty-one, for example, Hamilton cited a variant of the laws of mechanics (the means should be proportionate to the end) to defend the constitutional clause that authorized the new government to make any laws necessary to carry out its objectives. (For example, the Constitution says that the government shall regulate commerce, but it fails to mention banking. Nonetheless, according to Hamilton, the government can create a banking system to regulate commerce.)

Elsewhere in *The Federalist*, Hamilton and Madison advanced the Newtonian principle that an effect cannot exist without a cause, to show why factions are inevitable. Since the differences that give rise to factionalism are "sown" into human nature, government should abandon any hope of abolishing the causes of factionalism and attend, instead, to the establishment of political structures that will counterbalance natural conflicts, thereby preventing them from erupting into civil strife. Extend-