The Philosophical Society of Texas

PROCEEDINGS

1983

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OF THE ANNUAL MEETING

AT FORT WORTH

DECEMBER 2 and 3, 1983

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THE PHILOSOPHICAL SOCIETY OF TEXAS

1984

THE PHILOSOPHICAL SOCIETY OF TEXAS FOR THE COLLECTION AND DIFFUSION OF KNOWLEDGE *was founded December 5, 1837, in the Capitol of the Republic of Texas at Houston, by* MIRABEAU B. LAMAR, ASHBEL SMITH, THOMAS J. RUSK, WILLIAM H. WHARTON, JOSEPH ROWE, ANGUS MCNEILL, AUGUSTUS C. ALLEN, GEORGE W. BONNELL, JOSEPH BAKER, PATRICK C. JACK, W. FAIRFAX GRAY, JOHN A. WHARTON, DAVID S. KAUFMAN, JAMES COLLINSWORTH, ANSON JONES, LITTLETON FOWLER, A. C. HORTON, I. W. BURTON, EDWARD T. BRANCH, HENRY SMITH, HUGH MCLEOD, THOMAS JEFFERSON CHAMBERS, SAM HOUSTON, R. A. IRION, DAVID G. BURNET, *and* JOHN BIRDSALL.

The Society was incorporated as a non-profit, educational institution on January 18, 1936, by George Waverley Briggs, James Quayle Dealey, Herbert Pickens Gambrell, Samuel Wood Geiser, Lucius Mirabeau Lamar III, Umphrey Lee, Charles Shirley Potts, William Alexander Rhea, Ira Kendrick Stephens, and William Embrey Wrather. December 5, 1936, formal reorganization was completed.

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The Philosophical Society of Texas

PHILOSOPHICAL SOCIETY MEMBERS AND GUESTS MET AT THE Americana Hotel in Fort Worth for the 146th anniversary meeting on December 2 and 3, 1983.

A reception and dinner on Friday evening was hosted by Dr. and Mrs. A. M. Pate, Jr. at the Pate Museum of Transportation. After a meal with "all the Fort Worth trimmings," a program of outstanding musical talent was presented.

President Wayne Holtzman announced the following new members of the Society and presented certificates to those in attendance.

Roger N. Conger — Waco
Robert W. Decherd — Dallas
John R. Erickson — Perryton
T. R. Fehrenbach — San Antonio
Bobby Ray Inman — Austin
John Q. Taylor King, Sr. — Austin
Jon P. Newton — Austin
Chilton O'Brien — Beaumont
H. Paul Pressler III — Houston
Jo Stewart Randel — Panhandle
L. Donald Shields — Dallas
William E. Tucker — Fort Worth

On Saturday during the business meeting the membership was informed of the death of the following members since last year's meeting:

A. P. Brogan
George Rufus Brown
Herbert Pickens Gambrell
S. W. Geiser
Leon Jaworski
H. Neil Mallon

Officers elected for 1984 were Jenkins Garrett, president; Joe R. Greenhill, first vice-president; William P. Hobby, second vice-president; Mary Joe Carroll, treasurer; and Dorman H. Winfrey, secretary.

The membership had lavish praise for the work of the local arrangements committee which consisted of Chairman Tom Law, Jenkins Garrett, Jon Fleming, and Aggie Pate. There was a festive holiday atmosphere in nearby Sundance Square and members had an opportunity to visit the magnificent collection of paintings by Frederic Remington and Charles M. Russell in the Sid Richardson Collection of Western Art.

Attendance at 1983 Annual Meeting

Members attending included: Mesdames Randel, Scott; Messrs. Paul Gervais Bell, Boyd, Brown, Caldwell, Carmack, Edward Clark, Conger, Crim, Crook, Decherd, Doyle, Erickson, Estes, Fehrenbach, Durwood Fleming, Jon Fleming, Garrett, Gordon, Greenhill, Hanna, Hargrove, Heinen, Hershey, Holtzman, Inman, Dan E. Kilgore, William J. Kilgore, Law, LeMaistre, Levin, Locke, McCall, McGinnis, Mills, Newton, O'Brien, Pate, H. Paul Pressler III, Ragan, Risher Randall, Reynolds, Seybold, Shilling, Shirley, Sprague, Tower, Tucker, Ruel C. Walker, Watkins, Whitcomb, Dan C. Williams, Winfrey, James S. Wright, Zachry.

Guests included: Mrs. Paul Gervais Bell, Mrs. Howard Boyd, Mrs. John R. Brown, Mrs. John Clifton Caldwell, Mrs. George Carmack, Mrs. Edward Clark, Whitfield Collins, Mrs. Roger N. Conger, Mr. and Mrs. Judd Cramer, Mrs. William Robert Crim, Mrs. William H. Crook, Mrs. Robert W. Decherd, Dr. and Mrs. Joseph Deken, Mr. and Mrs. Norwood Dixon, Mrs. Gerry Doyle, Mrs. John R. Erickson, Mrs. Joe E. Estes, Mrs. T. R. Fehrenbach, Mrs. Durwood Fleming, Mrs. Jon Hugh Fleming, Mrs. Jenkins Garrett, Mrs. William Edwin Gordon, Mrs. Joe Greenhill, Mrs. Ralph Hanna, Mrs. James Ward Hargrove, Mrs. Erwin Heinen, Mrs. J. W. Hershey, Mrs. Wayne H. Holtzman, Mrs. Dan E. Kilgore, Mrs. William J. Kilgore, Mrs. Thomas H. Law, Mrs. Charles A. LeMaistre, Mrs. William C. Levin, Mr. and Mrs. Jack Llewellyn, Mrs. Abner V. McCall, Mrs. Robert C. McGinnis, Mrs. Ballinger Mills, Jr., Mrs. Jon P. Newton, Mrs. A. M. Pate, Jr., Mrs. H. Paul Pressler III, Mrs. Cooper K. Ragan, Mrs. Risher Randall, Ralph Randel, Mrs. Herbert H. Reynolds, Lawrence Scott, Mrs. William D. Seybold, Mrs. Roy B. Shilling, Jr., Mrs. Preston Shirley, Mr. and Mrs. Robert Trotti, Mrs. William E. Tucker, Mrs. Ruel C. Walker, Mrs. Edward T. Watkins, Mrs. Gail Whitcomb, Mrs. Dan C. Williams, Mrs. Dorman H. Winfrey, Mrs. James S. Wright, Mrs. H. B. Zachry.

A SYMPOSIUM ON THE IMPACT OF COMPUTERS UPON SOCIETY: INTRODUCTORY REMARKS

WAYNE H. HOLTZMAN

Computers and the field of information processing have grown so rapidly in the past several decades that few of us are aware of the profound changes already taking place in society as a result of this new wave of high technology. While our children and grandchildren are being introduced to personal computers, most of us have yet to interact with a computer-based work station. As the home of Radio Shack and a neighbor of Texas Instruments, Fort Worth is an ideal city in which to organize a symposium on the significance of the computer revolution. The program committee under Charles Sprague is to be congratulated for assembling a distinguished group of experts who can speak directly to both the technical and social issues characteristic of this emerging age of information. The opportunity for each member of the Society to interact with computers in a demonstration assembled in the next room by three leading computer manufacturers was a special treat for all of us who are unfamiliar with the new personal computers.

Any projections of recent growth in computers and information processing lead to astonishing changes within the next ten years. It is estimated that there will be over 170 million keyboards in operation by 1993 for entering information into computer systems, almost as many input devices as there are television sets in America. According to the U. S. Bureau of Labor Statistics, five of the top six fastest-growing occupations in the next decade will be closely related to computers. The price of raw computing power has dropped so rapidly that what cost $1 million in 1970 will cost only $10,000 by 1990. More importantly, these major technological advances have brought the computer within reach of all of us.

The keynote address on computers and information processing was given by Dr. William E. Gordon, provost and former dean of natural sciences at Rice University. An electrical engineer and space physicist, Dr. Gordon is eminently well qualified to comment upon the nature of high technology, how it differs from science or engineering, and the powerful impact of computers upon many aspects of modern life. As reproduced here, his address set a high tone for the conference. While generally optimistic about the future, Dr. Gordon also mentioned the downside of high technology and the imperatives we all face if we are to survive in a nuclear age.

The talk by George Kozmetsky, former dean of the UT-Austin College of Business Administration and a founding officer of Teledyne (a large corporation specializing in high technology), focused upon the nature of information processing in business management and business education. He pointed out that information technology is much more than simply the hardware and software comprising computers and communications. In addition to being a body of knowledge, this technology is based upon a number of behavioral sciences and social policies that are fundamental in a society where information is so important. He posed a number of key challenges to business management, as well as pointing out how computers and information processing are impacting upon business practices and education.

The impact of computers upon higher education has been just as profound as the impact upon business and industry, according to Richard Van Horn, the third speaker in the symposium. A newcomer to Texas as chancellor of the University of Houston-Main Campus, Dr. Van Horn was formerly provost at Carnegie-Mellon University, one of the three leading institutions in the country in the field of computer sciences and related technology. He was personally responsible for negotiating a major demonstration project with IBM Corporation for providing nearly every student and faculty member at Carnegie-Mellon with a personal computer tied in to networks of more powerful computer systems. Since his presentation in the symposium relied heavily upon visual aids to illustrate computers in higher education, no written paper would do justice to the scope of the presentation.

The talk by Bobby Inman concerning the unique new research and development corporation he heads, Microelectronics and Computer Technology Corporation (MCC), was also given extemporaneously and is not available for publication. Bringing MCC to Austin in the face of national competition from hundreds of other communities was a major feat in itself that involved organized efforts of a highly creative nature, ranging from the governor of Texas to collaboration between the cities of San Antonio and Austin and cooperation of the rival state universities, Texas A & M and the University of Texas. Admiral Inman, former director of the National Security Agency and deputy director of the Central Intelligence Agency, was chosen to head this unique enterprise just a year ago and is still putting together his top management team. Arising in part as a reaction to the Japanese challenge in microelectronics and the Japanese plans to develop a fifth-generation computer, MCC will be concentrating upon advanced computer designs, computer-aided manufacturing, very high-speed integrated circuits, and the use of artificial intelligence in engineering radical software. Over a dozen major American companies are the stakeholders in MCC. Each participating company commits funds for the support of MCC and, in return, receives leadtime in being licensed to manufacture products for which MCC will hold patents. After this three-year advantage enjoyed by shareholder companies, anyone can be licensed. Already the move of MCC to Austin has created a sensational wave of publicity throughout the country, leading many other high technology companies to consider Texas as an attractive location.

The fifth speaker, Bernard List, discussed the general impact of computers upon society. Currently a vice-president, Dr. List has been associated with Texas Instruments as an electrical engineer since 1957, with the exception of a six-year stint as director of the Air Force Avionics Laboratory. Consequently, he has participated directly in the development of high technology related to computers and information processing. As manager of education and training for Texas Instruments, he has given a lot of thought to the impact of computers upon individuals and the social organizations within which they live. After reviewing the tremendous technological advances over the past 38 years leading up to the modern computer, he pointed out the emerging importance of the personal computer as the natural successor to the slide rule and electronic calculator. Until recently, computers have been in central locations operated by computer professionals, but now everyone can look forward to having a personal computer under one's total control. The availability of a complete computer constructed on a tiny chip of silicon means that computers are already being installed in household appliances, automobiles, watches, and hundreds of other everyday products that we often take for granted. But the most powerful impact, according to Dr. List, is still ahead of us as the impact of computers upon education becomes fully realized.

The final presentation in the daylong symposium brought the personal computer home in a meaningful way for everyone present. Dr. Joseph Deken, a professor in both general business and computer sciences at UT-Austin, gave a number of exciting examples of how personal computing is changing the way we live. Taking examples from his recent books, *The Electronic Cottage* and *Computer Images:*

State of the Art, he demonstrated how personal computers could be used for a variety of creative activities ranging from manuscript writing to artistic productions with the computer as the medium. He closed his remarks with some cautionary notes about mental roadblocks and hidden assumptions holding back more effective use of personal computers — roadblocks that spring from human psychology as much as from the current stages of computer technology.

Following the symposium, everyone present had an opportunity for "hands on" experience in demonstrations of personal computers by three corporations — IBM, Texas Instruments and Tandy Corporation (Radio Shack). Ranging from small, handheld, low-priced computers from Radio Shack to fully-equipped, desk model professional computers, these demonstrations of the latest products in the personal computing field permitted many Society members to try out a computer for the first time under expert guidance. While reactions to the individual products were mixed, everyone was enthusiastic about the opportunity for such informal interaction and expressed their deep appreciation to the corporations for providing the computers and expert personnel to assist in the demonstrations.

COMPUTERS AND INFORMATION PROCESSING

WILLIAM E. GORDON

President Holtzman, distinguished speakers, members, guests of the Philosophical Society.

In trying to deal with computers, invented about four decades ago, one recalls the development of the telephone and wonders if some Philosophical Society a few decades after Alexander Graham Bell's invention held a similar meeting to consider the possible uses of the telephone.

The telephone, after all, is an equally complex technological product that we are all perfectly comfortable in using without having any idea of how it works. The telephone we have grown up with, and it provides us with services that we use, need and enjoy. The personal computer is at a stage of development and use that many of us are not ready to accept. It has not yet proven its usefulness to us (as the phone has), and we view it as a curiosity. Our children and grandchildren who are growing up with personal computers will view them when they are adults as we now view the phones. They will use, need and enjoy them.

My purpose, this morning, is to place computers and information processing in the context of an era of high technology, leaving to the speakers who follow applications to and the impacts on business, education, the family and society.

The organizing committee asked that the opening address deal with high technology, broadly though briefly introducing computing and information processing as an example that will be explored in some depth in today's program.

Technology is not new. You have lived with it, although it sometimes may have produced anxieties — in part because of the changes it brings, in part because of the rapidity of the changes. It affects business, education, individuals and societies, as you will hear today. It makes life better, and it has costs. It brings with it certain problems.

Technology is sometimes complex, but we needn't understand the details in order to deal with the phenomena. We needn't turn away from it because the details may be difficult. We should face it squarely as we are doing today. A distinguished group of speakers will follow, and they will deal with an important, rapidly changing technology and the impact it has on our lives in various ways.

In his address to the 1983 meeting of the National Academy of Engineering, President Robert White noted:

> It is now commonplace to ascribe to technology an unusual centrality in the affairs of society. We are simultaneously served, baffled, entertained, threatened, puzzled, and defended by technology. The development and use of new technology are shattering long established patterns of thought, practice, and organization as society adjusts to one technological innovation after another. Technology is changing our education systems, our means of transportation, our health care systems. We are part of an aging population, the escalating cost of whose care is in part a result of the revolution in the understanding of human disease and the ability of medical technology to maintain life under the most tenuous of circumstances. The capacity to communicate, store and process data leaps with each passing year, the result of radical changes in information, electronic and communication technology. Every facet of society is affected. It is symbolic that only a few months ago President Reagan announced that henceforth there will be a National Medal of Technology to parallel the National Medal of Science.

Technological developments have often been the pacing elements in the unfolding panorama of scientific discovery. The secrets of the universe are being unlocked as physical and biological processes become more amenable to observation and understanding. Technology allows probes on the largest — and the smallest — time and space scales. At one end of the scale, we drill into the earth to sample geological records locked in deep-sea sediments, the location of mineral deposits, and the ever changing climate of the earth. Space missions bring us new understanding of planets and the solar system and help position humanity to understand its place in the universe. At the other end of the time and space scales, new technology permits study of elementary particles and their properties and the molecular structure of living matter to a point where a more fundamental understanding of many aspects of matter and life seems within our grasp.

Never have so many of society's functions and activities been under simultaneous upheaval as a result of technological innovation. Never has competitiveness been so dependent on the ability to develop, deploy and assimilate new technology, and never has the general welfare of our country been so dependent on our being successfully competitive through increases in productivity. Never has it been so clear that our educational system must react quickly and effectively to new challenges.

What is technology? Technology is an art — the art of converting in a systematic way the work of scientists and engineers into products and processes that materially enrich civilization. The roles of the three, scientist, engineer and technologist, are often confused. They are different and can be sorted out by the purpose of each. The scientist's goal is knowledge, the engineer's goal is design, *i.e.,* applying knowledge in a useful, practical way, the technologists are the artists who efficiently and economically produce in the needed quantities the products or processes.

High technology, rather than technology, is used when the product is sophisticated, *e.g.,* a computer chip, an industrial robot or laser rather than a mouse trap or a can opener.

A prominent issue today on flickering television screens and in the columns of magazines and newspapers is the effect of technological change. At the beginning of the industrial revolution, the factory was regarded as a dehumanizing environment in which workers became "slaves" of machines. Since then, major technological changes — from water power to steam engines to electricity and the internal combustion engine — have periodically reshaped the structure of modern society and its working conditions, occasioning a recurring debate about the benefits and costs of technological change. Developments in electronics, computers and robotics are again bringing significant change to the workplace and the organization of work in industrial and commercial "enterprises." Technology is not new. You have lived with some of it, and some of it goes back to early history — *e.g.,* paper in the first century in China; the abacus known to the Greeks, Romans and Chinese and still in use in the Orient; the printing press; the typewriter combining paper and a manual keyboard; the telephone of Mr. Bell; the early television; and the postage stamp as a symbol of the most ambitious information distribution system in the world.

Henry Ford mastered the art of producing in quantity dependable, inexpensive automobiles. That technology combined with the roads in those days spawned new industries: auto and tire repair. The roads of today produce something different: an anxiety spawned by snarled traffic. And the ultimate in that anxiety over technology is illustrated by the *astronaut* arriving on another planet in what may be its garden of Eden in time to exclaim, "No, no, not again!" as Eve is about to pick the apple.

When the poet Walt Whitman heard America singing a century ago, he heard the voices of people who worked with their hands: "the shoemaker singing as he sits on his bench, the hatter singing as he stands," the woodcutter's song, the plowboy's, the carpenter's, and the mason's. When a Whitman of a century hence listens for the song of America at work, will he still hear the voices of American workers, "each singing what belongs to him or her and to none else"? Or will he merely hear the clank of robots, the silence of a silicon chip, or maybe a distant, exotic song wafted over the Pacific from Japan?

Imagination has largely failed in the past to envisage future technology. And it has failed even more dramatically to envisage the uses of that technology. No one can be sure today of the long-term technical trends that will most strongly affect tomorrow's work force. But history, reason and foresight all support an optimistic view.

The technology revolutions themselves show no signs of slackening. The revolutions in electronics, telecommunications, information, and computer science are now well under way, and others are emerging in medical science and biotechnology. Science and technology are still as much an endless frontier as they were four decades ago or four centuries ago. Whereas technology is not new, the pace at which new technologies develop is increasing, leading to anxieties about coping with the new, the complex.

The main trend in the most rapidly emerging of the new technologies is a growing complexity that must be mastered by the scientists-engineers-technologists. Modern electronics exemplifies this trend. It is itself complex, and it is also an essential tool for mastering complexity. The emerging generation of electronics (very large scale integration, or VLSI) will put hundreds of thousands of electronic switches on a silicon chip only a centimeter on a side. But the complexity of those circuits will be even more impressive. Circuits made by today's techniques are equivalent to putting a street map of Fort Worth onto a single chip. Within a few years, the equivalent of a street map of the entire state of Texas will be put on a single chip. And within the next decade, engineers will be putting the equivalent of a street map of the entire United States onto one of those chips. Those road maps that we could never fold properly will be replaced by a chip and a screen on the car's dashboard.

Even the complexities of biology are yielding to new ideas and new tools. The double helix and the central dogma of DNA (deoxyribonucleic acid) provided the conceptual foundation. The tools include recombinant DNA (the ability to rewrite the hereditary message of living organisms) and monoclonal antibodies (mass-produced magic bullets for targeting individual cells for detection or treatment). Surprising discoveries continue to be made almost daily, and the future economic impact is virtually unimaginable. The transfer of genetic material from bacteria to plant cells, the asexual generation of new plants, and the fusion of different species are examples of new possibilities for improving crop yields, improving nutritional content, and lowering the cost of food.

And we will see changes in the field of medical diagnosis. Nuclear magnetic resonance (NMR), for example, is now going to work in medicine. Its imaging capabilities give doctors a view of soft tissues, such as the brain, that even such previous techniques as CAT scanning could not obtain. And NMR spectroscopy techniques may someday enable doctors to determine the physiological condition of tissues and organs in selected parts of the body without cutting it or sticking needles into it.

The laser is a fine example of a tool produced in the science-engineering-technology interaction. The amplification ideas first recognized for microwave radio were transferred to optical and near optical frequencies in concept, and the outcome was the laser as a tool: in surgery; for cutting metals with speed and precision; by the surveyor in the field; at the supermarket check-out counter; and in analyzing materials, including dating and authenticating paintings. The laser is found in nature emitting powerful signals *(e.g.,* the Crab nebula); is being studied for use in producing energy through the controlled fission of materials; is the crucial element in information transmission by fiber optics, where two very large reels of copper cable can be replaced by one very small reel of fiber optic cable leading to the development by AT&T of the NE corridor (Washington, D.C. to New England) — not for the transportation of people but for the transmission of information.

So in one sense the future belongs to the masters of complexity, to the electronics engineer who can manage design tools, the materials scientist who can understand computerized quantum mechanics, the chemist who masters molecular biology, and the medical diagnostician who understands nuclear magnetic resonance. And it strains the imagination to guess the sources, much less the effects, of future revolutions — whether from neurophysiology, geophysics, developmental biology, or high-energy physics.

Note an interesting commentary on our society. One of the growth industries of the 1980s is physical fitness. It is now a $35 billion a year business, that is, nearly five times the size of the personal computer industry. And it probably accounts for well over half a million jobs. But at the same time, the industry that is in the biggest crisis today is our mental fitness industry, especially education. The next generation of computers, coupled with expert systems, may provide us with the tools we need to launch a mental fitness craze. A nation with a market for a $6,000 treadmill for indoor joggers that measures speed and mileage and displays distance on a small screen surely also has a market for equipment to jog the minds of Americans and get them off their mental treadmills. (This suggestion comes from Roland Schmitt of the General Electric Co.)

It is as hard to tell exactly what form this mental fitness technology will take as it was for people in the 1920s to envision the future of television. But surely one key to wholly new mental fitness products is the computer's capability for simulation, interaction and display. With VLSI (very large scale integration of circuits) and knowledge engineering, these capabilities will extend far beyond what we see in today's computer games. Not so far, one hopes, as to lose the playful spirit of those games, but far enough to add an appeal to the creative and inquisitive power of the mind as well. Coupled with advances in telecommunications, this may enable people, for example, to experience nature on a scale previously inaccessible to humans — the submicroscopic world of elementary particles, perhaps, or the supermacroscopic world of galaxies.

Although I am optimistic about the future with respect to technology and grateful for the benefits I have derived from blossoming technologies, there is a somber side, a down side. And I must in the presentation attempt to maintain some balance. So that I won't infringe on later speakers, I confine my few remarks on the liabilities to noncomputer technologies. As a random example, the impact on society of introducing an unusually high voltage electrical transmission line without preparing the community led to demonstrations over the uncertainties the high fields produced by the line might have on humans, animals and crops and to vandalism impeding the construction.

A recent event indicating the extreme of the down side of science-engineering-technology interaction occurred in mid-November, when

I expect many of you joined nearly one-half of the population of this country in viewing ABC's movie "The Day After," a film intended to depict the day after a major nuclear exchange. If you were not already convinced that a nuclear war would wipe out civilization as we know it, you found the film scary. If you were convinced, you found the film not scary enough, for the immediate aftermath would have been far worse than pictured and the "nuclear winter" created by the exchange would probably wipe out the human race and most of the other life forms — if not in the day after, in the month after, or the year after.

In the early 1940s, science-engineering-technology provided not just a major weapon of war but for the first time the ability to end life on this earth. Although understood by only a few at the time, social responsibilities were changed dramatically. Surely the most important change since life began on this earth. In the 40 or so years since the first bomb, society has not solved the problem presented to it but rather has concentrated the awesome responsibility for the future of us, our children, and their children in the hands of two mortal humans — a responsibility better left in the hands of the gods. Serious negotiations by the world's superpowers were never more urgently needed.

Computers are not magic, but they are here. In our schools we shall learn with them; in our homes they may become a new friend providing a source of compassion, patience and understanding. In our businesses they present another facet: they may provide more information than we want!

It was Arthur Clarke who said, "Any sufficiently advanced technology is indistinguishable from magic."

Let me conclude by saying computers and information processing provide services that enable us to set free the powers of our minds, that help us interact with information rather than merely absorb it, that educate and retrain us. The computer will handle the mechanics of logic, graphics and display, leaving us free to do the creative thinking, that job that belongs to us — not to it. The computer gives us new ways to enhance the power of our minds.

COMPUTERS AND INFORMATION PROCESSING: IMPACT ON BUSINESS MANAGEMENT AND BUSINESS EDUCATION

GEORGE KOZMETSKY*

Technology as a Societal Driver

Science and technology are altering the very nature of our society. Today's environment for change is fundamentally different from even two decades ago. The process of change has been dramatically accelerated. Solutions to critical issues and problems now demand an integrated, holistic approach that blends technological, managerial, scientific, socioeconomic, cultural and political ramifications in an atmosphere of extreme time compression.

Computers are a good example of a fundamental scientific-technological integration explosion that is occurring today. The computer industry, which emerged in embryonic form in the 1950s and reached its infancy in the 1960s, has now become a mature industry. However, the scientific roots of the computer industry are still relatively young and immature. These roots are no longer embedded only in the science of solid state physics or computer sciences. A whole range of newer scientific and technological advances are having an impact on computers and information processing. This is a transformation process. It is characterized more as information technology than information processing.

What do I mean by information technology? It has four essential components:

1. *Information technology is a body of knowledge.* It involves the collection, measurement, storage, manipulation, transmission and use of data and information.
2. *Information technology includes the hardware for information generation, flow, organization and use.* This includes computers, televisions, VCRs, satellites and telecommunications.
3. *Information technology includes software.* This involves computer software programs as well as substantive and methodological theories.

*The author wishes to acknowledge the assistance of Dr. Raymond Smilor, assistant director of the Institute for Constructive Capitalism, University of Texas, Austin.

4. *Information technology includes behavioral, organizational, and social policies and practices.* This involves group processes, social dynamics, new institutional arrangements between public/private/academic sectors, planning and foresight capabilities, decision and accountability methods, and system design.

Each of these components is multiscientifically based; each is undergoing its own metamorphosis. Integrating the eclectic branches of science and then converting them into technological resources has thrust us into a scientific-technological-knowledge integration explosion. This phenomenon is far more significant and complex than popularizers (and simplifiers) of the information age or the post-industrial society would like us to think.

In this environment of continuous time compression and scientific-technological-knowledge integration explosion, it is well to recall the remarks of the famous philosopher Alfred North Whitehead,

> that the role of progress is such that individual human beings of ordinary length of life will be called upon to face novel situations which find no parallel in their past. The fixed person, for the fixed duties who in older societies was such a godsend, in the future will be a public danger.

Lewis M. Branscomb, vice-president and chief scientist of IBM, has pointed to the critical managerial issue associated with non-parallel, novel situations:

> Indeed — since computer applications are designed to serve human needs — one must frequently depend more on humanistic experience and common sense than on science to determine how a computer system should be arranged.

The principles as enunciated by Whitehead and Branscomb have meaningful implications for each of us. They also have impacts beyond the computer and information processing industries and beyond our academic institutions.

The scientific-technological-knowledge integration explosion imposes a new set of demands. The demands that the last two decades of the 20th century will impose on our societies and their institutions are the increasing development of people for nonroutine tasks. We are seeing the rise of emerging technological industries, which are concerned with "nonroutine" kinds of problems that require a new order of solution. These emerging and expanding industries include space commerce, macroengineering, control of environment, water and air pollution, transportation, health care, waste management, biotechnology, computers and communications, and robotics.

These and other areas provide the bases for expanding nonroutine industries. They also pose a number of key challenges to business management:

1. What will be the 21st-century industries in the United States? How will their development be financed? What will be their markets?
2. Leisure as an industry is not only in its infancy but is not yet clearly delineated. During the transition to the 21st century, there will be four types to satisfy the following groups: first, the unemployed (waiting between jobs); second, the low-salaried employees working short hours; third, the higher-salaried groups working short hours; and fourth, the professionals (including scientists, statesmen, managers, etc.) working long hours and having limited leisure in sporadic bursts.
3. How will society create and allocate wealth?
4. How will new forms of organizations change institutions to fit societal as well as individual needs in a stable, sustainable society?

Communication and information technologies particularly are having an impact on nonroutine businesses, revitalizing basic industries, as well as economic and academic activities:

1. They are technically based, and their products have a relatively high proportion of technical and professional labor in the final product.
2. There is a continuous shift of the high technical content within the activity from the final product to its tooling or processing.
3. The number of final units is not large; in fact, it can range from "one of a kind" to what would be generally recognized as a "short production" run.
4. The problems and processes involved can be typified as "messy." That is, there are no single, clear-cut solutions including scientific and engineering principles. Often, so-to-speak solutions must be "invented" on the spot.
5. The nonroutine activities thereby utilize large quantities of intellectual capacities; *e.g.*, people ranging from semi-trained technicians and laborers to noted scientists — social as well as physical.
6. The management of these nonroutine activities often requires the full coordination of government, universities and industry. However, it is generally recognized that industry has a major

role to play in the economic commercialization of these technological advances.

7. Finally, the ability and capacity of our management of these technological and intellectual resources will determine to a large measure whether our nation will continue to increase its advantages in an emerging global economy.

From a managerial perspective, there are two underlying requirements to all these "nonroutine" pursuits. First, they demand large quanta of technical and intellectual resources such as individual scientists — social and physical — engineers and other professionals, as well as service personnel and technicians as aides to the professionals. Second, they require relevant and up-to-date knowledge necessary for the solution of the nonroutine problems. Of course, the key requirement is managers with the ability to identify and formulate the problems for solution. In other words, we need a new breed of creative and innovative managers.

This need arises from the internal and external institutional factors. Internally, the major forces for change are the shrinking of middle management and the microgeneration of computing and information technologies that are altering the factory, the office, the professional workplace, and even the boardroom. Currently, much of the hardware exists for the office and factory of the future, teleconferencing, local area networks, broad-band networking (both satellite and microwave), and remote management systems with computerized networks. In addition, software is available and expanding rapidly for decision support systems, professional and home computers, data service systems, and simulations. Large-scale supercomputers are now on the market and capable of handling vast accumulations of data at an incredible speed.

Equally important, the computer and information technology industries keep introducing new technologies so rapidly that they continue to increase the amount of processing 25 percent a year at constant cost. As a result, those who take heed of Whitehead's cogent observation as computer users will have to enhance their own productivity at least 40 percent a year. At that rate, 10 years from now the U.S. computer capability will be 20 times what it is today.

Management decision making has traditionally centered on efficiency and effectiveness. Innovative management decision making under rapid technological changes must rely more on flexibility and adaptability.

Externally, the forces for transformation are our educational system and the burgeoning industrial infrastructure for governmental policies and regulations. Managers of all our institutions are facing pressures resulting from changes in American ideology, demographics, public attitudes, concerns and life-styles, as well as demands imposed by the utilization of economic wealth and national resources, political philosophies, international trade barriers, and the rapid escalation of new clusters of technologies for the 1980s and 1990s.

To understand these forces more fully, we need a set of integrated, external computerized data, information, and knowledge bases. These bases must not only accumulate information for alternative generation and decision making but also synthesize it for use. Few business firms can afford to do this on their own. Consequently, they must look to developing new institutional arrangements that facilitate the acquisition and implementation of information.

The consequences from this myriad of interlinking forces are real and extend to more than economic growth or stagnation. Indeed, the consequences may well determine the future form of our society, the shifting socioeconomic makeup of our regions, the changing loci of American leadership, and emerging interinstitutional networks.

The simpler distinctions between owner or entrepreneur and professional manager or venture manager have to a large extent disappeared in the past decade. Managerial functions have been altered and extended by newer and more complex organizational structures, governmental regulations and relations, changes in generally accepted ethics and morals, and advances in technology. In other words, our society and economic infrastructure have changed dramatically, resulting in a very wide gap between the management knowledge base and the practice of management. To deal with these changes and narrow the gap, we must explore the new frontier for creative and innovative management in the 1980s and beyond.

Dilemmas Facing Education

At this point, we can look more closely at some major issues facing business education. First, our educational administrators are truly managers of our society's intellectual resources. These intellectual resources consist of the students, who are in inelastic supply, and the teachers, who will be in scarcer supply.

Second, it is appropriate to examine in some detail the use of computers in business education. I have discovered two concepts which are applicable to computer designers as well as to business educators. The first is that both are equally reluctant to use the principles or techniques which they develop. For example, computer designers, as a class, do not like to use computers to design new computers. Nor do educators generally apply the principles of management they teach to their own problems. The second is that both professions are reluctant to predict the future. Computer designers and educators feel that they do not want to be put in the position to make long-range predictions, for they may be held to it.

In industry, one quickly learns that a manager has no excuse not to try to predict the future. In fact, the reward system is such that it attaches heavy penalties for errors or omissions; conversely, the rewards for partial success are high. One cannot start to build a major new company within a five- to ten-year period in the United States without trying to predict the future. Indeed, one cannot enter into the electronic computer industry by extending a current operation or beginning a new enterprise without trying to predict the future.

No manager will give up his current noncomputerized or semi-computerized formal and informal management system for an untried "quantum jump" of an integrated management information system or "system" management on the computer. On the other hand, I do believe that providing the principles, methods and technologies — as well as the required training for those items which make these concepts relevant — is a proper function of the schools of business. In other words, I believe that the schools of business, if they are to provide leadership for our business communities, must undertake to fulfill these tasks of evolving the future managers for business, including computerized management.

The need to understand the role of the manager in organic systems has provided much of the impetus to perform advanced research in business education. Accomplishments to date have been significant. Advanced quantitative techniques which are applicable to management decision making rely on the aid of digital computers. Management sciences, with the aid of computers, have solved such problems as determining the location of warehouses or plants, scheduling production and inventories, selecting stocks and bonds for investment portfolios, determining the best advertising media for a product, estimating acceptance of new products prior to their distribution, and monitoring and controlling operations of a complex and continuous production system. Recent thinking, however, indicates that the piecemeal application of management sciences to separate aspects of industrial problems is not enough.

One of the major thrusts for looking at organic wholes came from the application of computers to the development of integrated total management information systems. Other current research indicates that even more is required in terms of looking at the problem as an organic whole. By development of computerized total data, information and knowledge systems, the interfaces between human decision making with machines, market requirements, technical confidence in new product development and their successful introduction for a world market becomes evident. In addition, concepts and methods need to be developed that will enable the procedures to be formed for the establishment of overall company policy goals and subgoals. Advanced techniques of an analytical nature are required before it is possible to minimize the usual corporate drives which operate through techniques of compromise, conflict, and occasional cooperation.

There is work going on in the research laboratory for new methodology on the conceptual level and on computer models, as well as various display devices. This is one of the reasons why schools of business can play such an important role in the development of computer applications in business. There is a need for stating requirements of top management so that they can be executed in meaningful devices that meet the flexible needs of executives.

Research on how to present meaningful management action reports is also required. One cannot help but speculate that some of the action reports should be given directly to other machines by the computers, while others come to management attention. To the best of my knowledge, there is still no truly cross-disciplinary research group for display of information to top management. Schools of business, colleges of engineering, psychology departments and mathematics departments can help to do basic research in this area. In fact, such cross-disciplinary exchange is a requirement if colleges of business are to extend their training of management for the future through computers. However, time-sharing for faculty member research is one thing; time-sharing for class purposes is another.

For the next decade, we will be involved with solutions and their implementation on many important issues that face the managements of our for-profit as well as not-for-profit institutions. Computer and information technology will have a definite impact on managerial decision-making processes. How much will depend on how well the linkages are structured among those who formulate the decision problems for solution, those who model the problems for specified telecommunication systems, those managers who make the decisions, and finally those who assess the accountability of the managers/ decision makers. These linkages were not required before; but their significance is really made visible and possible if we are to understand and be prepared to adapt new concepts that present and future technologies have made and will make possible.

The role of business education is to prepare a newer breed of creative and innovative managers so that they understand and have the knowledge of how to build and apply these computerized models. Our nation is currently in the midst of a management gap as well as an educational gap. Industry, especially the technically based, has developed managers only through limited experience. Their numbers are still too small to be effective in extending our nation's industrial leadership or continuing the rate of growth our companies require. The schools of business are lagging behind industry in this respect. They have yet to place on their faculties enough scientists, engineers, life scientists, etc., that are found in fair-sized projects in the technically based industries. While it is true there is much talk and excitement on our campuses about cross-disciplinary education, there is not enough being done. Even when there is such cross-disciplinary education, we have found that the computer may actually be a bottleneck. A central computer facility for teaching and research becomes quickly overscheduled, and delays extend for days, if not weeks. Waiting for computer runs is not conducive to such cross-disciplinary research and teaching. More recently, we have found that the use of a single class of computers can actually be a bottleneck for business research. We need several types of large-scale computers dedicated specifically to business research. We need to incorporate both data processing computers and supercomputer technology. Our research issues are large-scale interrelationships of emerging problems. Their usage of the resultant business research can be used by small, medium or large companies.

Management of technical industries and educators of management for all industries, however, cannot continue to wait for required breakthroughs or new curricula. Let me explain why I believe both managers and educators will need to use computers to expand their abilities and will need to rely on expanding their conceptual abilities through the use of computers to process large amounts of information for their strategic and tactical decision making. The requirement for such an evolutionary step comes from the rate of technological growth and the resultant scientific-technological integration explosion. As our technology advance continues to increase exponentially, so does our body of knowledge.

The diffusion of technology by computers will be an extension of present day data banks and retrieval systems. The use of computers for diffusion of technology will be a step-by-step development. Transfers of technical information will first be done by getting people together from different disciplines and professions to mutually discuss their needs and thereby transmit their research and development results. In other words, it will at first be a "mood" operation rather than a "computer mode" operation, and computers will maintain cognizance of each individual's area of interest in research and development in medicine, nuclear energy, defense, space chemistry, and so on. Cross-indexing of technical interests at detail levels is not a difficult task. A next step could be one in which information is extracted in an orderly fashion by technically trained personnel and filed in computers that are accessible to research and development experts, top management and educators, through time-shared computers. Another step would be to establish orderly informational systems for selected areas of technology so that there are acceptable hierarchies of information files that minimize extraction, communication and filing time.

At this point, it is appropriate to emphasize the importance of the economic and technological considerations in educating for the full development of each individual's abilities. How do we evolve the education of individuals for both the mass production, repetitive industries, and the technological, nonroutine problem industries? How de we bring the resources of our business and educational institutions into full, effective use so that each person's capabilities are fully utilized?

We must organize research programs for increasing our teaching effectiveness. Teaching machines and other material technologies provide only one means of doing this. Evolving social systems of permitting each person to develop at his own capacity may require provision of a large number of decentralized knowledge bases. It may even change our methods of grading and evaluating. The requirements are clear. Policies are fairly easy to enumerate. The implementation is not beyond our abilities, nor must the future of business management and business education be projected from the present lines of development. In many respects, a simple extrapolation of today's developments would lead to agony. On the other hand, the future must be imagined — and therein lies the ecstasy.

THE IMPACT OF COMPUTERS ON SOCIETY

BERNARD H. LIST

I am happy to have this opportunity to discuss the impact of computers on society with the Philosophical Society of Texas. We have already heard excellent discussions on computers and information processing and the impact of computers on business, business education and higher education. Admiral Inman has given us an informative talk on the Microelectronics and Computer Technology Corporation (MCC). Each of the previous subjects is of vital importance to all of us; whether we be in business or education, the impact of the computer will be very great.

However, I believe that the impact of the computer on society as a whole will be in orders of magnitude more significant since this impact will ultimately pervade all of society. In order to make this belief creditable, I want to review briefly the history of the development of the computer and then project where the evolution of the computer is likely to lead in the next decade.

First, let me set a time perspective. The electronic computer as we know it today is only 38 years old. The basic architecture of the computer was conceived in 1945 by Dr. John Von Neumann and consisted of placing the machine data and the instructions in the same memory. This is known as the stored program concept and is taken for granted today. However, this approach made possible the fast, powerful computers that we are all aware of. It meant that the computer could operate on input data based on the instructions stored within its own memory, limited only by the capability of the human to write the instructions the first time that they were needed. Today, we call the stored program approach "software."

On the hardware side, the electronic computer also dates to the mid-forties. In 1946 the ENIAC computer was placed in operation to do shell trajection calculations for the Army. It was built using vacuum tubes that consumed a very large amount of power and space and which had a much lower reliability than the solid-state devices used today. There would be no widespread application of computers today if we had been limited to the use of vacuum tubes.

What made today's modern, high-speed computers possible was the invention of the transistor by Bell Telephone Laboratories in 1948. The very small size, the low power consumption, and the computational speed made possible by the transistor (and its subsequent evolution to integrated circuits and large-scale integrated circuits) are the reasons we have modern computers. As we look back, we see that in a three-year span (1945-1948) the three key technologies became available — software, hardware and the solid-state technology with which to build the computer.

In order to illustrate the magnitude of the impact of the transistor, I would like to compare a commercial vacuum tube computer of the mid-fifties and an advanced scientific calculator of the late seventies. Table I shows the comparison.

TABLE I

	COMMERCIAL VACUUM TUBE COMPUTER (mid-fifties)	ADVANCED SCIENTIFIC CALCULATOR (late seventies)
COMPONENTS	2,000 vacuum tubes	166,500 transistors on single chip
POWER (watts)	17,700	0.18
VOLUME (cu. ft.)	270	0.017
WEIGHT (lbs.)	5,650	0.67
AIR CONDITIONING	5-10 tons	none
OPERATION	stored program magnetic drum 2,000 words	stored program solid-state memory 5,000 words
EXCEPTION TIME (milliseconds, add)	0.75	0.07
PRICE	\$200,000 (1955 dollars)	\$299.95 (1977 dollars)
	≈ \$800,000 (1983 dollars)	≈ \$150.00 (1983 dollars)

This comparison shows the dramatic reduction in size, weight and power consumption for two computers capable of doing essentially the same kinds of computation.

The advances made in semiconductor technology are in themselves amazing. In 1960 we could put the equivalent of one vacuum tube and its associated circuitry on a single chip of silicon. The cost of that single chip was approximately \$10. Today, we put 100,000 equivalent vacuum tube circuits on a single chip of silicon, and the cost of the chip is less than \$5. The cost of one equivalent vacuum tube circuit is .005 of a cent, compared to $10 in 1960. Put another way, one can get 200 equivalent vacuum tube circuits for one cent. Along with the reduction in size and cost have come orders of magnitude improvement in speed of operation. In the mid-fifties, a computer memory could handle .01 bits of information per microsecond. This is equal to 10,000 bits per second. Today's solid-state memory processes over 400,000 bits per microsecond, or 400 billion bits per second.

Solid-state memory is the key element that gives modern computers their computing power speed and application flexibility. Today the 64K dynamic RAM (random access memory) is the memory used in most computers. We have evolved from the 1K RAM in the early 1970s through the 4K RAM and the 16K RAM to the 64K RAM today. Semiconductor companies are already sampling the 256K RAM, and the 1 MEGABIT RAM will be the workhorse of the late 1980s. This means that the professional computer you use in your home or office will have over 15 times the memory available in the same size and for approximately the same cost in the late 1980s as you have today.

With this background and perspective of the evolution of the computer, I would now like to turn to a discussion of the impact of computers on society.

The computer that will impact society in the next decade is what today we call the professional computer or the personal computer. This type of computer belongs to someone either in the home or at the workplace. It is the natural successor to the slide rule and the electronic calculator. I believe that this feature of "ownership" of a computer is a very important one. In the early generation computer days, the computer was in a central location and was operated by computer professionals. The user took his data in the form of punch cards to the computer center to have it processed. Some days later he went back to the computer center and got his answers in the form of a computer printout. It was all very impersonal, and the user could not relate very well to what was happening to his data.

The next step occurred in the seventies. The user had at his workplace a terminal which was hooked to the central computer. The user could input his data and his problem and get the results back in near-real time. This was a step forward, but it was still impersonal.

Now with a computer of his own, the user is in complete control of his use of the computer. He can enter software programs to do, for example, filing, financial analysis, or circuit design. He can enter his data, he can do what-if's on his problem — all on his own. I believe that this will eventually lead to a much greater use of computers by individuals to do more things than has occurred up until now. It is much like the case with calculators. When calculators were mechanical and cost several thousand dollars each, they were in the hands of the accountants and the high-level managers. Today, when handheld calculators cost from $10 to $50, they are in the hands of anyone who needs them. What is more important, they are being used to solve problems that were never tackled by individuals before, such as statistical quality control, amortization calculations, and other similarly complex problems.

The pervasion of computers throughout society will not come overnight. We must remember that the personal or professional computer is only five years old. It took approximately 20 years — from the mid-forties to the mid-sixties — for the use of the mainframe central computer to become really pervasive. A whole generation of people had to learn how to use these machines before they became truly productive in the use of computers.

I believe that it may take only five to ten years before the professional and personal computers achieve an even greater level of usefulness across all of society. There is much more available software than there was in the early days of the mainframe computers. Large numbers of students in universities and in primary and secondary schools are becoming computer literate. Finally, computers are becoming easier to use and more user friendly.

I believe that the principal impact of computers on society will be in the area of education. I will address this impact after discussing briefly some of the impacts that computers are already having.

In addition to personal and professional computers, which we are all familiar with, there is another kind of computer that many people are not aware of and never see. It is safe to bet that each of you in the audience today has from five to ten of these computers in your home or automobile right now. This computer is called a single-chip microcomputer. The single-chip microcomputer is a complete computer constructed on a square single chip of silicon approximately one-quarter of an inch on the side. It has a full arithmetic unit, read-only memory, random access memory, control circuits, and input-output circuits. A microcomputer with all of this capability, including a 1K memory, sells for approximately $1 in large quantities.

These computers are in your digital controlled microwave oven, dishwasher, washer and dryer. They are used in your automobile to control your engine and perform the scanning function in your car radio. They are the basic element of handheld games. The same computer controls the gas pump when you pump gas. They are in your smart telephone and in your doorbell (if it plays 24 different tunes). They are also in your videotape recorder, your electronically tuned TV set and your clock radio. They may be in your home security system. They are also in your handheld calculator and may be in your digital watch. The point is that these small inexpensive single-chip microcomputers have already had an impact on society without most of us knowing about the technical details. There are many hundreds of millions of these single-chip microcomputers in use today.

However, as significant as the impact of the single-chip microcomputer has been, I still believe that the use of the personal or professional in education will be the area of largest impact on society in the future. All of the hardware has been invented to make possible the development of computer-aided instruction (CAI) courses. This hardware includes the computer itself and the random access video disk which can store vast quantities of video or other information on a single disk. There are CAI courses available in the marketplace. However, we have not yet learned how to use this technology most effectively.

Equipment manufacturers, educators and software development people are learning how to use this new technology to produce more effective courses. This will lead to the availability of inexpensive courses that can teach college-level courses, equipment maintenance courses, "how-to" courses, and courses for use in the primary and secondary school systems. One of the attractive features of CAI courses is that the person taking the course can study at a time and pace convenient to him or her. There is the feature of reviewing the material as much as is required (instant replay), and there are self-testing features that insure that a student has learned each segment of the course before proceeding to the next section.

The availability of the random access video disk is what makes CAI so powerful in education. The video disk makes it possible to store photographs, drawings, maps and other visual images that can be called up almost instantaneously in any desired order. The video disk is thus better than the videotape for CAI since the access time on tape can be up to several minutes.

The instructor who is preparing a CAI program has the resources of the computer, a very large memory and an extremely large amount of video material. Thus, if the instructor is developing a physics course, he or she can use the text to teach or use the video material to simulate a laboratory. For example, if the material being taught related to coupled masses and springs with friction, the text could provide the basic information for developing the formulations for motion, velocity, etc. The computer could be programmed to solve the equations as the student varied the parameters. Finally, the video could display the system just as would be done in a laboratory experiment. This makes possible a very dynamic way of teaching physics or any similar course.

In the primary and secondary schools, courses could be developed to match the pace of the different students in a single class. Well-prepared courses should have much of the motivation for the student to learn that a video game has. Thus, CAI at the primary and secondary level would make it possible for the teacher to be more effective in instructing all of the students.

Finally, CAI will impact us as individuals. How often have we said to ourselves, "I really would like to take a history course or an economics course or a dressmaking course." If it were possible to check such a course out of the public library or rent it at a nominal price, many more of us would likely take such a course at our own paces.

The impact of the computer on society has already begun. However, we have not yet seen the positive benefits from the availability of still smaller computers with much more memory and much better software. Personal and professional computers are already capable of recognizing and synthesizing speech. Before long, we will talk to our computers to give them instructions, and they will talk to us with information we need to proceed. I believe that the next 10 to 20 years are going to be very exciting as we continue to apply computers more to our daily problems.

PERSONAL COMPUTERS AND YOU

JOSEPH G. DEKEN

There are two important characteristics of this audience which I will rely upon in attempting to make germane remarks about "personal computers and you." These two essential traits, which bring into focus the audience (the "you" in my title), are leadership and intellect. My comments will be directed to you as leaders; I will further suppose that you expect as intellectuals to hear more about personal computing than the myriad pragmatic "how's" and "how-to's" of high technology survival. I am encouraged, by the name of your Society and the roll of its members, that my direction is apt.

Beyond all the clamor about personal computers as a technological watershed, they also mark, I believe, the first glimmerings of a true intellectual revolution. Let us address that revolution here as directly as we can. It would be brash to propose an array of definitive answers; I hope rather to find some key issues, raise productive questions, and encourage you to put your own intellects and values to work. We have before us all the challenge, promise and peril of a new human frontier.

Personal Computing Is Changing the Way We Live

Computers and computer advertising seem to be everywhere today. Even if the publicity does not make it clear what people actually do with computers, the message comes across that we all need at least one. Why? Who needs computers? Ten years ago, the answer to that question might have been, "Scientists, engineers, and large organizations of all sorts." Only for these types of people, with easily "mechanized" or highly valuable individual applications, would the substantial cost and more substantial inconvenience of dealing with computers be well justified.

In 10 years though, we have passed through a historic discontinuity. Certainly, computers were not in the dark ages 10 years ago: a "personal" computer system with enough power to do a bit of small-scale scientific computing, including some graphics, was available to all takers who had a few footlockers worth of space, and $10,000 cash or good credit. But nowadays you can buy a better system than that for a few hundred dollars, and walk out of the store with it under your arm. Computers powerful enough to be more than toys or ping-pong video games are now plentiful and cheap. In the next 10 years, their advance in power and collapse in price will continue.

The bottom line of the performance/price explosion is that hundreds of millions of people could now well-afford to buy personal computers, if someone could manage to make the little chippers useful. And in fact we are all unobtrusively beginning to buy computers already, in the form of microprocessors hidden in our gadgets — from microwave ovens to washing machines and automobiles. If you pick up the telephone within the next five years, you will probably be using a computer. And if only at the level of high-tech ambience and functional capabilities, computers are undeniably changing the way we live, as significantly as did the telephone or television technology — which computers are now remaking from within.

The computer as an affordable and powerful electronic servant is remarkable enough. The true revolution though, lies much deeper. The roles which the computer plays as an efficient automobile control center or an electronic bank clerk are purely functional. Beneath these roles, the power and potential of the computer is not as a functionary, but as an instrument. What a computer fundamentally represents (and the electronic ship-in-a-bottle types we have now are only a beginning) is a powerful symbol transformation engine — an unprecedented instrument for thought and expression. In learning to manipulate this new "pen" to generate and create with new kinds of symbols, the computer's automatic transformation capabilities will allow us to interact with our thoughts and our multiply expressed "language" as never before possible. Computers will change the way we think.

Historic Revolutions

The computer embodies the fusion of two epochal human technologies: the pen and the engine. For those here who may be justifiably skeptical that computer-as-gadget actually represents computer-as-mindtool, it would be worthwhile to recall the inauspicious roots of writing itself. Quite probably, the historic dents in clay which rendered the human race newly literate a few thousand years ago represented nothing more intellectual than an obvious clerical short-cut: Why not make and exchange (subsequently impressing in a mud packet) miniature clay cows, rather than have to follow around the real thing being traded on the hoof? And unlike the ancient farmeraccountant who invented writing without an inkling of sonnets or general relativity, we might at least acknowledge history in looking beyond our present key-pressing and tube-squinting symbol processors. We ought then to see, however dimly, the intellectual frontiers toward which they are launching us.

The pen and the engine combined, we are taking our first halting steps with literally "powerful language." Expressed in and supported by the medium of computers, our language now has the power to take action directly, whether timing spark plugs, extracting visual information from the movement of a dancer, or making a graphic analysis and comparison of the music of Mozart and Ives. The quaint keyboards and straitjacket syntax of today's computers are as ephemeral as the wedged stylus. Now that it is intrinsically empowered, our new form of language grows ever more fertile in its internal evolution and more accessible to our human senses of sight, sound and touch.

The Computer as an Active Medium

There is as yet no word in our language to describe the synthesis of pen and engine. I have proposed elsewhere that the term "actoracy" be used to describe skill with power-language, since it is built around the notion of an "actor" in the same way that "literacy" is built around the old, dead concept of a letter. But fortunately there is also an existing word which captures much of the essence of modern personal computing: the computer is a "medium," in all the dimensions that single rich word conveys:

A Communications Medium: Perhaps the most common use of the word "medium" is to denote the mass media such as radio and television. In this sense (as a transmission medium) the computer offers unprecedented versatility. Our present electronic display devices are undeniably limited; our information distribution schemes are only embryonic. But they are rapidly developing. (In a matter of months, one may easily receive packet personal computer radio broadcasts in Boston, or videotext nationally.) Personal computer networks will join us to our intellectual "neighbors" everywhere. Information and language are beginning to flow like lightning, able to reappear in myriad compelling forms. The computer transmission medium is a broad bridge to join any willing pair of human minds. Even now, the language of fields from chromatography to choreography is intertwining with the supporting computer medium, just as the score for a symphony intertwines with the orchestra. Whether the partners are scientists or set designers, language in the computer medium enables the recipient to "play" what the sender conceives and composes.

A Modeling Medium: Like the artist's colors or the sculptor's clay, the computer also represents a medium in which concepts can be translated into sensible, compelling reality. An aircraft can be modeled in the computer, to be electronically flown and redesigned a thousand times before it is physically manufactured. A composer can hear musical effects instantly as the score is written, even designing and auditioning new instruments to add to the ensemble. And unlike the words of the poet or the paint of the artist, the computer medium is infinitely malleable, restorable and cooperative, marshalled more like a skilled troupe of actors than a mass of pigments or letterforms.

A Nutrient Medium: In the supportive environment which powerful, graphic, and responsive personal computing provides, new ideas and new approaches can flourish like biological life forms in a sustaining ecology. Seymour Papert, a pioneer in teaching even young children to launch powerful ideas within this nutrient medium, speaks of his computer worlds as "environments for learning" and "incubators for knowledge." It is widely recognized by computer scientists that once "tools" are built within a supportive interactive environment, the tools' effects multiply and propagate exponentially through all subsequent efforts. The medium is fertile. We are initiating in it an intellectual recombinant genetics.

Personal Computing Is in its Infancy

The potential dimensions of the personal computing medium are fascinating to imagine and productive to explore. As practical persons though, it is important for us to look critically at what our present personal computers actually are, as well as what they could be and what their successors will become. The "misplaced future" is an insidious computer trap, as well as an excellent sales gambit. (At least one newspaper I know of declared a premature war on internal paper. The available electronic substitute, an early word processor, produced only peephole views of a story on the screen, and both the writers and the readers earnestly regretted the demise of yellow pads.)

Yellow tablets or other familiar tools are minimal benchmarks that new computer capabilities must comfortably exceed. And if our expectations are at all high beyond the status quo, we must judge the present generation of personal machines to be painfully primitive. That judgment ought to soften the impact of clamoring voices insisting on all sides that everyone should "buy a computer" and become immediately "computer literate" (whatever that is). Presently available computers are so primitive that many people will not be able to use them effectively or overlook their restrictions to appreciate the medium's creative potential. For such people, it may be far wiser not to take the plunge now, but to wait for the right computer, even if that computer only falls within their resources many years hence. Otherwise, they may have nothing more than years of false impressions, bad habits and negative reactions to overcome later on. (By the time the right computer is available, they may be long out of patience.)

If such wait-and-see diffidence seems negative, it should be said that it represents only one perspective, valid for many people but certainly not all. Equally valid for many others would be a "modern" attitude: New generations of technology are emerging ever more rapidly. As never before, today's leaders and today's intellectuals are those who are capable (by educating themselves as necessary) of dealing with novel situations. From that perspective, it is sound advice to plunge into personal computing now. But if you do, you must not expect to build up knowledge like static capital in a bank account. Your challenge will be to assimilate new ideas and to avoid constructing concrete stereotypes or inflexible expectations. Use the computer now, despite its limitations, as a communications, modeling, and nutrient medium. The lesson to be learned is the modern one, not "What to Know" but "How to Learn and Create."

There is much that can be learned, even with our present level of computers. Word processing programs are the beginning of creativity in effective communication. How many drafts will you write, if "retyping" is virtually painless? How will you look at and evaluate your own communication? Many systems now integrate both text and pictures. How much help will you need from the computer, before you break the image barrier and compose your own "illuminated" manuscripts? Similarly, the spreadsheet programs and sophisticated games on the shelf today can take you far beyond pragmatics or pastimes into the firsthand experience of interactive computer modeling. Communications software is now practical: if nothing else, your inexpensive computer may link you with a nationwide network of people who share your interests.

Mental Roadblocks and Hidden Assumptions

Whenever the "right" time occurs, and you choose to take charge of your own personal computing, you may be sure that some restrictions, restraints and challenges to your patience will remain to be overcome. Other more serious roadblocks spring up not from computer technology, but from human psychology.

Technological hubris, for example, is a rampant roadblock which undoubtedly will survive through generations of people and machines. Despite the salesperson's condescension, your ignorance of silicon microstructure or magnetic minutiae may be both sensible and healthy. Despite any bureaucrat's insistence, systems which do not work for people discredit the systems, not the people. Despite all its intimidating forms, technological hubris is a clear signal that technology needs to be put back into its place, as only the servant of human values.

Hobbyism is another recurring hurdle. It was less than 15 years ago that one would not speak seriously of a microcomputer without a soldering iron within reach. The residue remains, when computer neophytes join a local user's group only to be deluged with jargon, clock cycles and passionate esoterica. As the electrical engineers fade, the word processors or the religious fanatics for any one of 20 different computer languages rush in to make a caucus and fill the hobbyist void. Whichever limited intellectual viewpoint has currently "discovered" computing may easily convey the impression that the world goes no farther than their vision. If your hobby is the same as theirs, you are in luck. If not, you must break your own path, or wait for the medium's inherent fertility — a thousand flowers will bloom.

Other roadblocks are well established in our institutions. Until this powerful technology provided us with the capability to race rather than plod, they might have even been tolerable. Our educational institutions are largely built upon factology, the disconnected accretion of facts, formulas and recipes. That tired inventory is not only so well produced by computers as to be virtually unmarketable, it is of no human use in managing our new intellectual climate of novelty and innovation. In a flood tide of intellectual challenge, we need to learn swimming, while our "educators" are still trying to tell us where to stand.

Compounded with factology is a consequently parasitic view of "consumers," and particularly those educational consumers called students. Teachers and students by the hundred thousand pore over unproductive "exercises" which are all destined, excellent or ignominious, to become simple trash. At the same time, educational environments make little or trivial use of the computer's potential, for the lack of "educational software." Why is it so rare that the student intellectual effort now producing scrap paper is harnessed to produce software? Why is it unthinkable that students from elementary school onward (and long before graduating into traditional fundraising-fodder) should not only largely teach themselves but also "endow" their institutions, human teachers and fellow learners with priceless practical intellectual tools and environments?

Avenues for Thought

Power-language, "actoracy," and the computer as an active medium are challenging concepts. In order to begin to build with them, we will all in time construct a repertoire of new metaphors to match our diversity of new machines. A provocative metaphor is an avenue for thought, even if it is eventually outgrown or otherwise discarded. In that vein, I will close with some tentative images. It is time to stop thinking of computers either as omnipotent black boxes or esoteric, ship-in-a-bottle, programming brainteasers. Alan Kay has suggested that the ideal computer is a "dynabook," with the size, accessibility and familiarity of a traditional pocketbook. Like a good book or movie, but in an unparalleled interactive way, a good computer system should take us somewhere. As Papert envisions it, that world is an environment for learning.

Another metaphor which has been best expressed perhaps by Carl Hewitt is to conceive of (and actually implement) computer systems as ensembles of ACTORS. (I prefer to imagine armies of leprechauns — it keeps the proper subhuman scale and implies the potential for mischief if unattended.) Such a system operates by means of messages passed between the interacting leprechauns and the human director. The individual actors may be quite conversational, knowledgeable and amusing, and will work together well as a system, if carefully instructed. At first, their language may seem to have peculiar quirks, but after some practice it hardly intrudes. The personal leprechaun army scurries about with speed and skill, largely beneath the surface, to implement the personal computer medium. That medium, as we personalize it to suit our own interests and values, supports an unprecedented platform for human communications, creative construction, and intellectual growth.

N E C R O L O G Y

ALBERT PERLEY BROGAN

1889 - 1983

ALBERT PERLEY BROGAN, DISTINGUISHED PROFESSOR OF PHILOSOPHY for nearly 50 years and dean of the Graduate School of the University of Texas for 23 years, was born July 22, 1889, in Omaha, Nebraska. His parents were Francis Albert and Maude Haskell [Perley] Brogan. His father was an attorney, and it was in his father's fine library that he became an avid reader. In fact, his bookishness led his father to buy an acreage outside Omaha where he saw to it that Albert learned to care for the land and the animals on it.

He attended the University of Nebraska from 1907 to 1909 and entered Harvard in 1909, where he received the B.A. in 1911, with a major in literature; the A.M. in 1912; and the Ph.D. in 1914. His dissertation was on logical relations. The three areas of philosophy in which he developed an interest at Harvard — logic, value theory and ancient philosophy — were to remain the focus of his scholarly career. During his last semester at Harvard he was one of six students in a seminar on logical theory given by Bertrand Russell. It was Russell's first teaching visit to the U.S., and he brought to the class unpublished material from a then unknown philosopher, Ludwig Wittgenstein. One of Brogan's fellow students was T. S. Eliot.

Upon his graduation from Harvard he accepted a position as instructor in philosophy at the University of Texas, filling a position left by Sidney Edward Mezes, by then president of the University.

Brogan rapidly rose through the academic ranks: he became adjunct professor in 1917; associate professor in 1923; and professor in 1925. He served three times as chairman of the department — 1917-1920; 1927-1929; and 1931-1939. A history of the Philosophy Department at the University declares that "a history of his work and achievement for the 50 years he was active at the University is virtually a history of the Department since 1914." Except for a year as visiting professor at the University of Chicago in 1930-31, his entire career was spent at the University of Texas.

Between 1919 and 1933 he published several articles on value theory in major philosophical journals. His 1919 article in the *Journal of Philosophy,* "The Fundamental Value Universal," remains a classic work on the logic of value terms. He became president of the Western Division of the American Philosophical Association in 1932.

His entry into higher administration undoubtedly curtailed his scholarly work, and his long-planned book on value theory remained in draft. Nevertheless, many colleagues attributed important ideas to him, and in *A System of Ethics* (1950), E. T. Mitchell gave credit to Brogan's work and lamented that Brogan could not join him as a co-author. Even after his retirement, Brogan continued his interest in study and writing, and in the 1970s he published two more articles on Aristotle's modal logic.

Brogan's contributions as dean of the Graduate School from 1936 to 1959 constituted a permanent legacy to the University. Perhaps most notable was his creation of the University Research Institute in 1939. Designed to provide research funds to individual scholars outside the organized University research units — such as the Bureau of Economic Geology and the Bureau of Business Research, etc. — the Institute began with an initial budget of $25,000. Brogan insisted that support of research would bring more outstanding faculty members to Texas, hold them here, and as a consequence raise the University's ranking. Today, the University Research Institute continues to provide the most important source of funds for individual faculty research projects. Brogan's $25,000 has grown to $2 million.

Brogan introduced the Graduate Record Examination, a national achievement test, in 1943 as one means of screening applicants to the Graduate School. The test was made mandatory in 1957 and remains at UT and elsewhere in the country as one of the most widely accepted measures of potential for graduate study.

The interesting thing about Dean Brogan (we all remember him as "Dean Brogan") is that long ago he supported practices and policies that are standard today in many graduate schools — such as providing funds for sending faculty to professional meetings, giving close attention to promotion policies for faculty, and expanding library facilities and holdings. In a report for the 1941-43 biennium, he said, "It is widely agreed among American graduate schools that training in research must be the essential condition for anyone who wants a graduate degree. The Graduate School must be centered around training for research or it will be merely a continuation of undergraduate work."

Dean Brogan was appointed to the Development Board in 1954 and was instrumental in planning the University's retirement program. He was also responsible, in part, for the development of a modified service plan for faculty who wished to continue part-time teaching after age 70.

Besides membership in the American Philosophical Association, he was a fellow of the American Association for the Advancement of Science. He served as president of the Conference of Deans of Southern Graduate Schools in 1948 and president of the Association of Texas Graduate Schools in 1953. In 1949 he served as president of the Philosophical Society of Texas.

Dean Brogan died in San Antonio April 9, 1983.

—W.S.L.

GEORGE RUFUS BROWN

1898 - 1983

MORE THAN A YEAR AGO, TEXAS LOST ONE OF ITS ORIGINALS, A man who shaped his world and society in a way that serves as an enduring example to those of us sharing his passions for education, culture and business.

And when George Brown died January 22, 1983, in Houston, many of us lost a good friend.

Brown was a philanthropist and businessman. He was, of course, a guiding force in the growth of Brown & Root, Inc., from a small Central Texas road-building firm into one of the world's largest construction conglomerates. He was also co-founder, with his late brother, Herman, of the Brown Foundation, Inc., of Houston, in 1951. The foundation has played a crucial role in the histories of Southwestern University, Rice University and the Houston Museum of Fine Arts.

He was born May 12, 1898, in Belton, Texas, the son of a hardware merchant. Brown attended Rice and the University of Texas before graduating from the Colorado School of Mines. After returning to Texas, he joined the new contract firm founded by his brother, Herman, and Dan Root. The brothers built the company, which had its main office in Georgetown, into one of the world's largest construction enterprises. Brown's success as an engineer and businessman was matched by his devotion to higher education and the arts.

That devotion was demonstrated through selfless philanthropy. Brown's generosity with his time, ideas and resources achieved exactly the result he intended, by sparking others into action.

"I've tried to be a catalyst," he said once. "I don't think anyone can, per se, give away any money and have much influence on the welfare and betterment of mankind. But you can act like a catalyst and then you may have some influence on the betterment of mankind. That's what philanthropy is — trying to make a better world. Otherwise you're just wasting your time."

George Brown is survived by his wife, Alice Pratt Brown, of Houston; three daughters, Mrs. Maconda O'Connor of Houston, Mrs. Nancy Brown Negley of San Antonio, and Mrs. Isabell Wilson of Houston; two sisters, Mrs. Harry Austin, Sr. of Belton, and Mrs. J. L. Head of Temple; 14 grandchildren and seven great-grandchildren.

—E.C. AND R.B.S., JR.

SAMUEL WOOD GEISER

1890 - 1983

SAMUEL W. GEISER WAS BORN IN INDEPENDENCE, IOWA, ON June 11, 1890, and died in New Hartford, New York, on August 28, 1983. He was married to Bessie Adella Teeple, who died in 1973, and is survived by a son, David T. Geiser; a daughter, Phyllis Geiser Ashcraft; and four grandchildren.

He received the A.B. degree with a major in biology in 1914 and the A.M. degree in 1919 from Upper Iowa University. His Ph.D. in biology was awarded by Johns Hopkins University in 1922. In 1934 his *alma mater,* Upper Iowa University, bestowed upon him the honorary degree of Doctor of Science.

Before attaining his doctorate, Sam Geiser was instructor of biology and sociology at State High School in Moorhead, Minnesota, and professor of biology for two years each at Guilford College, North Carolina, and at Upper Iowa University. His first post-doctoral assignment was assistant professor of zoology at Washington University in St. Louis, a position he held from 1922 to

1924. During the summers of 1923 and 1924 he was an instructor in invertebrate biology at the Marine Biology Laboratory at Woods Hole.

Dr. Geiser joined the faculty of Southern Methodist University in 1924 as associate professor of biology and as chairperson of the department. His service to the University spanned 33 years, including 27 as chairman. From 1925 to 1926, Dr. Geiser taught courses in general biology, comparative anatomy of vertebrates, genetics and eugenics, vertebrate embryology, anatomy and physiology of mammals, general physiology and animal behavior. He participated in (and probably directed) a course dealing with current biological literature. In the classroom Geiser was a difficult taskmaster, and the students who came to class unprepared were often subjected to scathing tongue-lashings. On the other hand, no earnest student seeking help was ever turned away from his office.

Professor Geiser was an indefatigable worker with a monstrous curiosity; first, with his beloved isopods (those crustaceans commonly known as sow bugs, pill bugs), at least one species of which bears his name; and then with the history of science, particularly the old naturalists who had worked in the South and Southwest. His book, *Naturalists of the Frontier,* the first book published by the SMU Press (in 1937) was and still is widely read and used; and that book along with hundreds of published articles on other men and women of science brought him a well-earned reputation among historians of science.

As a result of the distinction earned in his field, Dr. Geiser was in 1946 elected a member of the Council of the History of Science Society and served as a representative of the southern states on that governing body for two years.

Sam Geiser was not narrowly trained in biology or, for that matter, in general. He was well read and remarkably current in all of the subfields of the biology of his time. He was well versed in classical literature and in languages as well and was able to read effectively Latin, Greek, German and French — and had some facility in several others. His memory for details was amazing; for example, the scientific names of organisms. As a matter of fact, these names were used almost to the exclusion of common names. The State Bird of Texas to him was *Mimus polyglottos,* never the mockingbird, and the State Flower, *Lupinus subcarnosus,* never bluebonnet.

Indeed, there is no doubt that Samuel Wood Geiser was one of those people whose work early on brought distinction to Southern

Methodist University and whose dedication to the University during the formative and difficult years provided the kind of leadership that served to guide not only the Department of Biology but the institution as a whole toward maturity.

Dr. Geiser was the last living member of that group of illustrious men who in 1936 restored the spirit and purposes of Mirabeau B. Lamar and his colleagues in the Republic of Texas, who founded our Society for the "collection and diffusion of knowledge" in Texas. Dr. Geiser and his creative scholarship was always an inspiration to those who serve these goals.

—W.M.T.

CHILTON O'BRIEN

1911 - 1983

CHILTON O'BRIEN WAS BORN JANUARY 3, 1911, AND WAS REARED in the shadow of the O'Brien Oak, a landmark on Riverside Drive in Beaumont. His lifelong contributions to his city and state were conscious and deliberate extensions of his inheritance.

His father, Chenault O'Brien, was a lawyer and lieutenant-colonel in the Spanish-American War. His mother, Christine Chilton, was the daughter of U.S. Senator Horace Chilton of Tyler. His grandfather was George W. O'Brien, an early Jefferson County district attorney and editor who opposed secession but later became a Confederate captain.

Young Chilton served as commanding officer of a motor torpedo boat in the South Pacific in World War II. He was commended for outstanding performance of duty and discharged with the rank of lieutenant-commander.

O'Brien attended the University of Texas, where he was a member of Kappa Alpha fraternity and of the Cowboys. In his senior year he edited the yearbook, *The Cactus*. He received a law degree from the University in 1936.

In the course of his legal career, O'Brien became one of the outstanding land title authorities of his profession. He became a fellow of the Texas Bar Foundation and served as president of the Jefferson County Bar.

At the time of his death O'Brien was serving as chairman of the Texas State Library and Archives Commission.

O'Brien's local civic contributions were extensive and continuous. They included chairmanship of the Beaumont City Charter Commission and membership on the Charter Revision Committee and on the Planning and Zoning Commission. He was president of the Beaumont Community Council and of Beaumont Family Service, and he served as a board member of the Salvation Army and as a director of the Central YMCA.

At St. Mark's Episcopal Church in Beaumont, O'Brien was a vestry member and served as senior warden. He was on the first board of trustees of the Palmer Drug Abuse Program. He served on the first board of trustees of All Saints Episcopal School, Beaumont, and was a member of the board of trustees of St. Stephen's School, Austin.

O'Brien served as chairman of the Executive Committee of the Young Democrats of Texas and three times was an alternate delegate from Texas to the Democratic national convention. Although he remained active in politics, he did not run for office or seek political appointment.

A director emeritus of the First City Bank in Beaumont, O'Brien was also a director of the Enterprise Company and was serving as chief executive officer of the Gladys City Company, of which his grandfather was co-founder, at the time of his death.

An acknowledged authority on Texas history, O'Brien was a founder and president of the Texas Gulf Historical Society and was a director of the Texas Historical Foundation. He was also a member of the Sons of the American Revolution and of the Sons of the Republic of Texas.

O'Brien was an honorary life member of the U.S. Lawn Tennis Association and twice chaired the Beaumont Labor Day tennis tournament, which drew wide participation beyond the city and the state. He found additional recreational pleasure in sailing on Sabine Lake and was a longtime member of the Port Arthur Yacht Club. He remained active in tennis and sailing until his final brief illness. He died in Beaumont on December 19, 1983.

—G.D.

MEMORIAL TO DR. HERBERT PICKENS GAMBRELL*

1898 - 1982

I DON'T THINK THAT IT IS INAPPROPRIATE OR IMPERTINENT TO take note of the fact that the man whose memory we recall here today was an originator of the Philosophical Society of Texas as well as the Trinity Valley Anti-Horse Thief Association and the Association of American Vice-Presidents.

Herbert Pickens Gambrell was born July 15, 1898; he died on December 30, 1982. His towering six-foot-five-inch statue cast a shade over all of Texas intellectual and cultural life for virtually half of a century, and in that shade have grown up institutions and persons who continue to quicken and enhance the civilized life of Texas.

Often on occasions such as this it is common to speak of a person as being "bigger than life" — and the temptation to such hyperbole is great — but it is far more appropriate to think of Dr. Herbert Gambrell as being fully the size of life. His great good humor — displayed even in the resuscitation of Mirabeau B. Lamar and Sam Houston's defunct Philosophical Society of Texas in 1936 — remembered by his students in violations of academic propriety and in the tall tales which enlivened many a classroom hour, undermines our temptation to remember him or to think of ourselves any more highly or lowly than is realistically appropriate. He lived his life fully and thereby taught many the abundant joys and pleasures of even a mortal life.

Herbert Gambrell's most distinguished contributions to the life of the state of Texas — and to us all — included certainly the revivification of the Philosophical Society of Texas. That learned society was reborn at his instigation in the company of "five citizens and five Professors" in his home.

Dr. Gambrell also contributed mightily to the Dallas Historical Society and the Hall of State, as well as making a vital contribution to the Texas Centennial Celebration.

He will also be remembered for his service to the Texas Institute of Letters. Along with J. Frank Dobie, he helped make that institution a significant aspect of Texas' cultural life.

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*Delivered on February 5, 1983, at the Texas State Cemetery in Austin, by Reverend Charles H. Cox, Jr., director, The Texas Bible Chair Foundation, Austin.

He was born in Tyler, Texas, the son of Joel Halbert and Victoria Pickens Gambrell. The family moved to Dallas before his school years began. His collegiate years began at Baylor University in 1916. The bachelor of arts degree was granted by Southern Methodist University in 1921 and the master of arts degree in 1924. His doctoral work was done at the National University of Mexico, the University of Chicago and the University of Texas, which conferred on him the Ph.D. degree. Dr. Gambrell joined the faculty of history at SMU in 1924 and taught there throughout his career, serving for many years as chairman of the department of history and of the division of social sciences. He was made professor emeritus in 1964.

His writings include *Mirabeau B. Lamar, Troubador and Crusader,* published in 1934; *Texas Yesterday and Today,* 1948; *Texas Today and Tomorrow,* 1961; the prize-winning *Pictorial History of Texas,* with his wife Virginia, published in 1960; and the prize-winning *Anson Jones, The Last President of Texas,* published in 1948 and 1964.

Dr. Gambrell met Virginia Leddy of Greenville during the early years of his teaching career. They were married in 1940. Together they contributed extensively to the cultural and literary life of Texas. Though two strong individuals, they fashioned for themselves a distinctive life together.

Herbert Gambrell was a man of history. He knew and appreciated the meaning of time. He taught us to value the lessons of the past, of the present, and of the future. He seemed to sense the dimensions of his own time and added to the measure of his age. His age in Texas history is a distinctive one. It is the age of Webb, Dobie, Bedichek — and Gambrell. He outlived his peers, and with his passing an age passes; but in its end we enjoy a richer, newer life. Something imperishable, glorious, powerful, spiritual is given birth in the person of Herbert Pickens Gambrell.

May I close with a quote used by Dr. Dorman Winfrey at the burial of Virginia Leddy Gambrell.

> When our use of this world is over and we make room for others, may we not leave anything ravished by our greed or spoiled by our ignorance, but may we pass on our common heritage fairer and sweeter through our use of it, undiminished in fertility and joy, that so our bodies may return in peace to the great mother earth who nourished them and our spirits may round the circle of a perfect life . . .

Because of Herbert Gambrell, life is fairer and sweeter, undiminished in fertility and joy.

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*Edward Randall	1944
*Umphrey Lee	1944
*Eugene Perry Locke	1945
*Louis Herman Hubbard	1946
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*Ernest Lynn Kurth	1952
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*Edward Randall, Jr.	1965
*McGruder Ellis Sadler	1966
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*Richard Tudor Fleming	1968
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