The Philosophical Society of Texas

PROCEEDINGS

1984

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OF THE ANNUAL MEETING

AT HOUSTON

DECEMBER 7 and 8, 1984

XLVIII

AUSTIN

THE PHILOSOPHICAL SOCIETY OF TEXAS

1985

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

HOUSTON'S INN ON THE PARK WAS THE SITE FOR THE 147TH anniversary gathering of the Philosophical Society of Texas on December 7 and 8, 1984.

A reception and cocktail buffet, hosted by Houston members of the Society, was held at the Bayou Club on Friday evening. The Local Arrangements Committee, headed by Chairman Paul Gervais Bell and members John H. Lindsey, Frank C. Smith, Jr., Risher Randall, and Herman Pressler, provided splendid atmosphere for the occasion. The Program Committee, consisting of Chairman Norman Hackerman, Peter T. Flawn, Charles A. LeMaistre, and Frank E. Vandiver, selected the topic of "Discoveries: Breakthroughs of Present Limitations of Knowledge and Their Significance to Our World."

During the Saturday luncheon, President Jenkins Garrett announced the following new members elected to the Society:

Ann Barber Brinkerhoff, Houston
Albert V. Casey, Dallas
Joseph M. Grant, Fort Worth
George Kozmetsky, Austin
Wales H. Madden, Jr., Amarillo
Hans Mark, Austin
Ralph Spence, Tyler
Robert S. Trotti, Dallas
Rosine McFaddin Wilson, Beaumont

At the afternoon business meeting, President Garrett announced the deaths of the following members since the Society met in Fort Worth last year:

Truman G. Blocker, Jr., Galveston
Nina Cullinan, Houston
Carl Hertzog, El Paso
Chilton O'Brien, Beaumont
Levi A. Olan, Dallas
George F. Pool, Hallsville

Emil C. Rassman, Rockport
Edward M. Schiwetz, Westhoff
James Lee Whitcomb, Houston
H. B. Zachry, San Antonio

Officers elected for 1985 were Joe R. Greenhill, president; William P. Hobby, first vice-president; Elspeth Rostow, second vice-president; Mary Joe Carroll, treasurer; and Dorman H. Winfrey, secretary.

Registration for the 1984 Meeting

Members registered included: Misses Duff, Hartgraves; Mesdames Brinkerhoff, Knepper, Matthews, Randall, Randel, Rostow, Scott, Symonds, Wilson; Messrs. Thomas D. Anderson, Andrews, Baker, Henry M. Bell, Jr., Paul G. Bell, Bennett, Bentsen, Beto, Brown, Caldwell, Edward Clark, Collie, Conger, Cooper, Crim, Crook, Daniel, Denius, Dick, Doty, Doyle, Fehrenbach, Fisher, Durwood Fleming, Jon Fleming, Galvin, Garrett, Gordon, Gray, Greenhill, Gresham, Hackerman, Hargrove, Christopher Harte, Harvin, Heinen, Hershey, Hoffman, Hook, Keeton, Kelsey, Harris L. Kempner, Sr., Dan E. Kilgore, William J. Kilgore, King, Kirkland, Law, Lawrence, LeMaistre, Levin, Lindsey, Livingston, Locke, Lord, Lovett, McCall, McCorquodale, McGinnis, McKnight, Madden, Margrave, Mark, Mills, Mosley, Herman Paul Pressler, Jr., Herman Paul Pressler III, Ragan, Edward Randall III, Risher Randall, Reynolds, Schachtel, Seybold, Sharp, Shilling, A. Frank Smith, Jr., Frank C. Smith, Jr., Sparkman, Spence, Sprague, Spurr, Teague, Topazio, Tritico, Trotti, Ruel C. Walker, Watkins, Wells, Wheeler, Whitcomb, Winfrey, Winters, Woodson, Worden, James S. Wright, Young.

Guests included: Mrs. Thomas D. Anderson, Mrs. Mark E. Andrews, Mrs. Rex G. Baker, Jr., Dr. and Mrs. Jay Ballentyne, Mrs. Henry M. Bell, Jr., Mrs. Paul G. Bell, Mrs. J. M. Bennett, Jr., Mrs. Lloyd Bentsen, Bob Brinkerhoff, Mrs. John R. Brown, Mr. and Mrs. J. P. Bryan, Mrs. John Clifton Caldwell, Mrs. Edward Clark, Mrs. Roger N. Conger, Mrs. John Cooper, Mrs. William R. Crim, Mrs. William H. Crook, Mrs. Price Daniel, Mrs. Franklin W. Denius, Henry Doscher, Mrs. Ezra William Doty, Mrs. Gerry Doyle, Mr. and Mrs. James E. Doyle, Mrs. T. R. Fehrenbach, Mrs. Joe J. Fisher, Mrs. Durwood Fleming, Mrs. Jon Fleming, Dr. and Mrs. Donald Foss, Mrs. Charles O. Galvin, Mrs. Jenkins Garrett, Mrs. William E. Gordon, Mrs. John E. Gray, Mrs. Joe Greenhill, Mrs. Newton Gresham, Mrs. James W. Hargrove, Mrs. William C. Harvin, Betty

Hendrick, Mrs. J. W. Hershey, Mrs. Philip G. Hoffman, Mrs. Harold S. Hook, Eugenia Hunt, Mrs. W. Page Keeton, Mrs. Mavis P. Kelsey, Mrs. Harris L. Kempner, Sr., Mrs. Dan E. Kilgore, Mrs. William J. Kilgore, Mrs. John Q. Taylor King, Sr., Mrs. Thomas H. Law, Mrs. F. Lee Lawrence, Mrs. Charles A. LeMaistre, Mrs. William C. Levin, Mrs. John H. Lindsey, David Livingston, Mrs. H. Malcolm Lovett, Dr. Elizabeth MacNaughton, Mrs. Abner V. McCall, Malcolm McCorquodale III, Mrs. Malcolm McCorquodale, Mrs. Robert C. McGinnis, Marguerite McKnight, Mrs. Joseph W. McKnight, Mrs. Wales H. Madden, Jr., Mrs. John L. Margrave, Mr. and Mrs. William Martin, Ellen Middleton, Mrs. Ballinger Mills, Jr., Martha Moore, Mrs. John D. Mosley, Mr. and Mrs. Paul W. Pigue, Mrs. Herman P. Pressler, Jr., Mrs. Herman P. Pressler III, Mrs. Cooper K. Ragan, Eliza L. Randall, Mrs. Risher Randall, Ralph E. Randel, Mrs. Herbert H. Reynolds, Mr. and Mrs. Tom C. Ryan, Mrs. Hyman J. Schachtel, Dr. and Mrs. H. Irving Schweppe, Dr. and Mrs. A. I. Scott, Lawrence Scott, Mary Helen Seibt, Mrs. William D. Seybold, Mrs. Dudley C. Sharp, Mrs. Roy B. Shilling, Jr., Mrs. Frank C. Smith, Jr., Mrs. Robert S. Sparkman, Josephine Sparks, Mrs. Ralph Spence, Mrs. Stephen H. Spurr, Ada Sullivan, Mr. and Mrs. Charles T. Terrell, Mrs. Virgil W. Topazio, Mrs. Robert S. Trotti, Kay Wagenknecht, Mrs. Ruel C. Walker, Mrs. Peter Wells, Mrs. John A. Wheeler, Mrs. Gail Whitcomb, Ruth Williamson, Will E. Wilson, Mrs. Dorman H. Winfrey, Mrs. J. Sam Winters, Mrs. Benjamin N. Woodson, Mrs. Sam P. Worden, Mrs. James S. Wright, Mrs. Sam D. Young.

DISCOVERIES: BREAKTHROUGHS OF PRESENT LIMITATIONS OF KNOWLEDGE AND THEIR SIGNIFICANCE TO OUR WORLD

WELCOME AND INTRODUCTION

JENKINS GARRETT

Welcome to the 146th annual meeting of the Philosophical Society of Texas.

Before beginning our program, I wish at the outset to express my hearty appreciation to the planning committee, Chairman Paul G. Bell, and his Houston crew (John Lindsey, Frank C. Smith, Jr., Risher Randall and Herman Pressler) for their outstanding job — far beyond the call of duty — in arranging the mechanics of this meeting. Their fine work will be more evident as the meeting progresses.

We are especially grateful to the Houston members of the Society who were our hosts at the excellent and enjoyable reception last evening at the Bayou Club.

We are indebted to Presidents Norman Hackerman, Peter Flawn, Charles LeMaistre and Frank E. Vandiver, of Rice University, University of Texas at Austin, University of Texas System Cancer Center and A&M University, respectively. I don't think one could imagine a committee of greater strength.

The program planning began with my letter to the committee, which in part read:

> Daniel Boorstin of the Library of Congress has done a magnificent job in his new book *The Discoverers* in telling the story of and catching the spirit of those discoverers of the past who, being impatient with the common knowledge of their day, brought new knowledge and truth about the world in which they lived.
>
> Now, probably more than any time within the past 400 years, man finds himself in a new age of discovery in many fields of inquiry and at a bewildering speed. Each of you is privileged to be directing an institution which is in the forefront of exploration and discoveries of 1984. I would hope that we could build a program for the Houston meeting that could tell the membership of the new breakthroughs of the present limitations of knowledge and their significance in understanding our world and universe.

As expected, this committee has put together a great program for us. Upon that note, I present Chairman Hackerman, who will preside and introduce the distinguished program participants.

PROLOGUE

NORMAN HACKERMAN

When Jenkins Garrett in the spring of this year called to see whether I would be willing to help a committee of Drs. Flawn, Vandiver and LeMaistre put together a program for the Society, he said he thought the theme should deal with "discovery," noting his interest in Boorstin's book on that topic. It was an interesting task to undertake.

In discussing the matter it seemed clear that the interest in the topic may have stemmed from the current concern in this country about our perceived lag in innovation and productivity. Consideration of this train of thought led to the conclusion that basic to the topic was the matter of ideas, how they are formed, how they are put to use, and what their effects are. It became evident that a meeting on "ideas" could be stimulating. It was equally clear that the topic is so big and broad that it would be possible to end up with just superficial considerations. However, we decided that if we could get the right four or five people and delineate their topics carefully, the possibility of a good session was high.

The result of these considerations led to the program you see here. Certainly it looks as if we have a fine chance of having a stimulating day dealing with a very basic human activity. At the end of the day, I am quite sure that we will all be much the better for having participated in this program because of the five people who will appear before you this morning and this afternoon. All are outstanding individuals in their fields and are people who have broad vision so that one can anticipate discussions which are probing, deep and broad.

IDEAS

JOHN ARCHIBALD WHEELER

An Unforgettable Idea

In that burst of enthusiasm for relativity that marked the early 1920s, Albert Einstein found himself seated at a dinner in Paris for French notables. He observed the neighbor on his left, the great French poet Paul Valery, making notes with a pen on the cuff of his shirt. "What are you doing?" Einstein asked. "I'm putting down my ideas before I forget them. How do you remember your ideas?" "Oh," Einstein replied, "I so rarely have a new idea that it's no problem to remember it."

Rare? Yes. And to be cherished, too. Einstein tells us in his own words of "the years of anxious searching in the dark, with their intense longing, their alternations of confidence and exhaustion, and the final emergence into the light — only those who have experienced it can understand that."

Light? What kind of light does a great idea bring? Shall we look for illustration at three great ideas? And then at three of the convictions that drive the hunt for a great idea? And then at the end, look at three of the hunting grounds where — many are convinced — great new game is to be found?

Einstein's 1915 and still standard general relativity theory stands today as a model of what an overarching idea, in the realm of physics, should be and do. It revolutionized our understanding of space, time and gravitation. It told us that gravity is not a foreign and "physical" force propagated *through* space, but a manifestation of the curvature *of* space. Einstein's account lets itself be boiled down to a single sentence: "Space tells mass how to move, and mass tells space how to curve."

Within a few months, Einstein had applied this "geometrodynamics" of his to the bending of light by the sun, the motion of the planet Mercury around the sun and the so-called red shift of light from the sun. Two years later, he was applying it to cosmology itself. To his surprise and dismay, he found the theory predicted a universe of changing size, not one forever static. He searched for some fault in his theory of gravitation. He discovered there was no natural way to change the theory. Therefore, he looked for the

least unnatural way he could find to alter it. He introduced a so-called "cosmological term" with the sole point and purpose to hold the universe static. A decade later, Edwin Hubble, working at Mount Wilson Observatory, gave convincing evidence that the universe is actually expanding. Thereafter, Einstein remarked that the cosmological term "was the biggest blunder of my life." Today, looking back, we can forgive him his blunder and give him the credit for the theory of gravitation that predicted the expansion. Of all the great predictions that science has ever made over the centuries, each of us has his own list of spectaculars, but among them all was there ever one greater than this, to predict, and predict correctly, and predict against all expectation, a phenomenon so fantastic as the expansion of the universe? When did nature ever grant man greater encouragement to believe he will someday understand the mystery of existence?

A Hundred-Thousand Wedges

Mystery of existence, yes; but there is the mystery of life, too! When was ever a deeper insight granted man into the nature of life than November 24, 1859? When was there a more revolutionary book than Charles Darwin's *Origin of Species?* How long it took the world to understand and accept his great idea, evolution through natural selection! And how long it had taken *him!* It had been more than 20 years since he made that first clear 35-page pencil draft. "[O]ne may say," he wrote, "there is a force like a hundred-thousand wedges trying to force every kind of adapted structure into the gaps in the economy of nature, or rather forming gaps by thrusting out weaker ones."

Without the insights that Darwin gave us, we would be deprived of many an advance that blesses agriculture, the breeding of plants and animals, and great areas of biology, physiology and medicine. Charles Darwin is an ever greater living force with each passing year that he lies dead under the pavement of Westminster Abbey.

Niels Bohr's Elementary Quantum Phenomenon

Einstein's relativity and Darwin's evolution were great ideas. Niels Bohr's "complementarity" of September 16, 1927 — with its central concept of "elementary quantum phenomenon" — is also a great idea which may in the end make a still greater upset in our view of existence. Elementary quantum phenomenon? Yes, the ejection of

an electron from an atom by the impact of light or bombarding particle; that is one example. Another is the radioactive decay of a radium atom. Still another example is the capture of a neutron by a uranium nucleus. Bohr's conception of the elementary quantum phenomenon was sharpened by his famous friendly but deadly serious debate with Einstein on determinism and reality. It extended from 1927 to Einstein's death in 1955. In all of history of human thought in recent centuries, I know no dialogue between two greater men on a deeper issue that extended over a longer period of time at a higher level of colleagueship. Quantum theory, as Bohr and all the other great leaders of modern physics conceived it, was to Einstein incompatible with any reasonable idea of reality. Bohr answered, in effect, "Your concept of reality is too limited."

I do not know any way more briefly and more clearly to summarize Bohr's final formulation than this, "No elementary quantum phenomenon is a phenomenon until it has been brought to a close by an irreversible act of amplification" — such as the blackening of a grain of photographic emulsion by an arriving electron or the click of a Geiger counter triggered by a radiation from a radioactive nucleus, something so definite that one person can communicate it to another in "plain language." We have no right to say what is going on at the microscopic level, no right to say what the electron or nuclear particle is doing in all its long travel, until by choice of a measuring device and an act of registration we have brought the elementary quantum phenomenon to a close. Moreover, our choice of the question we put to nature has an irretrievable consequence for what we have the right to say about the past of a microscopic motion which we used to think had "already happened." We once believed that we could be mere observers, able to look at the flash of a radioactive decay process or the blip of light from a distant star as if from behind the protective isolation of a foot-thick slab of plate glass. Now we discover that to observe even so minuscule an object as an electron we have in effect to smash that glass and reach out and install measuring equipment. Bohr's principle of complementarity tells us more. We can install equipment to measure the speed of the electron. Or we can install equipment to measure the location of the electron. But nature is so built that we cannot install both pieces of equipment at the same time in the same place. *We* have to make the choice. And when we choose to measure the position of the electron, we lose the possibility to know its velocity. It is not that the electron has a velocity and we simply don't know it.

It is much more serious. The velocity of the electron in that case is a concept utterly without meaning. Which measurement we choose to make has also an inescapable — and unpredictable — effect on the future of the electron. We have been promoted, willy-nilly, from observers to participators in the creation of what we call reality. In some strange sense, this is a participatory universe.

Whoever does not feel dizzy when he first hears about the elementary quantum phenomenon has not understood the first thing about it, Bohr used to say. It is the strangest thing I know in this strange world. Yet it lies at the heart of quantum theory, the overarching principle of 20th-century physics. No one can telephone today without using devices based upon the quantum principle. Almost all the basic novelties in the field of metallurgy and magnetic materials originate in ideas that came from quantum theory. Rare today is a new product of chemical industry which was not first formulated in terms of quantum orbitals. Atomic bombs and nuclear reactors could not have sprung in a single leap from pencil and paper to dramatic reality in the absence of quantum theory. Without the quantum idea, there is no hope to master many of the deepest considerations about biochemistry and the nature of life.

The elementary quantum phenomenon, springing as it does out of a foundation so solid, is today's brightest light on the nature of what we call "reality." It presses us insistently to make conquest of that ancient heart of darkness.

Knowability, Measurement, Analogy

Einstein's geometrodynamics, Darwin's evolution and Bohr's quantum phenomenon are great ideas; but what guiding principles led these men and other seekers of the wider view to their great ideas? Three above all, I would suggest: conviction that the unknown is knowable, keeping measurement and theory together as inseparable parts of the search, and seeking new truth by analogy, by similarity, by point of resemblance with old truth; or, in brief, belief in these three ideas: knowability, measurement and analogy.

Knowability! The unknown is knowable, every darkness can be lighted: that is the article of faith of the great investigators, and among them Einstein. As he put it on one occasion, "The most incomprehensible thing about the world is that it is comprehensible." And down the hall from his office, carved over the fireplace of the professors' meeting room, still stand his words, "Raffiniert ist der Herr Gott, aber boshaft ist er nicht" — "God is deep but he is not

malicious." Narrowly interpreted, Einstein assures us that the mysteries of space and time, of matter and energy, subtle as they seem today, can someday be unraveled. But in a broader sense he denies the existence in any sphere of nature or knowledge of a Pied Piper leading us on to a mystery of wheels within wheels within wheels, through never-ending cycles and caverns measureless to man, world without end.

That every mystery can be unveiled is not of course a theorem to be established by logic, but an article of faith, to be justified by its consequences. The idea works, we know — that is its proof, and all we shall ever have for evidence. Seen to operate in one field after another, the principle of knowability becomes a factor in the rise of men and nations.

Like a sword, "knowability" shows its worth only in combat. It demands a point of attack: a discrepancy, a contradiction between expectation and observation, an apparent paradox. If there was ever a motto for Bohr's very small but very great school of physics, it was this: "No hope of progress without a paradox."

Paradox, difficulty or discrepancy is the crack in the armor of the unknown, the favored point of attack for the sword of knowability. But how is discrepancy to be found except by measurement, by the confrontation and interplay of theory and observation? As Lord Kelvin used to say, "[W]hen you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind: it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be."

If measurement ferrets out discrepancy, the chink in the armor of the unknown, and if faith in knowability raises the sword for the victory, what guides the sword in the right direction? Often analogy.

Where did Theodore von Karman get the idea so central to understanding the lift of an airplane wing? From observing the alternating pattern of eddies generated in the wake of a rock as a stream flows by. How did Michael Pupin hit on the invention of the "loading coil" installed every so many miles along a telephone line, which alone made long distance telephony possible in the early days? By observing the vibration of beads sliding back and forth on a wire under the influence of connecting springs. Where did Linus Pauling conceive the template concept that guided Francis Crick and James

Watson to the discovery of DNA, that magic self-replicating spiral molecule that is the heart of life? From the templates used in molding typefaces.

Do analogies form themselves out of thin air? Does our problem click by magic into parallelism with another idea from our own area, or with a thought from quite another field? Not by magic alone, but magic plus the prepared mind, Abraham Flexner reminds us. We recall the leader of industry who went to Arthur D. Little for something in writing on the proper organization of a research laboratory. He came away with John Livingston Lowe's inspiring book, *The Road to Xanadu.* And where could one see better than in that study of where Coleridge got his ideas how the storehouse of the imagination is stocked by conversation, story, book and observation?

We exploring mortals so often do not see what we do not expect. What is the medicine for that malady? Analogy? Is it not the power of analogy that it makes the strange look familiar — and makes the familiar look strange?

Three Candidate Areas for a Great New Idea

From Einstein, Darwin and Bohr and their great ideas, and from faith in knowability, the partnership of theory and measurement, and the power of analogy in leading *to* a new idea, we come now to great ideas still over the horizon, waiting for discovery.

Have the great ideas all been discovered? Surely not! Surely greats are yet to come! Each of us has his favorite candidates. Let me beg your indulgence to mention three of mine: time, brain and the sociology of an achieving society.

In the understanding of time we are in a state today as primitive as we were a hundred years ago in the understanding of elasticity. The textbooks of that day took elasticity to be a primordial concept in the description of nature, beyond further dissection. Know the elasticity of bronze? Then, the old text explained, we could predict the speed of sound transmitted along a bronze rod, the bending of a bronze beam and the tones of a bronze bell. But how were we to predict in advance the elasticity of bronze or anything else? We couldn't! Our only possibility was to go out and measure it.

Today we can predict elasticity, knowing as we do the atomic constitution of matter. But that very knowledge also tells us that there is no such thing as "elasticity" in the space between the atomic

electron and the nucleus. The concept of elasticity has fallen in a hundred years from primordial and precise to secondary, approximate and derived.

"Time" we likewise take today as a heaven-sent concept, beyond deeper justification, likewise primordial and precise. Surely the day must come when we will understand "where time comes from," see it based on considerations that do not presuppose time, recognize it to be, like elasticity, secondary, approximate and derived. Of all challenges to thought, I do not know one more difficult, more important and more likely to open up an entirely new outlook on nature than "time."

A second idea waiting for us over the horizon is the central principle in the organization of the brain. There are more people today investigating the brain from more directions in more great centers than ever before. However, the very fragmentation of the enterprise tells us how far we are from seeing the dominant idea behind it all. Happily, recent advances by John J. Hopfield and others in understanding the mechanism of the memory permit us to believe that a promising new line has been opened up that may someday give us the whole grand picture of what the brain is and does.

There is a third great idea that I dream of someone, sometime, capturing for us humans: what makes the magic of an achieving society? The automobile is stopped beside the highway. The hood is up. The worried driver is standing there wringing his hands. He asks the wise mechanic who finally fixes it, "How did you know what to do?" "I didn't," is the reply. "I only knew enough to keep trying." There is not one of us in this Philosophical Society who has not at some time had some great responsibility encumbered with the same difficulty as the car: the business wouldn't "go" — and not one of us who did not recognize in the end the answer: keep trying!

As one who has had the honor to be a Texan for going on nine years, I thank my lucky stars to be in a place with its élan and morale, to be in a can-do group, in a can-do university, in a can-do city, in a can-do state. But what is the magic that builds that spirit? And the *idea* behind that magic?

We Live Still in the Childhood of Mankind

Our friends of the Rome of long ago spoke of "Flammanda moena mundi," the flaming ramparts of the world. That poet of the past knew that sometimes the Northern Lights make the night sky pink

with beauty and mystery. We of today call ourselves "modern." Yet we know in our hearts that our own sky, our own great firmament of knowledge and beliefs, is night sky too — night except in those quarters of the horizon where the rosy hue of a discovery, a great new *idea,* lights up the sky. Dawn is yet to come. We live in what is still the childhood of mankind!

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COGNITIVE PSYCHOLOGY: THE MIND DISCOVERS ITSELF

DONALD J. FOSS

Art does not reproduce the visible, rather it makes visible.
—Paul Klee

There is nothing so practical as a good theory.—Kurt Lewin

Thinking, feeling, and acting — these have been traditional areas of human study since the time of the Greeks. It is hardly surprising that modern psychology has also been concerned with these enduring issues; indeed they are among the central topics that drive the field. In this informal presentation I will discuss thinking or cognition, a topic that has had a great rebirth in psychology over the past fifteen years. Among the reasons for such renewed interest in cognition is the technological revolution we are experiencing. The computer has stimulated us to think about thinking in new ways; it has spawned ideas about cognition that psychologists are now busy testing. And, perhaps somewhat surprisingly, certain fundamental advances in computing systems await a better understanding about how the mind works. There are computing bottlenecks due not to the speed of present-day computers nor to their memory limitations, but due to a lack of basic understanding about how you and I do some seemingly simple tasks like understanding this sentence. It is arguable that what you are doing right now — comprehending a written message — is among the most complex activities in the universe. Clearly we would like our computing systems to be able to understand spoken or written messages in "simple, everyday English," and to solve problems for us (or to present us with alternative solutions from which to pick). Although there have been substantial gains in using computers as problem solving aids (e.g., management information systems, and the so-called expert systems), no existing computer system can aid us over a wide range of problems. A better understanding of how *humans* understand problems and solve them may be able to help us advance our technology. Happily, the technology will then be able to help us where we are weak — a point I'll amplify upon below. First, however, I'd like to give a brief overview of some central areas of concern to cognitive psychology. It is important to note that the fundamental problems

and ideas of cognition did not arise from a concern with computers; they far predate such machines.

One of the great ideas of the late nineteenth century was that the study of mind could be carried out in a scientific fashion. Pioneers such as Wundt and Ebbinghaus in Germany and William James in the U.S. began to study systematically such topics as learning and forgetting, attention, and problem solving. They had the insight that the mind can study itself, and the genius to devise methods for studying it beyond mere armchair reflection. They made the study of mind one of the experimental sciences. Of course, the field has changed a lot over the years. Presently I think it is fair to divide the study of cognition into three very broad areas:

- Knowledge Representation
- Learning
- Use of Knowledge in Skills and in Solving Problems

(I'll add parenthetically that workers in Artificial Intelligence, a branch of computer science, have similar areas of study.) I'll try to give the flavor of some work in the first and third of these areas. Time and space limitations force me merely mention the fascinating topic of learning.

Knowledge Representation

A classic problem in cognitive psychology (and philosophy as well) is how to represent our knowledge. When first asked about how knowledge is represented, there seems to be no problem. Many believe that we have something like a videotape memory, our experiences are recorded in the brain with about the same accuracy that videotape provides. Further, the images on the tape decay with time or disuse, thus accounting for forgetting. There are many reasons for calling into question that "videotape theory" of representation. For one thing, we can easily show that much of what we see is not stored. The other night I decided to adjust our (circular) thermostat in the dark, but could not remember which way to turn it to make the room warmer. I've adjusted that thermostat many hundreds of times over the years but was unable to "play back" even one of the pieces of tape that should have recorded those events. Such failures are commonplace. Another reason for doubting the videotape theory is that it provides no way for representing abstract ideas such as "faith" or "justice." It doesn't even work for such ideas as "triangle." It will not do to have our representation of triangle con-

sist of the collection of triangles that we've happened to run across. The same thing is true for any term that represents a class or a concept. Even such an everyday concept as, say, "girl" cannot be represented as the collection of particular girls that we've seen. Something more general is needed.

IMAGES. Denying the videotape theory does not, however, mean that we should deny the existence of mental representations that have image-like qualities. Recent work has shown that some mental representations behave very much like mental images. Consider, for example, an experiment devised by Roger Shepard of Stanford University. He asked his experimental subjects to judge whether a figure he showed them was a regular capital R or an R that had been made into a mirror image, like this: Я . The figures he showed to them had been rotated so that they looked like  or  . Shepard timed the decisions. To clarify, the subjects saw a rotated letter and had to decide whether it was in regular or mirror image position. Shepard found that the time to decide whether the R was "regular" or "mirror image" was shorter if the R had been rotated only a little, and longer if it had been rotated a lot. It was as though the person mentally rotated the test figures back to the normal upright position and then made the decision.

Other investigators have devised other ingenious tasks for studying the nature of such "mental images." Steven Kosslyn asked some subjects to imagine either an elephant or an elephant's foot. Then he asked them to imagine a mouse next to it. Finally he asked questions about the imagined mouse and timed the responses. Subjects who imagined the mouse next to the elephant's foot gave faster responses than did those who imagined it next to the entire elephant. It is as though the image of the mouse next to the foot had more detail since, as it were, the mind's eye was closer to the mouse in that case. One's point of view had to be "further away" to fit in the entire elephant so details about the mouse were harder to discern. I want to emphasize the fact that the response times gathered in these experiments are quite regular and lawful. These workers have been able to bring "images" into the laboratory and to show us some properties of our representational system. Also, theorists such as Kosslyn suggest that the images themselves are produced from some deeper, underlying representation.

Images are suggestive of the "mental videotape" that I've been at some pains to discredit. Nearly everyone, including those who work on images, agrees that other representational systems are needed.

Space does not permit a systematic review of the systems that have been proposed. Instead, I'll simply mention that two very broad classes of representations get the most attention. One class is concerned with the concepts that we acquire — concepts such as triangle and girl. The problems of conceptual representation are closely related to problems of representing the meanings of words. Representing the meaning of "girl" is at least a first cousin to the problem of representing the concept girl. A second class of representations is for knowledge that is more fleeting: for example, knowledge about your friend's automobile preference at the moment, knowledge about who is Secretary of the Interior, and your representation of the information in this sentence as you understand it.

CONCEPTS. There are lively controversies about how we represent concepts. Some cognitive theorists have suggested that we have in memory a "prototype" of each of our concepts — as though there is a best example of "triangle," or "girl," or "bird" and it is that best example that is stored. Your prototype of bird is, approximately, the average of all the birds you know about. There are some observations consistent with this point of view. Imagine that we ask someone the two questions below, and we time how long it takes before we get the correct answer.

a.) Is a robin a bird? b.) Is a penguin a bird?

In order to answer such questions, we search in memory for information about robins and penguins. When we find that a robin (or penguin) is an instance of the category bird, we respond "yes." For most of us, the argument goes, the robin is closer to our prototype of a bird than is a penguin. Thus, we might expect that the search of memory will go faster in that case and that question a.) will be answered faster than question b.). Results like that have been observed in experiments. (Alternative explanations have been suggested for the results — perhaps you can think of one yourself.) One advantage claimed for prototype theory is that there are no fixed boundaries around many concepts; one concept shades into another. Thus, there is no hard line that separates cups from bowls, bowls from vases, etc.

Other theorists claim that concepts cannot be represented by prototypes. They might point out that each of us seems to have a concept corresponding to "English sentence," yet it seems odd to say that there is some "average" or prototypical sentence that we have stored in memory. If we are asked whether some unusual

string of words like c.) is a sentence, we have to see whether it follows the patterns or rules of the language. (It does.) For these theorists, then, concepts are represented in part by some mental rules for how they are constructed.

c.) The man that the committee Chuck chaired chose refused to serve. As I said, space does not permit a thorough airing of the alternatives, let alone all the arguments for and against the proposed candidates. The main point I want to make about the representation of concepts is that, once again, experimental techniques have been brought to bear on these age-old questions. Cognitive psychologists are empirically investigating basic categories of mind.

LANGUAGE. Before leaving the topic of representation, I'd like to give one or two examples of how psychologists are studying the mental representation and understanding of materials such as sentences, paragraphs, and larger units. Let's begin with an example taken from an experiment conducted by Caplan. He presented sentences like d.) and e.) below to his subjects (the sentences were given auditorily). Then he gave them one word from the sentence and asked them to give the next word in the sentence as fast as they could. Caplan timed how long it took to give the next word. In these examples the test word was "night" and the correct response in both cases is "rates."

d.) Whenever one telephones at night rates are cheaper.
e.) Make your calls after six because night rates are cheaper.

The two critical words are physically adjacent in both sentences. However, "night rates" is a phrase in example e.) but it is not a phrase in example d.). Caplan found that the time to give "rates" was faster in e.) than in d.). This suggests that the listeners have organized the sentences in memory into units that correspond to phrases. When asked to give the next word in the sentence, subjects are faster if the second word is a member of the same psychological unit as the first word. By use of such techniques it is possible to discover the psychological units of memory and also to examine how long they are represented in memory (e.g., will we get the same results if we test the subjects five minutes after the sentences were presented?).

The above example shows that sentences are represented in our memories in units or structures larger than individual words. It has also been shown that our understanding of sentences, and how we represent the information they convey, is influenced strongly by

our other knowledge — our knowledge of the world, if you will. This is not surprising. Obviously, we interpret the sentences that we hear in some context; we are with our spouse, we are talking to someone who shares a hobby, we know that our friend watched the big game last night. Still, such context effects are an important area of study; we would like to understand in detail how context effects work. Such understanding will have important implications for practical applications, as I'll show momentarily. Again, let's consider an example, sentences f.) and g.).

f.) Three turtles sat on a log and a fish swam under it.
g.) Three turtles sat next to a log and a fish swam under it.

Sentences like these were given to listeners in an experiment carried out by John Bransford and Jeffrey Franks of Vanderbilt University. A particular subject in the study got either f.) or g.). A short time later the subjects were tested to see whether they could accurately recognize the sentences that they had heard. Those people who had originally heard sentence f.) were tested with h.); those who had heard g.) were tested with sentence i.).

h.) Three turtles sat on a log and a fish swam under them.
i.) Three turtles sat next to a log and a fish swam under them.

Look again at sentence f.) If you understand it and believe it to be true, then you most likely will conclude that h.) is also true. If the turtles are on the log and the fish swam under *it,* then it is very likely that the fish swam under *them* as well. You use your knowledge of the layout of the real world to draw such a conclusion — and, indeed, your representation of sentence f.) in memory may be strongly influenced by such additional "real world" knowledge. Bransford and Franks found that many people who had actually heard f.) were willing to say that they had heard h.). And many of them were very confident in that belief. They were wrong, of course, but it is easy to see why they felt so confident. On the other hand, those people who had heard g.) in the first place were not so likely to be fooled into saying that they heard i.). If a fish swims under a log that turtles are near, then the fish may swim under it without swimming under them. Again, the subjects' knowledge of the world affected how they stored the information from g.). One implication of such a result is this: In order to interpret a simple sentence like f.) or g.), we bring to bear a tremendous amount of relevant information that we have stored in our memories.

Suppose we wanted to build a computer-based understander, one that could search its memory and answer a wide range of questions for us. Clearly, the computer will have to have stored in it a *tremendous* amount of information; its knowledge will have to be encyclopedic. Not only that, we'll have to figure out how to tell what information in the encyclopedia is *relevant* to correctly understand the message. The problem of selecting what is relevant information is a very, very difficult one.

I would now like to give an example of how the very act of understanding is affected by the context in which it occurs. Read the next paragraph through once at your normal reading speed.

> With hocked gems financing him, our hero bravely defied all scornful laughter that tried to prevent his scheme. Your eyes deceive you, he had said, an egg not a table correctly typifies this unexplored planet. Now three sturdy sisters sought proof, forging along sometimes through calm vastness, yet more often over turbulent peaks and valleys. Days became weeks as many doubters spread fearful rumors about the edge. At last, from nowhere, welcome winged creatures appeared, signifying momentous success.

Now try to recall as much as you can about the paragraph. As you probably noted, it is difficult to make sense of it and difficult to recall it. That is what was observed by Dooling and Lachman, who devised this demonstration. Now re-read the passage, but this time we will give it a title. It is called, "Christopher Columbus Discovers America." You will probably have quite a different response to the paragraph now. While the first time through you were probably quite confused — each sentence may have made some sense, but the whole thing did not hang together — now you readily understand the paragraph and the various metaphors it contains.

In the experiment conducted by Dooling and Lachman some of the subjects were given the title before they read the passage the first time while others were not. Those who had been given the title were able to recall much more of the paragraph. If you try again to recall it you will probably do much better than last time.

One lesson we learn from this demonstration is that our understanding of individual sentences is supported by a large framework of supporting information. When a new sentence fits into such a framework it can readily be comprehended. In addition, each new sentence will typically modify the framework itself — that's one important way our knowledge of the world changes. The interpreta-

tion of the next sentence that comes along must then fit into a slightly modified framework. There is presently a large amount of work going on in cognitive science attempting to clarify and make explicit the idea of frameworks and how they are modified.

Problem Solving

A few years ago the Nobel Prize in Economics was awarded to Herbert Simon of Carnegie-Mellon University. Psychologists were delighted with the award, for they consider him to be as much psychologist as economist. During much of his career Simon has been concerned with how decisions are made and problems solved. He and others have tried to describe and explain how people actually solve problems, as well as how we ought to solve them to get maximum gain from the decision. For Simon, the emphasis has been on the former topic.

Suppose we are faced with a relatively simple problem, like what move to make in the middle of a game of checkers. Our overall goal is clear, to win the game. But at the moment, there is nothing we can do on the next move to reach that goal. Instead we set up a subsidiary goal, for example, to jump one of our opponent's checkers without getting jumped back on the next move. But that will not be a satisfactory sub-goal if it leads inevitably two moves later in a major advantage for our opponent. So we try to look ahead, to examine the various possibilities and, in turn, to see what possibilities follow from each one of them. Ideally, we would like to examine every one of our possible moves at the moment, and every one of the possible responses to all of them, and then all of the things we could do in return to each of those possible moves, and so on through the dozens of moves left. But we can't. It is clearly beyond our mental abilities to carry out all of these "mental moves" and keep track of what the board looks like after each of them. In fact, many, many millions of possibilities exist for how the game can continue so it is not surprising that we cannot examine them all and decide which is the best next move. If we collected together all the possible ways that the game could continue we would have what is called the "problem space." Like outer space, the problem space is generally vast. The problem space for a somewhat more complex game, say chess, is so huge that even the best computers cannot examine all the possible sequences in order to pick the best one. Solution techniques that try to examine all possibilities are called

"brute force" methods; they have little relevance for what people actually do. Instead, problem solvers have a representation of the present situation and their goal, and they have a stock of techniques or strategies that they have learned for trying to move toward the goal. These are not brute force strategies. Instead, they are "best guess" strategies. Consequently, the "moves" that problem solvers make often lead to errors. We are all well aware of that! What problem solvers actually do is determined by two things then: by how they represent the problem — this connects to our earlier topic of representation — and by the strategies they have for mentally operating on that representation to see whether it seems to get them closer to their goal.

In the space remaining I'd like to give an example of how our problem solving — our thinking, if you will — is affected by the representation of the problem itself. First, though, I need to remind you that what we do when we solve problems is affected by the risks that we think we are taking. We all know people that seem willing to take risks, and others that are more conservative in this regard. In fact, most of us tend to avoid risks when taking the risk means foregoing a sure thing. On the other hand, most of us will seek a risk if we have a chance of avoiding a sure loss. Let me clarify that by an example. Suppose I give you this choice: $800 for sure, or 850 raffle tickets to win $1,000 — and you know that there are only 1000 tickets. The probability is, therefore, .85 that you will win the $1,000. Statisticians would say that the "expected value" of the second choice, the raffle tickets, is $850. In one very clear sense the tickets are the better choice. Yet few of us would take that choice. The happiness the extra 50 dollars would bring is far offset by the sadness we would feel if we came away with nothing. We generally avoid risk when we have to forego a sure thing. Let's change the example a bit. Suppose I now give you this choice: You *lose* $800 for sure or you take 850 raffle tickets out of the 1000 tickets that exist. If one of your tickets is drawn then you lose $1,000. In this case, if you take the tickets your "expected" loss is $850 (there is a probability of .85 that you'll lose $1,000). Most people now take the gamble, they become risk takers, even though taking the risk will most likely lead to a worse outcome than not taking it. We generally seek risks when the alternative is a sure loss.

Now that the role of risk has been introduced, I want to show how people's decisions are influenced by how they mentally represent the problem they are trying to solve — in particular, by how they

perceive the risks involved in the problem. Recently, Daniel Kahnemann and Amos Tversky presented a very clear case to just this effect. They described a particular situation and then gave college students a choice between two alternative actions. Here is an example:

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

- If Program A is adopted, 200 people will be saved. (72%)
- If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved. (28%)

The numbers in parentheses indicate the percent of students who made each choice. A large majority picked option A. The "expected" number of people saved in each case is 200, but in choice A there are 200 saved for sure. These subjects avoided the risk.

A second group of students was given the exact same problem, but with these alternatives to choose between:

- If Program C is adopted, 400 people will die. (22%)
- If Program D is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die. (78%)

Again, the numbers in parentheses indicate the percent of students picking each option. Now a large majority picked option D over option C. They now chose the option that seemed to be the riskier one. What is somewhat startling to note is that C is *exactly* the same as A, and that D is *exactly* the same as B. To say that there is a "two-thirds probability that no people will be saved" is just to say that there is a "two-thirds probability that 600 people will die." But the choices made by the vast majority of decision makers flipped in the two cases. (Incidentally, this was true even when the same people were given the two versions of the problem just a few minutes apart!) This means that their decisions were greatly affected not so much by the objective facts of the case (for these were identical), but by how the problem was presented — and, therefore, by how it was represented. They did not objectively evaluate the problem space and choose a solution based on that evaluation. Instead, they used the informal strategies of risk seeking and risk avoidance that work

more-or-less well in everyday life. They applied these strategies not to the objective facts of the case but rather to the way that they represented the problem. In the first pair of alternatives (A vs B), the wording emphasized a "sure thing," saving 200 people. So the decision makers represented the problem that way and chose the alternative that avoided risk. In the second pair of alternatives (C vs D), the wording focussed on a sure loss, the death of 400 people. Again that affected the way subjects represented the problems to themselves and led most of them to choose the risky alternative.

One is tempted to say that these decision makers acted irrationally, but that would be too simple. Their representation of the alternatives was affected by the wording, and their choice was affected by the strategies that stand them in good stead most of the time. These two factors conspired to lead them to inconsistent choices. Since we can easily imagine falling into the same trap, we are apt to be forgiving. But still — it would surely be an advantage if we could provide an aid to decision makers, one that would let them know when they were making inconsistent decisions.

At the beginning of this paper I noted that computers might be able to help us in solving a wider range of problems than is now possible. And I also noted that progress in this area depends in part upon a better understanding of how the mind does its work. I hope that I've convinced you that the way we make decisions is tied up very intimately with how we represent the problem in the first place. What we would like is a decision aid that would not be so easily misled by the initial representation, one that would search the problem space for solutions that were not so dependent upon our risk seeking and risk avoiding strategies, and one that pointed out to us our inconsistencies. In the end, of course, we will want to reserve for ourselves the act of deciding among important alternatives. My view of a helpful aid is one that presents alternatives to me and that points out the likely consequences of them. I believe that an intelligent decision-making aid is possible. But before we have one that is of general use we'll have to understand a lot better how we represent problems, and we'll have to understand better the strategies we have for examining the problem space. A computer-based aid must have ways of deciding which of the facts it knows are *relevant* to the problem of the moment; and it will have to determine when other ways of looking at the problem are *similar* to the initial way. It will have to take in sentences of our natural language and represent them in much the way that we do. All of these present fundamental

problems to those of us concerned with how the mind functions. They pose a challenge, no doubt. But, of course, they also present a substantial opportunity for basic research into how we think and act. Over the next decades we may see great advances in our understanding of the very processes of thought, one of the truly great frontiers of discovery.

IDEAS AND THEIR CONSEQUENCES: INDIVIDUALISM RECONSIDERED

WILLIAM MARTIN

When President Hackerman invited me to speak at this meeting about "Ideas and Their Consequences," the topic seemed a bit broad. I considered delivering an overview of world intellectual history until I learned I had only 30 minutes; I could talk about that for at least an hour. I tried to look for ways of narrowing down, of choosing a single idea or set of ideas. As I examined things I had been teaching and thinking and reading about, it occurred to me that several of them could be examined fruitfully in light of what is clearly one of the key philosophical ideas in western society: individualism.

Since individualism has occupied such an enormous amount of the attention of philosophers, deciding to talk about it did not help me narrow down as much as might be desirable. But since I am not a philosopher, my ignorance will doubtless serve me well in making it possible to say less than might be said, while maintaining a clear conscience and a conviction that I have done the best I could.

The first known use of the term "individualism" was in the 1820s by the French, who did not think it was an especially good idea. The Saint-Simonians, blaming it on the Reformation, with its doctrinal emphasis on the salvation of the individual and the priesthood of all believers, attacked it for its glorification of self-interest and individual conscience in the political realm, exploitation in the economic sphere, and unchecked egoism everywhere. A French dictionary published in 1836 treated individualism as a strange term for a "hitherto unknown" evil, but allowed there was no cause for alarm, since both the term and the condition were sure to pass away soon.

In America, "individualism" conjured up a whole set of social ideals and acquired immense ideological significance, a significance it continues to hold in remarkable measure. Here, individualism was seen as the final stage of human progress, a stage characterized by equal individual rights, both regarded as "natural," equal opportunity for self-development, limited government, a laissez-faire economic system, and individual freedom and dignity.

Various foreign observers took note of this new idea as it worked itself out in American society. Tocqueville, of course, had several opinions of note on the matter. Individualism worried him. He viewed it as a source of isolation, of concern only for one's family and private circles, of indifference to ancestors and descendants alike. He feared, in the absence of adequate appreciation for tradition, hierarchy, society and community, that American democracy would lead to powerlessness and, ironically, a tendency to conformity that could rob individuals of their liberty. For their part, most Americans thought the apprehensions of Tocqueville and his countrymen were unfounded. To them, individualism was not a threat to civilization, but its highest manifestation, the goal toward which it was progressing. And its apotheosis was "the masterless man" (Crevecoeur), the "American Adam" (R. W. B. Lewis).

In the interest of time, I'm going to skip discussion of the intellectual sources of individualism. Since you are all philosophers, I trust that you are sufficiently familiar with the contributions of the Puritans, of Hobbes, Locke, Rousseau, Jefferson, Adam Smith, Jeremy Bentham, John Stuart Mill, Walt Whitman, Herbert Spencer, William James and John Dewey to make omission of their contributions bearable.

But whatever the sources, whatever the particular details of its several versions, Americans have been profoundly influenced by the idea and ideology of individualism. Any philosophy that expects to capture the attention of a significant segment of the American public or affect the character of American institutions must understand that and take it into account (as some of our most successful political leaders have recently demonstrated). That an ideology should have such an impact is remarkable enough in itself. In the case of individualism, it is even more remarkable, since the idea is so fundamentally faulty, as its critics have been pointing out for generations.

It is rooted in a faulty psychology and sociology. The autonomous individual the philosophers described, born lord of his person and possessions, born with a moral will and individual conscience, born with presocial instincts and reason that flourish best when free from institutions and the burdens of association, has never existed, cannot exist. The newborn infant is a contraption that doesn't work. If left alone, it will not become an autonomous person possessed of reason and conscience and capable of morality. It will not become a person at all. On the rare and tragic occasions that children are isolated

from normal human society, we call them "feral" children — wild animals — or, even less flattering, vegetables. They cannot become "selves" — human beings with a sense of who they are and what they are doing — on their own. Individuality is a group project. And the product varies enormously, depending on the group in charge of production.

Individualism is also psychologically and sociologically faulty in its optimism and human nature. The body, the natural part of the human, is selfish and antisocial. It must be made social, be made to accept discipline, to develop will, to behave in ways that are at least in some degree unselfish. Removal of the frustrations mandated by social norms — letting children do whatever they want to do, in the belief that children are naturally good and will, left to themselves, choose action beneficial to themselves and, consequently, beneficial to society — will not produce peaceful, kindly children. It will produce outlaws.

Because our selves are social, we need groups all our lives. They mediate between us and the Leviathans. They bind us to others from birth to death. They sustain us, they enable us to maintain our equilibrium under the shocks of life. If a group breaks up around us, if we leave a group of which we are a valued member and find no new group to which we can relate, we will develop disorders of thought, feeling and behavior. I am awed by the intellect of men such as Locke and Rousseau. I would be fascinated to know what they would say about human nature and human selfhood if they knew what we know today. I am sure it would not be what they said in the 17th and 18th centuries.

American individualism draws much of its inspiration from a faulty reading of history. Our Puritan heritage was concerned with individuals, to be sure, but primarily as part of a people joined together in a covenant, a social compact that subordinated the will of individuals to the common good. In *A Model of Christian Charity,* Governor Winthrop wrote: "We must delight in each other, make each other's condition our own, rejoice together, mourn together, always having before our eyes our Communion and Community in the work, our Community as members of the same body." And this communal spirit did not die when the Puritans were superseded by rugged individualists acting in solitary and courageous fashion. The Revolution and the founding of the Republic demanded that citizens sacrifice private want and interest to public good. And, as Roger Rosenblatt pointed out in a recent *Time* essay, "The West

was won by wagon trains, the East by sailing ships, and they all had plenty of passengers aboard, by necessity working together."

The philosophy and religion intrinsic to individualism are also faulty. The Judaeo-Christian tradition is quite unsentimental about human nature. That was and is hard for Americans to accept. As descendants of the American Adam, we want to see ourselves as not yet fallen, as free from the interior flaw theologians call "original sin." Again and again in our history — one might say, until Viet Nam and Watergate — we have clung desperately to our protestations of innocence of wrongdoing, to our conviction that any serious problems and conflicts we have are caused by others, must be caused by others, because virtue resides naturally in our breasts. This ignorance about innocence, this innocence about imperfection and imperfectibility, about the tragic dimensions of human existence, have repeatedly left us without the psychic and spiritual resources needed to deal with the complex challenges that face us, have left us vulnerable to the lure of quick-fix solutions for problems that require instead a capacity for sustained, sacrificial endeavors undertaken with a clear realization that even the best of efforts may not succeed.

Perhaps most ironic of all, the economic theory of individualism is not only faulty; it is far from the one we have actually followed. There was never a time when successful economic systems rested simply on purely individualist drives or impersonal relationships. Even Adam Smith justified laissez-faire individualism by arguing that it helped society. In the colonial economy, the lack of specific government regulations of business was compensated for by the values of close-knit communities. As these informal social controls lost their hold, there emerged rapidly more formal methods of regulating and planning and directing the economic enterprise. Where these were not adequate, critics of the economic system began to demand even more government control, observing that individualistic economics, though enormously productive, was often little more than a code word for selfishness and rapacity. More recently, modern business has championed "free enterprise," but it has not typically insisted that this include freedom from tax-relief, protectionist tariffs, oil depletion allowances, or billion-dollar loans.

Despite its faulty theoretical basis, despite a reality rather different from the popular mythos, despite the extensive critical analysis, often quite negative, to which it has been subjected, individualism continues to have a powerful influence in American thought and practice. Without question, some of its effects have been magnificent.

Belief in the primacy and dignity of the individual has undergirded an avowal and, to a significant degree, attainment of a remarkable set of rights and freedoms. Our political freedom, including the freedom to dissent, has been no small bulwark against the tyranny of authoritarianism. Our federal system allowed institutions to adapt to local conditions and situations. Our economic freedom has produced an abundance of goods and services and invention and opportunity unlike those available to any people in human history. Our religious freedom has been a cornerstone in a system that has enabled an astonishing variety of faiths to be practiced alongside one another in relative peace. Though imperfectly realized, our insistence that these rights are contingent only on a person's being an individual, not on his or her race or sex or religion, exerts a constant moral pressure in the direction of true equality of opportunity.

These are all consequences of individualism of which we can be proud. They are not, unfortunately, the only consequences of individualism with which we must reckon. In its darker appearances, individualism can and does manifest the selfishness and privatism its critics have attributed to it. It is not the only source, to be sure, but I think its influence can be felt rather clearly and directly in a number of important spheres.

In politics, we have seen it manifested in a naive belief that all the evil rests on the other side, in a cowboy diplomacy that too often ignores the interdependency of nations, in a decrease of a sense of collective responsibility for people and problems not demonstrably our own, in a decline in respect for traditional institutions, in single-interest political groups concerned with little beyond their pet projects, and in a notable weakness of political organization that leaves us ever more vulnerable to a potential tyrant.

In the economic realm, we — and I include myself in this category — too often justify our activities by the bottom line rather than the higher purpose. That may involve exploitation of the environment, destruction of landscapes and neighborhoods, unjust behavior toward people powerless to resist us, efforts to avoid regulation of our enterprises, and protection of our interests with the assistance of CPAs, whom we certainly do not expect to take too seriously the significance of the word "public" in their occupational titles.

In religion, we have moved more and more toward the privatism of Paine, who said, "My mind is my church," and Jefferson, who said, "I am a sect myself." We are apt to say, "I have my own religion." Such assertions are appealing to those of us nurtured on individual-

ism. The reality is often an incoherent view of the world that leaves people without the social support of strong communal religion and therefore more vulnerable to the appeal of every passing band of missionaries, especially those who promise to give us authoritative answers in return for our freedom.

In most universities, we see far greater concern with narrow job preparation than with preparation for citizenship, cultivation of character, or immersion in the cultural traditions that provide greater understanding of and appreciation for the varied and interdependent components of human civilization.

In the personal and social realm, individualism has fostered a preoccupation with what is called "self-actualization" and written about in books with titles like *How to be Your Own Best Friend, Looking Out for Number One,* and *Sexual Fulfillment through Intimidation.* In a variety of studies of the values of Americans, the most important of which is reported in *Habits of the Heart,* a new book by Robert Bellah and his colleagues, sociologists have found a dominant concern with the personal growth and fulfillment of the individual. Convinced that "We're all in this alone," and that "In the end, you're responsible for yourself and no one else," millions of Americans feel justified in discarding any job, person, relationship, community, or commitment that does not meet their needs or make them feel good. They are, in effect, denying any claims of reciprocity or community or collective responsibility, any claims others might make on the self.

In the more radical forms of this narcissistic denial, such as that manifested in the therapy program known as *est,* participants espouse a kind of philosophical solipsism, asserting that the individual will is all-powerful, that nothing happens to them that they do not will. What is more surprising, a considerable number of otherwise intelligent folk regard that kind of nonsense as plausible. In more garden-variety forms, a lack of concern for the collectivity, a lack of feeling bound by common ties and rules, frees people to murder, to rape, to rob, to steal, to defraud, to vandalize, to drive while intoxicated, and to alter or obliterate their consciousness with drugs.

What I want to concentrate on more fully for a few minutes, however, are the effects of the ideology of individualism on the family. I certainly do not want to finesse the impact of economic or other personal and social factors that contribute to family problems in America, but I have no real doubt that a high proportion of the devastatingly serious problems threatening the American family are

traceable in significant measure to an obsessive concern with self. How often we have heard divorce justified by such statements as, "I was being stifled." "We're both good people, but we've grown stagnant. We need a chance to grow and develop in new ways." "She doesn't appreciate my need to expand." "It is unrealistic to expect me to limit myself to just one person." "I've only got one life, and I don't want to spend the rest of it weighted down by him."

During the 1970s, it was common to find popular books and sociological studies that indicated that divorce might be not only creative and painless, but of considerable benefit to everybody concerned, even the children. If handled right, we were told, all of the parties to a divorce could reasonably expect to come out of the experience happier, wiser, and more creative and self-actualized. A lot of people wanted to hear that, some people wanted to say it, and, for a time, the evidence seemed to support it. Perhaps it was true that concentration on individual desires maximized the well-being of the family and society as a whole. Increasingly, however, the evidence seems to be leading us in a different direction.

It now appears that painless divorce is a myth. Divorce, for everyone involved — husbands, wives and children — is a traumatic occurrence. And a substantial percentage of those involved, particularly the children, experience longstanding negative effects. Dr. Albert Solnit, director of the Yale Child Study Center, has said, "Divorce is one of the most serious and complex mental-health crises facing children of the '80s."

Please do not misread my attitude as one of smugness or judgment. Certainly, there are situations in which it is clearly better to get a divorce than to stay married. Certainly, there are situations in which you may want to stay married and your spouse does not give you an effective choice. And certainly, most people who have been married for any length of time — say, 27 years — can understand how divorces can happen to good and honorable people who love their children and are deeply concerned to protect them from harm.

And yet, having said that, divorce is still an occurrence quite likely to have serious negative effects on those it touches. In their landmark study of divorce, *Surviving the Break-up: How Children Actually Cope* (1980), Judith Wallerstein and Joan B. Kelly revealed that virtually all children respond to news of their parents' divorce in uniform fashion, characterized by shock, surprise, depression, denial, anger, low self-esteem, guilt, and feelings that their world has been shattered and that the rules no longer make sense. Further,

hardly a child they studied did not cling to a fantasy of magical reconciliation. Even more striking was their finding of far more turmoil than expected, even long after the divorce. Ten years later, for example, only one-quarter could be said to be doing well. Half were "muddling through," but still having to cope with periods of unhappiness and diminished self-esteem. A final one-quarter were still badly bruised; some had been that way before the divorce, but most of their difficulties appeared connected to the divorce. About one-third experienced far-reaching change again when their parents remarried.

Will instability in the family make social institutions unstable? The jury is still out. But when one million children a year experience divorce, and one-third of those — approximately 250,000 people, enough to populate a city almost the size of Austin — are still suffering rather seriously after ten years, I think it would be naive to believe we are not going to feel some bad effects. Unwillingness to make the sacrifices necessary to rear children successfully has led many couples to postpone or forego having children, and has led others to give those children less than an optimum upbringing. There is a fair amount of evidence to indicate that children do best in — even need — a situation in which at least one, preferably more than one, person is irrationally attached to them. The popular assertion that what children need is "quality time" is, in large measure, an illusion, a rationalization offered by people who do not wish or who feel guilty about not being able to spend "quantity time" with their children. Children need quality time, to be sure, but they need it in substantial quantities. I am inclined to think that people who are unable or who don't want to devote sufficient time to rear sound and emotionally healthy children should not give birth to them. On the other hand, I am uncomfortable with abortion as an easy means of avoiding the responsibility of children. I believe there are some cases in which abortion is justified. I don't think I feel that way about a million cases a year. And I think that deciding to get rid of other populations that inconvenience us in our quest for self-fulfillment — the elderly, for example — is not entirely unthinkable.

As you may have gathered, I am not exactly an optimist regarding the future of the American family. The family, as an institution, is in a lot of trouble, and I am not sure things are going to get better. I want very much to believe they will, and there are some hopeful signs. But they consist of renewed commitment to the institution and recognition that successful families often require significant sacrifices

of one's personal wants and interests. And that is not a message inherent in the ideology of individualism.

All right, then. Individualism has its shortcomings, but what would we do without it? How could we accomplish a fraction of what we have accomplished without the emphasis we place on individuals? Well, perhaps we could not have. But the Japanese provide us with living and impressive proof that a successful society, characterized by prodigious accomplishment, can consciously reject one of the West's most cherished ideas, and get by with it.

As Edwin Reischauer, among others, has observed, no difference between the Japanese and Americans is more significant than the greater tendency of the Japanese to emphasize the group, somewhat at the expense of the individual. The stereotype is overdrawn in both directions. Just as Americans are not quite the individualists we consider ourselves to be, the Japanese have more concern for the individual than they sometimes let on. But the differences are real, and one cannot help but notice the pronounced tendency of the Japanese to conform to the group in dress, conduct, lifestyle, personality, and even patterns and modes of thought.

Some observers attribute Japanese group consciousness to traditional rice culture. The basic fact of the rice-farming economy was that a single family could not produce enough to survive, but a dozen families could produce a surplus. They therefore developed a capacity to work together in harmony, no matter how strong the forces of disagreement or social disintegration. In an urban setting, the density of population also contributes to de-emphasis of individual rights. When 28 million people live in Tokyo and its suburbs alone, most in cramped quarters, they must exhibit great personal restraint and consideration for others, if life is to remain tolerable. They must develop skills of cooperation and tone down individual whims and idiosyncrasies far more than is necessary for a people who have lived much of their national life on the frontier. In any case, William Ouichi has observed that "The one value without which Japanese society could not continue was that an individual does not matter."

To many westerners, Japanese anti-individualism is a forbidding picture. And yet, as we all know, it seems to be working. And one of the reasons it works is because the Japanese work at it. Children are taught that everyone benefits from cooperation and restraint of ego. They learn early in life that "the nail that sticks up gets hammered down." They learn that conformity, cooperativeness, reason-

ableness, understanding of others, a harmonious spirit — traits that nurture a group — are more admired than personal drive, forcefulness, and self-assertion. Indeed, a personality that would be described as forceful in the U.S. is seen as neurotic in Japan.

New workers in large Japanese companies are received as if they were newborn children or newly adopted sons-in-law, often with elaborate annual ceremonies. They stay in company dormitories during their training; wear uniforms and badges; exercise and sing company songs during opening ceremonies each day; have company parties in company reception halls to celebrate birthdays, transfers, promotions and retirements; socialize with each other after work, typically in a familiar bar frequented mainly by people from their company; vacation together at company resorts; live together in company apartment buildings, or buy their own homes with mortgage money furnished by the company at favorable interest rates. Presidents and managers of a large company may eat in the company cafeteria and attend birthday parties of assembly-line workers.

Such measures are apparently quite successful at helping Japanese workers to feel they are not just cogs in a machine, but part of something big and important, on the same team with owners and managers, bound up in a single enterprise, as members of a family. Unions exist, but most are company unions rather than the craft unions common in the U.S. They occasionally give some trouble to management, but they are just as likely to pressure each other not to strike or even to give up some demand to make sure that another company does not gain an advantage over their company. And the famed "quality circles" — groups of ten or so workers who meet together regularly with a supervisor to analyze and discuss shop problems — contribute far more to their companies than do the archetypal individualistic assembly-line workers in American factories.

Decision making at all levels is affected by this communitarian ideology. The key value is harmony, or consensus, which they seek to achieve by mutual understanding, almost by intuition, rather than by sharp analysis of conflicting views or clear-cut decisions. Business leaders work closely with each other and with government bureaucrats to map out comprehensive strategies, strategies that may call for several years of sacrifice of short-term profits in order to lay the groundwork for long-term success. They wonder how Americans can hope to remain world economic leaders without this kind of cooperation.

I don't want to romanticize Japan or the Japanese or their culture. I am fascinated with them, but not in love. Their conformist tendencies can restrict healthy dissent and make them rather passive in the face of strong leadership, even when that leadership is unhealthy. The cliche about their role in World War II — "Because the Japanese do nothing alone, they all went mad together" — has more than a grain of truth in it. Their sense of themselves as a people often takes the form of an unpleasant and unhealthy ethnocentrism. Their discomfort with variant behavior can diminish freedom and stifle creativity. Their painfully slow process of getting decisions made can be maddeningly inefficient.

On the positive side, once a decision is reached, the swiftness with which a Japanese group can be mobilized is unparalleled. Furthermore, the claim of some Japanese that their system is a more effective democracy than America's is not altogether farfetched. The villages, towns, firms, professional associations and other groups that constitute the working parts of the Japanese polity, economy and society generally appear to be quite systematic and successful at representing the wishes of their membership.

When the system is working properly, members enjoy considerable emotional support and satisfaction, and produce a prodigious amount of work. The Protestant Ethic is having some trouble among individualist Protestants, but it is doing just fine in collectivist Japan.

As for the future, there are obvious attractions of the Japanese system. In business, for example, some American companies have adopted quality circles and other Japanese techniques. And American workers in such unlikely centers of international understanding as Smyrna, Tennessee, appear to like them a great deal. Conversely, some observers see a weakening of the group ethos in Japan, particularly among the young, and a spread of some of the less attractive, centrifugal forces characteristic of western society. Whatever the future, however one assesses the desirability of the Japanese rejection of the idea of individualism, they have shown that wholism can work, for an entire society, and they have done it at a time when group consciousness was attenuating in other nations.

Let me summarize what we have done. We have seen an idea — or, more properly, a complex of ideas — arise, develop and take tangible form in human history. We have seen its power to inspire men and women to remarkable accomplishment. We have seen its capacity to generate unfortunate consequences, as a cell gone hay-

wire can generate a cancer. And we have seen that a people at least a hemisphere away from possessing the same ostensibly inborn reason, morality and outlook as our own can look at one of the most powerful intellectual forces in our culture and say, "No, thank you. That seems like a bad idea." What can we reasonably conclude from all this?

By itself, individualism is seriously flawed. By itself, collectivism can be stifling and oppressive. But we do not have to choose between them. The key is to try to accommodate both in a creative tension that seeks to balance the precious rights of individuals with equal concern for group and public responsibility. We need to cultivate a deep sense of responsibility for our own behavior and its impact on our fellow beings, on the political, economic, educational, religious and familial institutions to which we and others belong, and on the environment we share with all living creatures. We need to learn to recognize when we have enough, that we may turn our attention to something more beneficial to society than unbounded acquisition and consumption. We need to strive constantly toward peace and nonviolence among individuals, groups and nations. We need to honor those who truly serve mankind and to attach positive value to virtue and character and to the kinds of human community in which they can develop and flourish most readily. And we need a confidence in ourselves and a dedication to society that will move us to recommend these measures to others.

I recognize that such a vision is optimistic. I hope it is not blindly utopian. I acknowledge the dismal weight of Robert Heilbroner's observation that when people can acquiesce in, even relish the destruction of their enemies, and be indifferent to those who rot in prison, live in slums or starve, why should they be expected to take steps to prevent the destruction of generations they will never see? And yet nothing is of more importance to humankind than the formation and nurturing of a collective bond of identity with all who live today and who may live in future decades and centuries.

Obviously, we cannot expect immediate success, or even all the success we might wish. In fact, we have to proceed with full knowledge that we may well fail. But as free individuals who have been nurtured by and owe a profound debt to myriad human groups and institutions, it seems to me we have no choice.

IDEAS AND NATURE: PHYSICAL EFFECTS

A. I. Scott

Man's innate curiosity about nature has been evident since the first written historical records. Early ideas (Greek, Roman, Chinese) centered on *astronomical phenomena,* water clocks (a very early device), Euclidian *geometry,* the *mechanics* of wheels, levers and devices for construction of buildings, bridges and ships, and the development of *empirical methods* for agriculture, including irrigation and crop rotation. In the absence of any objective theories of physics, chemistry and biology, natural events could only be rationalized in superficial ways, and the influence of religious dogma must have been responsible for the disappearance of intellects comparable to Newton until the 17th century.

Perhaps the first change in man's attitude in terms of working on imaginative and (at the time) daring ideas began in the field of astronomy. The revolutionary ideas of Copernicus and Galileo, and the resultant humility of at least some early 17th-century scientists who realized that our planet is not the center of the solar system, generated an atmosphere where scientific ideas could flourish. It is agreed by most historians of science that Newton's contributions in the consecutive years of the Great Plague and the Fire of London (1665-1666) marked the greatest burst of creativity that had to wait until 1905 to be equaled or exceeded by Einstein's five papers of that year. The first of Einstein's 1905 papers revealed the quantum theory of light, the second was the special theory of relativity, followed by three on Brownian motion. Thus he stood at the watershed of the very small (quantum physics and statistical mechanics) and the *almost* infinitely large — the study of space by relativity. His later search for a unified field theory was not crowned with the same success. But there is no question that he set the stage for subsequent work on the quest for such a unification via elementary particle research, which in the ideas of Glashow and others are now finding experimental vindication in the hands of Rubbia. The seminal nature of a *great* rather than a *good* idea, i.e., one with wings rather than legs, in my opinion bears a special hallmark of philosophical depth characterized by a soaring imagination and an eventual outcome that changes the course of science in a dramatic way. In addition to Michael Faraday, whose ideas on magnetism and electricity laid a

firm foundation, Einstein relied heavily on the electromagnetic theories of James Clark Maxwell. Einstein had his inspiration at a unique point in the history of physics. He was influenced by all that had gone before but able to synthesize the apparently divergent ideas of Newton, Faraday and Maxwell into a theory of light that combined both electric and magnetic components. His imagination was then free to soar into the fourth dimension in deriving the space-time relationships of special relativity. Einstein was *26*, Newton *23* at the time of the genesis of their great ideas. Perhaps no other discoveries will ever equal this kind of synthesis.

What about ideas in biology and chemistry, which are surely comparable in their long-term impact on the understanding and harnessing of physical phenomena to those in physics (in spite of Dirac's pronouncement in 1929 that with the arrival of rigorous quantum mechanical calculations there was nothing left to discover in chemistry)? However, since chemistry, biochemistry and biology continue to pose enormously difficult experimental and conceptual problems such as cellular control mechanisms, memory, intelligence, dysfunction and immunology, to name only a few, let us turn from the great ideas of physics to those of chemistry, biology and medicine.

Kekule's dreamlike vision of a serpent biting its tail and becoming hexagonal in form led (perhaps apocryphally) to the structure of benzene, which bears his name.

> I was sitting writing at my text-book; but the work did not progress; my thoughts were elsewhere. I turned my chair to the fire and dozed. Again the atoms were gambolling before my eyes. This time the smaller groups kept modestly in the background. My mental eye, rendered more acute by repeated visions of the kind, could now distinguish larger structures, of manifold conformation: long rows, sometimes more closely fitted together; all twining and twisting in snake-like motion. But look! What was that? One of the snakes had seized hold of its own tail, and the form whirled mockingly before my eyes. As if by a flash of lightning I awoke; and this time also I spent the rest of the night in working out the consequences of the hypothesis.

The idea of tetracovalent carbon, attributed solely to Kekule, was, however, promulgated independently in 1858 by a young Scottish graduate, A. S. Couper, whose manuscript was suppressed. A century later this concept was renamed Kekule-Couper Theory. Couper never knew that he had won scientific immortality. He died in 1892

"of a broken heart," unhonored and unknown. In 1931 his discovery was in fact recognized, and a plaque was placed above the doorway of the house in which he was born to commemorate his tragic genius.

The great figure of organic chemistry at the turn of the 19th and 20th centuries was Emil Fischer, who showed the polypeptide nature of proteins and also advanced the idea in 1894 that enzymes were specific in choosing their substrates, suggesting a lock and key mechanism. This idea persisted in the three-point attachment concept until 1949, when A. G. Ogston showed that for tetrahedral carbon it is only necessary to bind two of the four substituents to achieve complete specificity. It is amazing how long this idea took to germinate, yet Ogston tells us that it came to him in a "blinding flash lasting five seconds." In the late 1920s, the Dirac pronouncement that "there was nothing to be discovered in chemistry which had not been predicted by physics" seemed to cause a hiatus, although biochemistry proceeded apace in the hands of Warburg, Szent-Gyorgi and Krebs. Following his success in demonstrating the urea cycle in the kidney, Krebs evolved the idea of the citric acid cycle. His paper to *Nature* in 1936 (which was later to win a Nobel Prize) was politely but firmly rejected as being too speculative. However, a flood of experimental support in the next year led to its acceptance in 1937. The rest is history.

We could cite other examples of *great* ideas, but perhaps the best known at the interface of physics and chemistry which led to the entire field of molecular biology is the double helix of Watson and Crick, a brilliant synthesis of ideas and results available from X-ray diffraction.

Turning from a general survey of a few of the really important ideas that affected man's view of nature in the most dramatic way, I have selected a particular field close to my own areas of interest which will illustrate the affects of ideas in physics, chemistry and biology on our ultimate understanding of the physical world, or at least our perception of certain physical and biological phenomena.

The development of electromagnetic theory by Maxwell and Faraday and the quantum theory by Planck, Einstein, Born and others paved the way for the development, at the end of World War II, of a new principle involving measurement at the radiofrequency energy level of the magnetic resonance of certain nuclei (the proton, carbon-13, nitrogen-15) whose spin systems could "report" in a very specific way during relaxation in a high magnetic field. The ideas of Bloch and Purcell were applied to the production of

nuclear magnetic resonance (NMR) spectrometers, which by the 1960s were used widely in chemistry since each reporter nucleus in a molecule as complex as vitamin B_{12} gives rise to a specific, invariant signal. In this way structural assignment became routine. By the late 1970s the idea that living systems could be examined by this method became a reality, although not without a great deal of skepticism (the hallmark of a great idea). Since that time, groups of biologists, chemists and physicists working closely together have been able to elicit important information from organisms as diverse as the B_{12}-producing bacteria, insects, parasite organisms, red blood cells, and perfused liver, kidney and heart. An interesting sidelight on the porphyrin-B_{12} connection is the idea advanced by McCalpine in "George III and the Mad Business" (and corroborated by documentary evidence from the relevant physicians' casebooks) that the loss of the Colonies in 1776 was due to the fact that George III (and indeed the whole House of Hanover) suffered from the inborn, genetically transmitted error of metabolism known as porphyria. Even more speculative is the idea that the acute form of this disease, where the patient becomes light-sensitive, grows hair on the back of the hand and cheekbones and suffers from periodic bouts of madness, explains the origin of the legend of the werewolf, which was prevalent in early farming communities in Eastern Europe (e.g., Transylvania) where family intermarriage perpetuated the genetic error. To this day, porphyria is rife in such inbred and still primitive communities in South Africa and Australia. Returning to George III, it is also remarkable to note that Benjamin Rush, the great American physician and signatory of the Declaration of Independence, who has been called the Father of American Psychiatry, suggested in 1811 that George's physicians might use the "Rush Restraining Chair" on the king to alleviate his condition, an offer which was fortunately declined.

So much for two minor but interesting consequences of porphyria metabolism. The recognition of the importance of this pathway in producing hemoglobin, chlorophyll and vitamin B_{12} has already led to several Nobel prizes in chemistry and medicine. The more recent work on the vitamin could only have been carried out with the help of NMR.

Finally, the idea that the relaxation times (T_1) of the water molecule associated with different organs and different densities of tissue *in vivo* has led to the development of whole body imaging — NMR scanning — which turns out to be more powerful and sensitive than

CT-scanning in that many cases have been reported recently where the NMR technique has led to diagnosis of small brain tumors and effects of multiple sclerosis which do not show up on the CT-scan.

The ultimate goal (which will combine many physical techniques) is to synthesize our ideas on the function of the brain and devise noninvasive methods of studying the behavioral response to stimulus by light, sound, smell, taste and feel. The study of brain biochemistry and development is one of the greatest challenges for scientists of the 1990s. Finally, the idea that man can harness biological and biochemical methods (biotechnology) to provide a clean and safe source of energy and food is already being actively pursued. The Watson-Crick discovery of the double helix and their early idea that DNA provides the genetic code for RNA and thence protein is perhaps the most important development in the realm of biology and chemistry since it gives the next several (or many) generations of scientists the confidence to search for solutions to problems of world health using non-mammalian genetic engineering for the enhancement of the quality of life for everyone on this planet.

N E C R O L O G Y

TRUMAN GRAVES BLOCKER, JR.

1909-1984

THE FOLLOWING MEMORIAL WAS DISTRIBUTED BY THE UNIVERSITY of Texas Medical Branch upon Dr. Blocker's death.

Truman Graves Blocker, Jr., 75, president emeritus of The University of Texas Medical Branch, died Thursday, May 17, 1984, in John Sealy Hospital. The UTMB chief executive during 1964-74 had been hospitalized since January 1, when he suffered a stroke at his home in Galveston.

A 1933 graduate of the Medical Branch, Dr. Blocker was the first to carry the title UTMB president and has played a leading role in the history of this institution for almost 50 years. He was an internationally recognized authority in the field of plastic surgery and burn therapy. He was a brigadier general, U. S. Army Reserves (Ret.), and, among his many affiliations at the time of his death, was chairman of the Galveston College Board of Regents and a trustee of Austin College, Sherman.

William C. Levin, M.D., UTMB president since 1974, praised his predecessor and longtime medical faculty colleague as a person of extraordinary accomplishment in medicine and university administration. He characterized Dr. Blocker as a builder of the specialty of plastic and reconstructive surgery and a builder of the Medical Branch.

Dr. Levin noted that Dr. Blocker was a forceful, effective civic leader as well, and "much of what he did at the Medical Branch served the Galveston community he loved." In mourning his death, Levin said he joins with the Blocker family and the large circle of colleagues and friends who "rejoice in a life so splendidly lived."

Dr. Blocker was associated with the Medical Branch almost continuously since beginning his medical studies there in 1929. Born April 17, 1909, in West Point, Miss., he attended public schools in Sherman, Texas, and received a bachelor of science degree from Austin College. He received his medical degree from UTMB in 1933, served an internship at the Graduate Hospital in Philadelphia and returned to UTMB for a residency in surgery. After brief service

as an instructor in surgery at Presbyterian Hospital, Columbia University, he began his almost 50 years on the UTMB medical faculty with his appointment as an assistant professor of surgery in 1936.

He was certified in the specialty of plastic surgery in 1942, the year he was named an associate professor and began an extended leave for service during World War II. He entered the Army Air Corps as a captain, then was transferred to the Army Medical Corps where he rose to the rank of colonel and was awarded the Legion of Merit for his outstanding work in plastic surgery. He gained particular recognition in the care of war casualties as chief of surgery at Wakeman General Hospital, a 2,000-bed facility in Indiana. He continued in the U. S. Army Reserves after his active duty discharge and a decade later achieved the rank of brigadier general.

Returning to UTMB in 1946, Dr. Blocker was named a full professor and director of the new division of plastic and maxillofacial surgery. From this post he produced an increasing number of research reports drawing international acclaim. Many of the some 200 published articles during his long career were co-authored with his wife Virginia Howard Irvin Blocker, a 1939 graduate of UTMB and an established physician in her own right. He also co-authored many papers with Dr. Levin and Stephen R. Lewis, M.D., the noted surgeon who succeeded him as division chief.

The Drs. Blocker published a major survey on 3,000 casualties of the massive explosions known as the 1947 Texas City Disaster, then did a nine-year follow-up on 800 of the victims. He was director of medical operations at the time of the disaster. The couple in 1971 were joint recipients of the American Burn Association's Harvey Allen Award.

Prior to his appointment as UTMB chief administrator, Dr. Blocker served variously as director of the postgraduate division, director of the special surgical unit, director of UTMB hospitals, dean of the clinical faculty, chairman of the interim executive committee and chairman of the department of surgery. In 1964 he succeeded John B. Truslow, M.D. as UTMB executive director and dean, and in 1967 became the institution's first president. He was named the Ashbel Smith Professor of Surgery concurrently in 1973.

The 10 years of Dr. Blocker's leadership were a period of unprecedented growth for the Medical Branch. New programs included the Chronic Home Dialysis Program, the School of Allied Health Sciences, the Marine Biomedical Institute, the Family Medicine Program, the Center for Audiology and Speech Pathology, the Depart-

ment of Human Biological Chemistry and Genetics, the Renal Transplant Center, the Area Health Education Center, the Hyperbaric Medicine Program and the Institute for the Medical Humanities. He was influential in campaigns to save the historic Ashbel Smith Building (Old Red), the development of ancillary programs such as University Police and educational television, the acquisition of a UTMB research vessel, purchase of the historical microscope collection, the naming of the first full-time dean of graduate studies, and the collection of rare medical books.

A most visible effect of his leadership was the extensive building program. Beginning with the 1964 construction of the Shriners Burns Institute (a UTMB-affiliated hospital), the medical complex grew with the addition of the John W. McCullough Outpatient Clinic, the Jennie Sealy Hospital, the Alumni Field House, the Animal Care Center, the Libbie Moody Thompson Basic Science Building, the Clinical Sciences Building, the Moody Medical Library, the Administration Building, the Child Health Center and the 12-story John Sealy Hospital South Addition.

Dr. Blocker served many, varied consultantships over the years and garnered special appointments and honors of national and international distinction. He has been a consultant to the Army, Air Force, Veterans Administration, Department of Defense, M. D. Anderson Hospital, Shriners of North America, Public Health Service and Office of the President. He has served on committees of the National Institutes of Health, the some 30 professional organizations to which he belonged and any number of special investigative bodies. He was acting dean of the UT Medical School, San Antonio, for part of 1972 and was acting president of the UT Health Science Center, Houston, in 1977-78.

His many honors, in addition to those already mentioned, include the Distinguished Alumnus Award from UTMB and from Austin College, an honorary doctor of science from Austin College, the Leone Award for Administrative Excellence at UTMB, distinguished service awards from the Texas Medical Association and many national and international scientific groups, and many appreciation awards from student and civic groups. The Blocker-Lewis Plastic Surgery Society honors him and Dr. Stephen R. Lewis. A Truman G. Blocker, Jr. Distinguished Chair in Plastic Surgery has been established at UTMB with funds from the Moody Foundation, the Blocker-Lewis Society and other friends.

Upon retirement in 1974, Dr. Blocker became the first to hold the title of UTMB president emeritus. He has maintained an office on campus since then and continued much of his teaching and research work as well as his involvement in many development efforts at UTMB. Particular interests included the library's rare books collection and the restoration of the Ashbel Smith Building, begun this year. He continued much civic work also. He was on the governing boards of Shearn Moody Plaza Corp. and Rosenberg Library, Galveston, and the Texas Scottish Rite Hospital, Dallas, as well as those of Galveston College and Austin College at his death. Business affiliations included boards of InterFirst Bank, Galveston, and American National Funds Group. In 1977, Dr. Blocker was president of the Philosophical Society of Texas.

He is survived by his wife, Dr. Virginia Blocker; a daughter, Anne Singleton Blocker of Woodland Park, Colorado; three sons, Dr. Truman G. Blocker III of Dallas, Dr. Sterling Blocker of St. Louis, and Gordon Blocker of Dallas; and 12 grandchildren.

HELEN HARGRAVE

1894-1985

HELEN HARGRAVE, FORMER LAW PROFESSOR AT THE UNIVERSITY of Texas School of Law and longtime law librarian, died on May 15, 1985.

Miss Hargrave, a native of Bay City, Michigan, was born November 7, 1894. She moved to Austin in the 1920s, and with characteristic energy pursued degrees in both the liberal arts area and the School of Law. She received her law degree in 1926 and was admitted to the law practice in Texas forthwith. While enrolled at the University of Texas, she was an active member of her sorority, Pi Beta Phi, and received academic honors by earning membership in Cap and Gown, Mortar Board, and a place on the Editorial Board of the *Texas Law Review*. She was appointed assistant law librarian at the University of Texas School of Law in 1930 and became head librarian in 1940. She continued as head librarian for 25 years. After retirement from full-time service in 1965, Miss Hargrave continued to work and teach until 1971, at which time she was named professor emeritus.

During her tenure as law librarian, Miss Hargrave gave generously of her time outside the University of Texas. She served as president of the American Association of Law Libraries, played a major role in establishing the law library at Texas Southern University, and helped create a library for the Supreme Court of Texas. Many times, she chaired important committees for the Public Library Board of Austin, the Philosophical Society of Texas, and the Law Library Journal.

The University of Texas and the legal profession owe a particular debt of gratitude to Miss Hargrave. She was in large part responsible for guiding the law library from obscurity to prominence — from being just another law library to being one of the finest law libraries in the United States. Joe R. Greenhill, former Chief Justice of the Supreme Court of Texas, said it very well: "It is because she gave unstintingly of her time and energy that the library has today a collection, unequalled in many aspects by schools with larger resources, which has attracted outstanding legal scholars from all parts of the country."

Many law graduates remember Miss Hargrave primarily because of her compassion, concern, and assistance. During her 41 years of service with the Law Library she assisted law students in a variety of ways, especially those students who chose to participate in legally instructive extracurricular activities, such as briefwriting and appellate advocacy, legal aid, and student research for practicing attorneys. Never was her compassion and altruism more evident than in the trying days of World War II. She began the publication of a newsletter that went to 2,500 men and women throughout the world about the law school and about past and present law students in service to their country.

Now Miss Hargrave is gone, but not the effects of her life. Her life spanned the better part of our century, and she spent it well.

—P.K.

LEVI ARTHUR OLAN

1903-1984

LEVI ARTHUR OLAN DIED IN DALLAS OCTOBER 17, 1984, ENDING a distinguished career as rabbi, scholar, educator, and social justice advocate. Born Levi Olanovsky, March 22, 1903, near the city of Kiev in the Russian Ukraine, he and his parents came to the United States when he was two years old to escape the severe persecution then being directed toward Russian Jews. The family settled in Rochester, New York, where his father was first a peddler and later managed a clothing store.

Rabbi Olan graduated from Hebrew Union College in Cincinnati, and then served as rabbi in Worcester, Massachusetts, for 20 years. In 1949, he came to Texas to head Temple Emanu-El of Dallas, a position he held until his retirement in 1970. During those years, in addition to being the spiritual head of a distinguished congregation, he rose to become the president of the Central Conference of American Rabbis, the highest honor within reach of this branch of American Judaism.

Rabbi Olan's presence went far beyond the boundaries of a local congregation and a particular religious family. His compassion for all people of all religions, races, and economic status made his service on many civic and cultural boards distinctive. He was concerned to improve the quality of life for all men, and such concern led him frequently into conflict with other members of the Dallas community. In such battles, Rabbi Olan's articulate expression of the demands of justice and mercy many times tipped the scales toward a more humane solution or attitude. When he died, one Dallas paper, in an editorial, concluded: "To look back on Olan's long career in Dallas — which ended Wednesday with his death — is to see that he was right more often than Dallas wished to think him, and that, because of him, this is a wiser, kindlier city."

From the beginning of his residence in Texas, Rabbi Olan's influence spread quickly over the state. Widely sought as a lecturer, he very quickly became a resource figure where educational and social issues were raised. Because of these wide-ranging services, an appointment to service on the Board of Regents of the University of Texas followed. During his term, 1963 to 1969, his support of the

bibliographic programs of the late Harry Ransom was pivotal in bringing to Texas many important manuscript and book collections.

Rabbi Olan is survived by his wife, Sarita M. Olan; a son, Dr. David Olan; and two daughters, Mrs. Elizabeth Hirsch and Mrs. Francis Olan-Joseph; and four grandchildren. Final services were conducted in the architecturally famous Temple he himself had led in building, Temple Emanu-El, Dallas, on October 19, 1984. Burial followed in Temple Emanu-El Cemetery, Dallas.

—D.H.T.

FRED POOL

1908-1984

FRED POOL OF HALLSVILLE DIED APRIL 29, 1984, AFTER MANY dedicated years of service with Chamber of Commerce organizations and personal efforts to improve international business relations.

Born in Rotan, TX, on April 23, 1908, Pool was a descendant of settlers who had followed Stephen F. Austin to the original Texas colonies. His grandfather served in the Texas Army and fought at the Battle of San Jacinto.

After graduating from Brady High School in 1926, Pool attended Southern Methodist University, the University of Texas, and Cumberland University in Tennessee, where he received a law degree in 1935. He taught Spanish and commercial law at Castle Heights Military Academy in Lebanon, TN, after receiving his degree. During this time he met and married Norma McCullough of Houston.

In 1942, Pool was commissioned to serve as a captain in the U.S. Army. He returned from military service to take the position of manager of the Chamber of Commerce at La Porte, which began a lengthy career in commerce and international business relations. He served as Chamber of Commerce manager at Georgetown and Alice before joining the staff of the East Texas Chamber of Commerce (ETCC) in 1952. In 1956, he became executive vice-president and general manager of ETCC, in which capacity he served through 1969.

During his tenure at ETCC, Pool established a tourism department and conducted national and international industrial tours. He organized world trade tours to 38 countries, including every Latin American country and nine European countries. He also initiated

a Texas Ranch Tour for cattlemen from El Salvador and Venezuela, as well as the Texas Junior Ambassador Tours for high school boys.

After retirement, Pool served as a foreign trade consultant and organized tours to Central America. For his service in international affairs, Pool was awarded the first gold medal at the Houston International Trade and Travel Fair, and he received awards from Peru, Argentina, Mexico, El Salvador, and Guatemala.

Pool's professional and civic associations included presidency of the Southern Association of Chamber of Commerce Executives and the Texas Chamber of Commerce Managers Association; vice-presidency of the Council of State Chambers of Commerce of the U.S.; and membership on the Governor's Special Water Development Committee, Advisory Committee to the Chairman of the Texas Industrial Commission, board of directors of the Texas Safety Association, Committee on Christian Social Relations of the Episcopal Diocese of Texas, and the Regional Import-Export Council of the U.S. Department of Commerce.

A longtime member of Rotary International, Pool was a member and lay reader of Trinity Episcopal Church. He had been a member of the Philosophical Society since 1963.

Pool was formerly a part-time reporter for the *Houston Chronicle* and was the first news reporter on the scene of the Texas City disaster. He later wrote editorials for ETCC's *East Texas,* and many were distributed in the media statewide.

He and his wife raised championship Irish setters, for which he received recognition by the American Kennel Club.

Survivors other than Mrs. Pool include a stepson, Calvin Clausel of Houston; sister, Mrs. Joe Brown of Arlington; and two stepgrandchildren.

H. B. ZACHRY

1901-1984

THE PHILOSOPHICAL SOCIETY LOST A VALUABLE MEMBER, AND THE state of Texas lost a valuable citizen with the sudden death of Henry Bartell "Pat" Zachry from a stroke on September 5, 1984.

Mr. Pat was born in Uvalde on September 9, 1901, to John and Emma Zachry. His father was a businessman who, early in his son's life, taught him the principles of business by giving him a small number of cows, hogs, and chickens, and telling him he had to earn his own spending money. The early experience seems to have worked!

Young Henry attended public schools in Uvalde and, in high school, won the first A&M scholarship awarded to a Uvalde graduate. He lettered in both baseball and football in high school and was a member of the debate team. It was as a member of the debate team that he earned the lifelong nickname of "Pat" when his father called him Patrick Henry due to his considerable ability at public speaking.

When Henry attended A&M his intent was to major in agriculture, ranch management, and animal husbandry in order to become a rancher. Typically, if he was to be a rancher, he wanted to be a good one. But because he was in school at the time of World War I, he changed to a major in engineering and received a bachelor's degree in civil engineering.

After graduation, his first engineering work was on a county road job near Laredo. In 1924, he founded the H. B. Zachry Company which became a worldwide construction company, adopting the hallmark, "A creative imagination, courage, the will and the skill to work are the priceless ingredients of progress." Zachry was actively engaged in all types of construction and related industries. Through his ingenuity, organization, development, and management, the company grew from a modest beginning to a multi-million dollar worldwide construction operation.

Subsidiary business interests of the H. B. Zachry Company included: oil and gas, aggregate production, cement manufacturing, modular construction, ranching, insurance, hospital and medical center, hotel ownership, and others.

Zachry served as president of Associated General Contractors of America; director of the Dallas Federal Reserve Bank; and chairman and chief executive officer of the Board of San Antonio Fair, Inc. (HemisFair 1968). He was one of the original founding board mem-

bers of the Southwest Research Institute and remained a member of the board for life.

Over the years, Zachry's interest in education was far-reaching. He was a member of the Alamo Heights Independent School District Board in San Antonio for nine years and served as its chairman. He was a member of the Board of Directors of the Texas Board for Special Schools and Hospitals. He served for six years on the Board of Directors of Texas A&M University and was chairman for two years. In 1963, the governor of Texas appointed him to head a 25-member "Committee on Education Beyond the High School" to write a program to make the 22 state universities and colleges and 35 junior colleges part of an educational system second to none in the United States. This resulted in the establishment of the Coordinating Board for Texas Colleges and Universities, on which he served an additional six years. In 1972, the Zachry Engineering Center, a modern, four-story, complete engineering facility, was dedicated at Texas A&M University — a fitting tribute to his many years of service to education in Texas.

Among the additional honors Mr. Zachry received are: "Distinguished Alumnus" Award from Texas A&M University — 1964; "Distinguished Citizen Service Award as Engineer of the Year" from the Texas Society of Professional Engineers — 1962; Member with Special Honors, Chi Epsilos, National Civil Engineering Honor Fraternity — 1966; "Men Who Made Marks" by *Engineering News-Record* — 1967; Silver Keystone Award from Boys' Clubs of America for distinguished service; "Mr. South Texas" — 1968; Miles' Non-Member Award for "Outstanding Achievement in Construction" — 1975; first recipient of C. C. "Polly" Kruger award from San Antonio A&M Club — 1977; Golden Deeds Award for 1979 from San Antonio Exchange Club; and numerous commendations and awards for outstanding construction performance from all branches of the military.

Although his professional accomplishments were many, and he could be called a success as an engineer and as a businessman by any standards, his personal qualities were what made him a great community leader and a great family man. He was known to be a man of great competence in many fields, a man of ultimate honesty, of great courage, and of great good humor. People simply liked to be around him and to work with him. He was a man of action and persistence. "Pat" Zachry stories and anecdotes abound, and it was a rare community gathering where some event of his past was not

told or "Mr. Pat" quoted. His absolute integrity made him a uniquely fine individual and an inspiration to friends and associates.

But his philosophy of life is best given in his own words:

> "I do not choose to be a common man. It is my right to be uncommon if I can. I seek opportunity — not security. I will refuse to be a kept citizen, to be humbled and dulled by having my state and nation look after me.
>
> I want to dream and to build, to fail and to succeed — never to be numbered among those weak and timid souls who have known neither victory nor defeat. I know happiness can come only from the inside through constructive work and sincere positive thinking. I know that the so-called pleasures of the moment should not be confused with a state of happiness. I know that I can get a measure of inner satisfaction from any job if I intelligently plan and courageously execute it.
>
> I know that if I put forth every iota of strength that I possess — physical, mental and spiritual — toward the accomplishment of a worthwhile task ere I fall exhausted by the wayside, the Unseen Hand will reach out and pull me through.
>
> Yes, I want to live dangerously, plan my procedures on the basis of calculated risks, to resolve the problems of everyday living into a measure of inner peace.
>
> I know if I know how to do all this, I will know how to live and, if I know how to live, I will know how to die."

Although he lived to almost his eighty-third birthday, in his presence one never noticed his age, and he enjoyed good health until the last few days of his life. His attitude toward old age is given very well by one of his favorite poems:

> I will grow old perhaps, but not today,
> Not while my hopes are young, my spirit strong,
> My vision clear — because life has a way
> Of smoothing out the wrinkles with a song!
> I will grow old perhaps, but not today,
> Not while my dreams remain a shining shield,
> My faith a lance, and 'neath a sky of grey,
> My colors wave upon the battlefield.
> I will grow old perhaps, but not today,
> Not while this pen can write upon a page,
> And memories turn winter into May,
> Shall this stout heart be brought to terms by age!

I will grow old perhaps, but not today,
  And scorning time who would enlist my tears,
I stand convinced there is a better way,
  Of occupying all the coming years.
I will grow old perhaps, but not today —
  In my own style and in my own sweet time.
No night so dark there does not fall a ray
  Of light along the narrow trail I climb.
O say of me, when my last hour slips
  Like one bright leaf to softly rest among
The others . . . "Life was honey on the lips
  Of one who died believing he was young."

"Pat" Zachry had a fine family on every count: supportive, congenial, and with love, esteem, and respect for the patriarch. Perhaps his family did not consider him the patriarch, but his friends and the community did. His two wives, Marjorie and Polly, each in her own way, contributed greatly to the family and were each a source of encouragement and enjoyment to Mr. Pat. He is survived by Polly, by his sons Bartell and James, by his daughters Mary Pat Stumberg, Emma Leigh Carter, and Suzanne Word, by 17 grandchildren, and by a greatgrandson.

A local newspaper summed it up in reporting the funeral at the First Presbyterian Church at which over 2,000 people attended by printing the headline, "An era ends for San Antonio." It could easily have said for the state of Texas.

—F.H.

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*Mirabeau Buonaparte Lamar	1837-59
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*Charles Shirley Potts	1937
*Edgar Odell Lovett	1938
*George Bannerman Dealey	1939
*George Waverley Briggs	1940
*William James Battle	1941
*George Alfred Hill, Jr.	1942
*Edward Henry Cary	1943
*Edward Randall	1944
*Umphrey Lee	1944
*Eugene Perry Locke	1945
*Louis Herman Hubbard	1946
*Pat Ireland Nixon	1947
*Ima Hogg	1948
*Albert Perley Brogan	1949
*William Lockhart Clayton	1950
*A. Frank Smith	1951
*Ernest Lynn Kurth	1952
*Dudley Kezer Woodward, Jr.	1953
*Burke Baker	1954
*Jesse Andrews	1955
James Pinckney Hart	1956
*Robert Gerald Storey	1957
*Lewis Randolph Bryan, Jr.	1958
W. St. John Garwood	1959
George Crews McGhee	1960
*Harry Huntt Ransom	1961
*Eugene Benjamin Germany	1962
Rupert Norval Richardson	1963
*Mrs. George Alfred Hill, Jr.	1964
*Edward Randall, Jr.	1965
*McGruder Ellis Sadler	1966
William Alexander Kirkland	1967
*Richard Tudor Fleming	1968
*Herbert Pickens Gambrell	1969
Harris Leon Kempner	1970
*Carey Croneis	1971
Willis McDonald Tate	1972
*Dillon Anderson	1973
Logan Wilson	1974
Edward Clark	1975
Thomas Hart Law	1976
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Price Daniel	1979
Durwood Fleming	1980
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*Leon Jaworski	1983
Wayne H. Holtzman	1983
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**Deceased*

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JOHN WILLIAM SPIES
TOM DOUGLAS SPIES
ROBERT WELDON STAYTON
RALPH WRIGHT STEEN
IRA KENDRICK STEPHENS
ROBERT GERALD STOREY
GEORGE WILFORD STUMBERG
HATTON WILLIAM SUMNERS
ROBERT LEE SUTHERLAND
GARDINER SYMONDS
ROBERT EWING THOMASON
J. CLEO THOMPSON
LON TINKLE
CHARLES RUDOLPH TIPS
HENRY TRANTHAM
GEORGE WASHINGTON TRUETT
RADOSLAV ANDREA TSANOFF
EDWARD BLOUNT TUCKER
WILLIAM BUCKHOUT TUTTLE
THOMAS WAYLAND VAUGHAN
ROBERT ERNEST VINSON
LESLIE WAGGENER
AGESILAUS WILSON WALKER JR.
THOMAS OTTO WALTON
ALONZO WASSON
WILLIAM WARD WATKIN
ROYALL RICHARD WATKINS
WALTER PRESCOTT WEBB
HARRY BOYER WEISER
ELIZABETH HOWARD WEST
CLARENCE RAY WHARTON
WILLIAM MORTON WHEELER
JAMES LEE WHITCOMB
WILLIAM RICHARDSON WHITE
WILLIAM MARVIN WHYBURN
HARRY CAROTHERS WIESS
DOSSIE MARION WIGGINS
JACK KENNY WILLIAMS
JAMES BUCHANAN WINN JR.
JAMES RALPH WOOD
DUDLEY KEZER WOODWARD JR
WILLIS RAYMOND WOOLRICH
BENJAMIN HARRISON WOOTEN
GUS SESSIONS WORTHAM
LYNDALL FINLEY WORTHAM
FRANK WILSON WOZENCRAFT
WILLIAM EMBRY WRATHER
ANDREW JACKSON WRAY
RAMSEY YELVINGTON
HUGH HAMPTON YOUNG
STARK YOUNG
HENRY B. ZACHRY