60 YEARS • ALBERT G. WILSON

Thirty years ago this Autumn, the world's first great Schmidt Telescope was put into operation on Palomar Mountain. This instrument could not only penetrate to great depths in space, but unlike other large telescopes, it had a wide field of view. It could photograph the entire bowl of the dipper in one exposure, while the 200-inch telescope would require scores of exposures to cover the same area.

I had the privilege of working with this telescope as it revealed for the first time what our universe was like to a distance of a billion light years. Many startling and exciting objects were discovered, some of them possessing great beauty, like the nebulosity on the cover. I discovered this particular object early in 1949 and gave it the prosaic name of "Cone Nebula." Now I feel the nebula should have a new name more in accord with its rich beauty: "The Madonna Nebula."

60 YEARS

ALBERT G. WILSON

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If a man is fortunate he will, before he
dies, gather up as much as he can
of his civilized heritage and transmit
it to his children.

Will Durant

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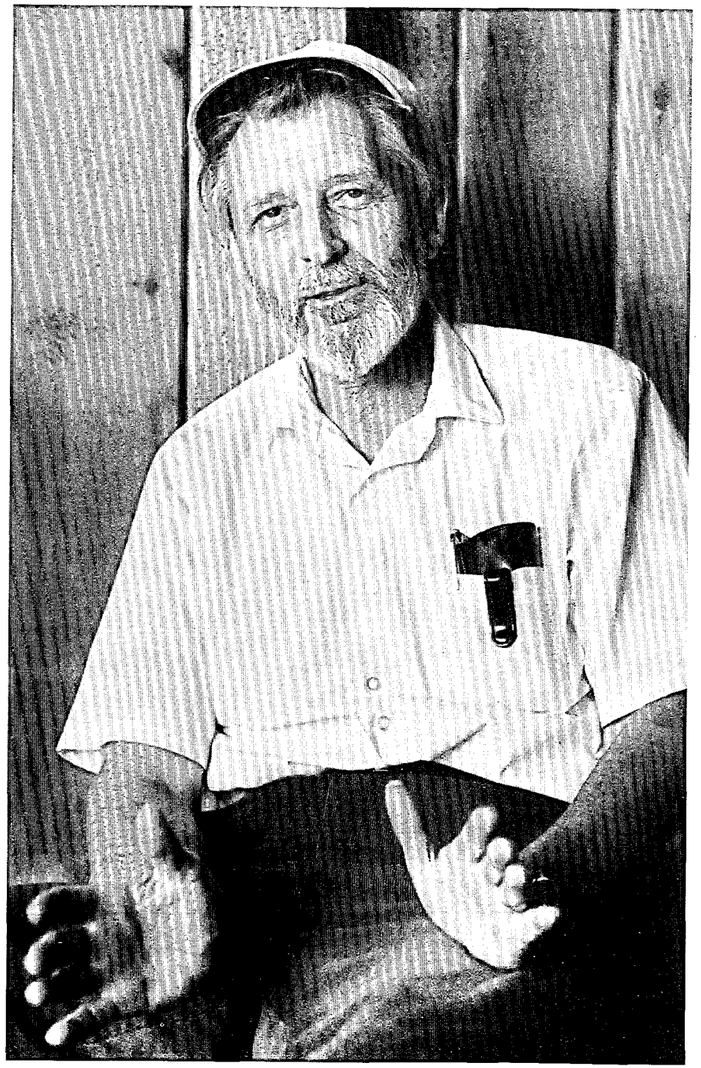

PREFACE

This little booklet has developed in response to a challenge thrown my way by my older son. Last Christmas he phoned: "Dad, next summer you will be turning sixty. That is an important birthday—one of Life's watersheds, so to speak. I want to come to Topanga to help you celebrate. You have been around six whole decades so you have probably learned something worth passing on to the rest of us. When we get together to celebrate, why don't you get it together and share with us what you consider to be the most important things you have learned in your first sixty years on this globe."

At first I took this as just a nice compliment, the same sort as he had given me when he was eleven and asked me one day, "Dad, are you the secret chief editor of Mad Magazine?" Then, I began to see this was something more than a compliment. It was a challenge—a challenge to prove whether I had really in all this time learned anything worth passing on. Being a Leo, I accepted the challenge, and the chips were down.

As I thought more about this idea of getting something really worthwhile together to pass on, two notions began to overwhelm me. The first was, 'What is worth doing is worth doing well,' but I have always favored the version, 'What is worth doing is worth doing to excess.' This seemed to imply that something more than a few notes on odd scraps of paper was called for, and the idea of a pamphlet emerged. After further thought, it became evident that the name of this game was *distillation.* I had to condense into a few 'golden words' anything I had to say. I recalled Goethe's apology to a friend: "Please forgive my writing you a long letter—I did not have time to write you a short one." And this led to the second notion that began to overwhelm me: If I am going to get it together by next July 28, then I should have had a little more warning—something like an additional 59 years. But here I was beginning to take the task too seriously. After all I should not mistake a good humored compliment for an election to the office of Sage of the Age.

Nonetheless, the idea is a good one, not just for me at sixty, but for everyone at key birthdays throughout life. We prepare wills bequeathing our material goods, but is it not just as important that we prepare testaments passing on to our friends whatever nonmaterial wealth we may have accumulated. I prepared this pamphlet as a paradigm, urging all of my friends and relatives to follow suit—get your testaments together too and share your treasures.

Finally, in view of its history, I dedicate this booklet to its progenitor, Arthur Seymour Wilson.

PATH TO 60

It isn't what we don't know that gets us into trouble, it's what we know that ain't so.

Will Rogers

To young people, many of the intellectual problems of older people seem unnecessary and even somewhat ridiculous. This is because the young have no need to extricate themselves from a maze that they never entered. And, to a degree, Youth is right in holding that the wisdom of old men is obsolete. "It just ain't that way anymore, Dad," and counseling that takes as its point of departure, "When I was a boy . . ." has never reached a lower ebb of illuminative validity than it has today. But the young, in their turn, have entered new labyrinths from which we can but hope in time they will escape. Every generation has different *unlearning* as well as different *learning* to do. But most of us never get very far with the unlearning, for as Winston Churchill said, "The human mind, except when guided by extraordinary genius, cannot surmount the established conclusions amid which it has been reared."

Unlearning is not a matter of erasing, suppressing or forgetting what we have learned. It is rather seeing what we have learned in a larger context, discovering that it is but a special case, and most importantly, that it always must be viewed as open-ended. On the other hand, this does not mean that everything is relative or situational. It means that every principle has a characteristic spatial and temporal domain of validity or importance within which it may be held to be absolute, but beyond which it may not even apply. The ongoing task of human learning and unlearning is not only to find the basic principles applicable to our experience but to discover their boundaries.

Since learning/unlearning is an ongoing task for each of us personally and for all of us collectively, for me to make a record, such as this pamphlet, of what I hold to be valid or important seems rather presumptuous. It is presumptuous, and is excusable only with the awareness that the record is open-ended. No one should ascribe finality to any of it. The compiler himself certainly does not.

Having said this, since every event can best be interpreted in terms of its time line, I feel it would be illuminating to include in this booklet a few glimpses of the path along which I have come. I feel one useful view of my path is that of my teachers, so I first give a brief description of five particular teachers that it was my especial good fortune to have had.

Even at the age of sixty, one can still name all the teachers who tyrranized or inspired his days in school. But as school days recede into the mists of time, some teachers and their lessons still shine forth brightly. These were the teachers who served not as wardens, but as emancipators, allowing us to fly beyond the walls and fences of the school, beyond the subjects and disciplines they were hired to teach, and to discover greater worlds than we had ever dreamed existed—finding some in far places and others within ourselves. For me, those remote yesteryears still contain the same freshness of new discovery as when they first happened. They exist in past, present and future. They have acquired an eternity of their own.

Learning preserves the errors of the past as well as its wisdom.

A.N. Whitehead

The Denver Public Schools. Teller Elementary School, 1925-30. Elizabeth Feltner, Principal. Calvin Coolidge, President. Lindbergh to Paris. Herbert Hoover over Al Smith. Wall Street to the bottom.

The forever vivid teacher here was an outsider who came one morning each month (we never knew just when) to give us a half hour of gymnastics. He was in his 70's, tall, heavy set, but ramrod erect with close clipped gray hair and a huge gray mustache. He was a cartoonist's Teuton—German in every respect from his winged collar to his heavy accent. He was a veteran of the Franco-Prussian War and had had a distinguished academic career in Germany before coming to Colorado at the turn of the century. He was introduced to us simply as Professor Schmidt (I never knew his first name). Whenever Herr Schmidt appeared (he was always escorted by the Principal and never preannounced), everyone was thrilled. It not only meant a break in the three-R routine with a chance to move about, but we were always imbued with a sense of personal importance in his presence. Not just that someone important had come into the classroom, but that *we* were important was the reason he had come.

The Prussianization of the elementary school children went to the extent that we leaped to attention when he walked into the room and remained rigidly motionless until he would greet us with, "We will begin with a breathing exercise." Sometimes our standing at attention was for 5 or more minutes. He had somehow inculcated us with the idea that this was a most important form of endurance. To scratch, giggle or even move was unthinkable. Such acts would not have been rebellion toward Herr Schmidt, they would have been an absolute disgrace, a manifestation of a defect in our self-control.

I still wonder how Herr Schmidt was able to create such enthusiasm for stoical attitudes in 8 and 9 year old children. However he did it, the effects were lasting. Discipline after that for me always became self-discipline and was afterwards seen as the real key to freedom. The twist that Herr Schmidt had given Prussianization was that we were taught to project the disciplining authority not onto him or any external autocrat but onto an inner officer figure.

My inner Prussian Drill Sergeant is still with me. He has proved both an asset and a liability. When I am alone, he is a good companion, but he has often made relationships difficult for me, and through him, I am very much alienated from the drifting, hang-loose, do your own thing world of today. But I look on Herr Schmidt and his influence on my life as positive, for in the subtlest sense he was an emancipator. However there remains the question: In exchanging the slavery to our undirected, uncoordinated, unconscious desires for disciplined direction on an aware and rational level, are we yet free? While in this step an important measure of freedom has certainly been attained, what is the discipline of the further path to higher freedom?

The Denver Public Schools. Aaron Gove Junior High School, 1930-1933. Betty Morris Principal. Herbert Hoover, President. The Depression. Amos 'n Andy. The Bonus March. The Chicago World's Fair: A Century of Progress.

Alice M. Watson, Home Room 201. In junior high, there was a new blend of continuity and discontinuity. Evidently in our culture, by the time one reaches the level of the 7th grade, there are no longer any renaissance men. Specialization is required. Since no one teacher can handle all of the subjects, we must move from room to room, teacher to teacher, subject to subject. To protect us from the trauma of this fluidity (we were not aware at the time that there was a trauma, we found it all so exciting), the concept of *Home Room* was invented. This was a secure base from which we could operate in the ever-changing environment. We found we no longer had a desk we could call our own. It was ours only while we occupied it—another step in our conceptual path from ownership to stewardship. In lieu of a permanent place to sit, we were given a locker, allowing us to keep apart those treasures we wished neither moth nor rust to corrupt, and we were given a lock so that thieves could not break through and steal, but it didn't always work out that way.

But most importantly, so that the cultural value of continuity could prevail in the highly mobile world of junior high, we were supplied with the home room teacher who would be with us at least 45 minutes each day for the three years we were at Gove. This proved to be a deeper relational continuity than we had yet experienced outside our own homes, and the home room teacher became as familiar and close to us as a member of our own families. The intensity of this relationship magnified the influence that this teacher would have on our lives. To this day, Alice Watson's is a voice as pervading in my psyche as that of my mother. It is the voice with which my conscience frequently speaks and a voice that prepared me for many of the crises of life. It showed me the existence of a 'star map' by which I could successfully navigate if I would but become familiar with it.

Perhaps the most accurate description of Alice Watson was that she was a real moral philosopher. Her concern was with all the difficult situations that arise in human relationships—individual and group, and like Dear Abby, she had answers for them all. To borrow from Margaret Mead—Her language could get values across to children in such simple terms that even a behavioral scientist could have understood her.

Her central message was the morality of minimization of pain and suffering—a morality she taught without requiring either philosophical foundations or religious revelations. It was all quite simple: Be sensitive to what hurts in yourself and in every creature. But never assume that others will feel only the same pains that you feel. Develop a sensitivity to their unique pains. Go beyond the Golden Rule: Do unto others as they would be done unto. A splendid

doctrine but a bit advanced for a world that has not yet caught up with even the Golden Rule.

But there is no teaching, however wise, that ever stands solely on its own merits. All great teachings ultimately stand on the living example of the teacher. And it was the example of her life that gave life to what Alice Watson taught. She did understand each of us and led us in our own way—not in hers.

Denver Public Schools. East High School, 1933-36. Roscoe C. Hill, Principal. Franklin Delano Roosevelt, President. Repeal. 'Nothing to fear but fear.' NRA, AAA, WPA, PWA, CCC, TVA, ... Shirley Temple. The Burlington Zephyr. The Dust Bowl.

Ralph B. Putnam, Latin: Caesar, Cicero, Virgil and Commercial Law. Putnam was the first scholar I ever encountered. Both his extensive knowledge and his skill in criticism placed before me enviable paradigms. Never before and only rarely since have I ever felt so uncertain about myself, what I knew and where I was going, as in Putnam's Latin classes. Whether this had to do with the uncertainties inherent in Latin subjunctives and ablative absolutes, or just in being a teenager, I am not sure. Whatever the cause, Putnam both fanned and channelled the uncertainty.

He *fanned* it by giving numerous inside exposes of higher-ups taken from his years of experience in practicing law in Washington. Evidently Watergates have been around for some time. He taught us to suspect, to question, to challenge. Or perhaps it would be more accurate to say he encouraged our teenage proclivities to suspect, to question and to challenge.

He *channelled* our uncertainties by introducing us to the classics. To replace our crumbling beliefs in personalities—no matter how highly placed—he gave us principles. While men might be shams, we need be neither disillusioned nor disenchanted with life. With numerous illustrations from the classics, he showed us the power of ideals and principles. He introduced us to heroes worthy of emulation, saying that they probably didn't do any of those things attributed to them, but that it didn't matter. The fact that men can visualize and honor such deeds is what matters. The hero may not have been real as a historical figure but he was and is real as a *carrier* of the ideals and principles of mankind. That perfection does not exist, and may never exist, is not what is important. What is important is our ability to conceive of perfection and be inspired to pursue it. The world taken as it is may depress us, then in a fit of what's-the-use, we may fall in with it. But if we can see beyond the corruption and degeneracy of the world as it *is* to the world as it *ought* to be, and as we have the power to make it, then life always remains worth living.

Heady stuff for teenagers? Not at all. Putnam was speaking to the unbattle-scarred idealist alive in every teenager. He was telling it 'like it was' while reminding us that there was another side to the coin.

The Rice Institute, Houston, Texas, 1936-1941. Edgar Odell Lovett, President of the Institute; Franklin Delano Roosevelt, President of the U.S. Roosevelt over Landon. Helium tanks at the Houston Ship Channel. The Hindenberg explosion. The Spanish Civil War. Invasion from Mars. Anschluss with Austria, Munich "Peace in our time," Blitzkrieg, Neutrality, the Graf Spee, the Phoney War, the Fall of France, the Battle of Britain, the draft.

Among many unforgettable teachers in my undergraduate years, the one who stands out trenchantly above all others is Lewis Babcock Ryon, Professor of Civil Engineering. Ryon was a tough no-nonsense professor who concealed his warm human side until you had proved yourself worthy of his respect—an essential father characteristic. He was clearheaded, with an unusual mix of imagination and practicality, being meticulous in his work and demanding the same in others. In class, one of his techniques was to pose a question, survey the room for several moments while we each struggled to prepare an answer, then invariably select the student who through either ignorance or knowledgeability would contribute the most to an illuminating dialogue. The name of the game was to find *an* answer, not to give *the* answer.

Sometimes he would reverse this procedure and call out a name, giving that person ample time to work up a sweat, then throw his question. There was one fellow in the class, the melodiousness of whose name seemed to appeal to Ryon since he descended on him so often. "Witherspoon," he would bellow while rubbing his chin, "What is an engineer?" Witherspoon never knew an answer, so Ryon was free to come directly to his point. "An engineer is a person who can solve the problem at hand with the means at hand. He makes up for what he lacks in resources or tools with ingenuity. Engineer and ingenuity are synonymous." I suppose that this is what Ryon really taught—ingenuity. Surveying, strength of materials, railroad earthworks, structures, highways, hydraulics were but the vehicles for his message, which was straightforward and simple: "You are never helpless. You can always find a satisfactory solution, whatever the problem." The content of the course was always adapted to illustrate this message.

Ryon was always interested in expediting calculations. We were drilled in the use of slide rules, log tables, planimeters and even mental arithmetic. When we had achieved what he considered a sufficient level of proficiency, he would share with us the then seventh wonder of the world, his brand new, hand-powered Marchand calculator. He would show us all of the algorithms he had personally developed—how to extract square roots and even how to get a cube root. I know Ryon would be thrilled with today's high-speed electronic computers, and you can be sure that he would have mastered all the important program languages. He could always efficiently use the most sophisticated tools, instruments and methods, but if they were not available, then he could use the more primitive ones—surveying Egyptian style, or deriving his own log and

The future of science may not lie so much in unraveling the properties of our particular environment as in working through the possibilities permitted by all the kinds of environments that may exist in the universe.

Sir Fred Hoyle

trig tables. He would certainly have had no quarrel with Fritz Schumacher; but he would have said, "Before you can know the *appropriate* technology, you must know all the *available* technologies."

But Ryon taught us more than that we never need be helpless whatever the situation. He taught us the joy of excellence, and that the vitality of the human spirit is nurtured through dedication and persistance—even in work with such 'cold' and unsentimental entities as measurements, numbers and equations. He launched us on the path of discovering who we were by learning what we could do.

California Institute of Technology, Pasadena, California, 1941-1944, 1946-1947. Robert Andrews Millikan, Chairman. Franklin Delano Roosevelt and Harry S Truman, Presidents. Pearl Harbor, Midway, El Alemein, Stalingrad, Kamikazis, Hiroshima, Tokyo Bay, Nuremburg.

To rate the intellectual influences of the various Nobel Laureates and Members of the National Academy of Sciences that populated Caltech in those days would be most difficult. Each made an impression on me in some way, some a lasting impression. But as to the person who had the greatest impact on my general orientation and way of thinking, I have no hesitation in naming Fritz Zwicky, Professor of Astrophysics. In addition to being an astrophysicist, Zwicky was also a crystallographer, a rocket engineer, a morphologist, philosopher, mountain climber and humanitarian, to name but a few of his areas. He thought of his relation to science as similar to that of Luther's to Christianity. He was the first "Scientific Protestant." In attempting his Reformation in science, Zwicky burned Bulls and threw bull and nailed his theses to every door that would take a nail. The trouble was that most of the doors had become obdurately calcified before Zwicky's time.

I began my work with Zwicky after I returned to Caltech from the Navy in 1946. That was the beginning of a colleagueship and friendship that was to last until his death in 1974, and it developed into one of the most important relationships of my life. Zwicky and I were not what one would call close, we did not see each other that frequently. But when we did get together, the intensity of our discussions and arguments was transcendental. We seemed intellectually to have come from the same place. We worked together on many projects: Searching for novae at Palomar, establishing the astrophysical library for the new Department of Astronomy at Caltech, launching the first particles into space, studying the spectra of the night sky, collecting scientific books and journals for war-destroyed libraries, founding the Society for Morphological Research, studying clusters of galaxies, organizing a symposium on New Methods of Thought and Procedure and editing a book of the proceedings.

This is not the place to elaborate on the many colorful facets of Zwicky's personality. The number of stories about him is legion—most of them apocryphal. But it is the number of apocryphal stories that a personality attracts

that is the measure of its importance. Zwicky was too far ahead of the times to become famous, but not so far ahead of the times as to be dismissed as a dreamer or a crank. Many tried to dismiss him, but his ideas just could not be ignored.

If I were to distill what I consider to be the essence of Zwicky's approach, it would be this: For centuries, the intellectual progress of mankind has taken place through the process of formulating a question and seeking *the* answer, defining a problem and seeking *the* solution. Sometimes people would come up with two answers to a question. Then customarily those who favored one answer would engage in a holy war with those favoring the other answer. This is not only the history of politics and religion, it is also the history of economics and science. Zwicky proposed an alternative for all of this. The energy which, in the past, has gone into 'determining who is right' must go, in the future, into finding the *totality* of possible answers, the *totality* of possible solutions. A cylinder looks like a circle in one view, it looks like a rectangle in another view. Instead of asking which of these views is true and which false, we must continue to seek other views. Only then shall we be able to discover the 'third dimension' of our problem, the dimension in which the projections of circle and rectangle merge into the unifying reality of the cylinder.

This is a sensible and simple prescription. Why has mankind not been able to adopt it? Perhaps the answer has to do with humanity's level of maturity. The search for alternative views, answers, solutions requires time, and while the search goes on, we must have some modus vivandi, we cannot live with uncertainties and ambiguities. It was Freud who said that the measure of maturity is the ability to accept and deal with ambiguity. But since we still find wars, hot or cold, more agreeable than the tensions of ambiguity and easier to conduct than the search for alternatives, we cannot expect to find higher dimensional resolutions to our problems—the resolutions that would enable us to retain and make use of the truth in each of our different views.

There is no awareness of form except through the viewing of alternatives.

In addition to teachers, there have been certain specific events that have had a major influence on my way of looking at things and in shaping my current world view. I have selected five of these events to recount here. Although there are other events of a similar nature that have affected my world view even more profoundly, I feel the more "conservative" ones described here will suffice for present purposes.

The Tehachapi Quake

In the summer of 1952, I worked at Caltech and lived in Altadena near the foothills. My family then consisted of two children ages 8 and 10 and a baby girl only a few weeks old. Customarily, my wife and I slept in the front bedroom of the house, and since May, the baby's crib had been in our room. On this particular night, because one of the older children had been upset, I slept in the back

bedroom to be near her. About 1:30 in the morning, I heard my name called—"Albert." I heard it called a second time—"Albert." I sat up in bed. It was very strange. Although some of my closest friends today call me Albert, in those days everyone called me Al. To my wife I was Al, and to my children I was Daddy. Who had called me? I got up and checked the children; they were sound asleep. Then I went to the front bedroom. My wife was also sound asleep. I next checked the baby. I leaned over her crib and adjusted the quilt. And at this very moment as I was bending over the crib, the house was suddenly and violently shaken. The room began to rock to and fro, the windows rattled and the furniture moved. I grabbed the edges of the crib and remained bent over the baby to protect her. The shock lasted about 20 seconds, then died out. Everyone was now awake and frightened, and we were trying to explain to each other what had happened. We looked about for damage, but there did not seem to be any, except for a few chips of plaster that had fallen on me where I had stood over the baby.

During the next few hours, there were several succeeding shocks, each less intense than its predecessors. But it was not the house that these tremors were shaking, it was my basic beliefs in the nature of reality. I had received a warning of the quake some three minutes before the first shock and this by hearing a voice call my name. I could not put all of this together in terms of my scientific knowledge and training. After daybreak we made a thorough inventory for damage, and there was essentially none, except for the plaster over the crib. The real damage that night had been to my belief system. My notions of sequential causality had been jarred far more deeply than anything material.

Today people believe that earthquakes can be predicted by certain physical parameters, change in height of the water table, the conductivity of rocks, etc. And for a long time, the strange behavior of certain animals before earthquakes has been observed. But there must be even more to the quake phenomenon than our current ideas incorporate. Beginning that summer night, there was for me—a question mark, one that began to change my perspectives on science and reality.

The Ginkho Leaf

In August of 1958, the International Astronomical Union met in Moscow. I attended the meeting to present an observational paper on some spectral similarities between the Martian blue haze and the earth's noctilucent clouds, which certain Soviet geophysicists had also been studying. A second purpose of my visit was to coordinate worldwide observations of the planet Mars, so that it could be kept under continuous surveillance. To do this, I visited Soviet observatories from Leningrad to the Chinese border and met face to face with many of the astronomers with whom I had been corresponding.

I was particularly anxious to meet with Professor G. Tikhov, an astonomer who had set up a "Mars Institute" in Alma Ata in far off Kazakhstan. Tikhov, then 84 years old, had been the first to set up laboratories in which simulations

of Martian atmospheric and physical conditions were maintained to study optical and biological effects. He was perhaps the world's first 'astrobiologist'—concerned with life as a cosmic phenomenon. I enjoyed several fruitful conversations with him, and we were able to exchange ideas fairly well through one of his students who had a very good command of English. On our last day, he gave a garden party in my honor attended by the entire staff. In accord with Soviet custom, there were numerous toasts, and we all became very friendly. At the end, he walked over to a tree in the middle of the garden and asked, "Gospodin Wilson, do you know this tree?" I confessed ignorance. "This is a Ginkho tree, one of the most ancient species of plant life inhabiting the earth. In this part of the world, the leaf of the Ginkho tree has a very special significance. Whenever friends part, they each pluck leaves from the tree and exchange them to signify that their friendship is as enduring as has been the Ginkho tree." Professor Tikhov and I then exchanged leaves and embraced as was the custom. Then he turned to the tree and picked a second leaf. "Professor Wilson," he said, "I want to give you a second leaf to take to the President of the United States, conveying the hopes that our two great nations will ever remain at peace. Take him this leaf as a symbol of the great feelings of respect and friendship that the Soviet peoples have for the people of the United States, and express the hope that we shall preserve the peace by working together on a great mission, the conquest of space." I thanked Professor Tikhov and reiterated his sentiments of friendship and hopes for cooperation, but I said that I did not move in those circles where I would be likely to give the leaf to the President. He smiled and, with a twinkle in his eye, said, "Do not be concerned. I have not the slightest doubt but that this symbol will reach its destination."

We said goodbye, knowing it was to be Proshchaetye and not Dosvedanye. As I got on the plane, loaded with fruit and flowers, a spokesman for the staff said, "Gospodin Wilson, you are a man of good will, and we are proud to be your friends." I was very aware as the plane took off that I was leaving a part of my heart forever in that far place in central Asia.

A few weeks later, I was attending a scientific meeting in San Antonio, Texas, when I ran into my old friend, Dr. Hubertus Strughold, one of the pioneers in the development of space medicine. He had conducted many of the important experiments prerequisite to Mercury, Gemini and Apollo that determined that man could survive under the conditions of outer space. Strughold was interested in Tikhov and his work and, over a glass of beer one night, I told him the story of the Ginkho Leaf. The next day, he called to say that he knew just the person to whom I should present the Leaf—the Chairman of the Senate Committee on Space and Astronautics, who was a friend of his. If I would agree, he would arrange a meeting.

A few weeks later, a presentation ceremony, complete with TV coverage, was held in the offices of the Chairman. I repeated Tikhov's words, adding some of

my own, and presented the Leaf to the Chairman. He replied, expressing gratitude and similar sentiments of friendship and desire for cooperation, and saying that he would place the Leaf under the glass on his desk, where its message would be continually before him.

I have often wondered whether Chairman Lyndon Johnson, when he became President of the United States a few years later, still had the Leaf before him.

The Gift of Shiva

I spent several months in India in 1959/60 as an American Specialist on loan to the Government of India's University Grants Commission. My assignment was to assist in the determination of the best site for the location of a new observatory near Hyderabad. The survey work enabled me to go into some wild country off the beaten tracks, and I began to tune to the feel of the land and its people. My interest in the traditions and cultural heritages of the Indian peoples had become kindled, and near the end of my term, I planned a trip through the south of India, not just to visit observatories and scientific institutions, but also to indulge my new cultural interests. There were some select temples, shrines and monuments that I was especially interested in visiting.

My itinerary took me to Madras on the Bay of Bengal, where I rented a car and went about 40 miles down the coast to the temple city of Mahabalipuram. The city dates from about 650 A.D., when the great Pallava King, Narasimhavarman, had shrines and monuments hewn and carved from the granite monoliths that abound in the region. These are smooth domes of solid granite that rise from a few feet to several hundred feet above the otherwise flat plains. The most famous monuments at Mahabalipuram are the five Rathas or chariots, the shore Pagoda and the magnificent bas relief known as Arjuna's Penance. But the area is dense with less well known temples and cave shrines.

Upon arrival, I immediately had one of those attacks of deja vu that I frequently have in the presence of ancient temples. I found a map and took off to the monuments with the happiness of a butterfly moving between beautiful blossoms. I felt it important to conserve film so that I would ensure having enough for all of the important pictures, but soon I found I was not taking any pictures at all. Getting the feel of a temple had become more important than getting its picture.

Late in the afternoon, after exploring the principal temples and caves, I came upon a path taking off behind a group of monkey carvings and winding to the summit of a monolith. Near the top was a rock-hewn cave temple, dim and refreshingly cool on such a hot day. I went inside; when my eyes had adjusted to the light level, I could see that the temple was dedicated to Shiva. There were carvings on three walls depicting him in his various roles. Being tired, I sat on the floor and soon became lost in some sort of reverie. Finally, I looked at my watch and was alarmed to see how late it had become. I had to leave. I arose and started out of the cave, then on impulse I turned, stood a

moment, and said, "Great Shiva, give me a gift." I stood there, again in a reverie, then felt in some way that I had indeed received a gift, but I did not know exactly what it was.

That night, I boarded the train for Madura. Just as the train was pulling out of the station at about 11:00 P.M., a Saivist priest ran down the platform and jumped into my compartment. He was a short, dumpy fellow and had on his forehead the horizontal ashen marks that all Saivists wear. He had no baggage and was wearing only a dhoti. He scrutinized me, and I uncomfortably stammered, "Good Evening." But he said nothing and sat at the far end of the bench. A question or two on my part received no acknowledgment. Either he spoke no English or did not want to become contaminated by a foreigner (foreigners are lower than untouchables). After about an hour, I decided to go to sleep, climbed onto the upper shelf, adjusted my pillow and dozed off.

I then had a most incredible dream: Two monkeys came to me and said, "Tell us, what is it that Shiva has given you?" I was very uncomfortable and said, "I don't know what you are talking about." "Come on, come on, we know Shiva gave you a gift, what was it?" I honestly replied, "I don't know." Then they said, "Show it to us. We will know what it is and can tell you." I didn't trust them and refused. They continued to tease and tease. I was very perplexed. They kept wearing me down. "Give us just a peek, it will be all right." Finally, to get them off my back, I held out my fist and opened it, palm up. They snatched at my hand and began laughing hysterically. "Oh, you fool, you believed us!" I was angry and humiliated; "Give it back," I said. They continued to roar and called me the greatest fool whoever was. I felt that they were right and woke up very distraught. I was alone. The Saivist priest was no longer in the compartment. It was about 3:00 A.M. Evidently, the train had stopped at some station and he had had gotten off. Anyway, he was gone—and I was more perplexed than ever.

This whole incident deeply disturbed me and continued to disturb me for several years. I tried to interpret it in many ways but was never able to get a satisfactory handle on it. I had Freudians and Jungians interpret the dream for me, but no one could really get anywhere with it. I tried the story out on my Indian friends and finally began using it as a "Guru Tester," hoping one of these alleged wise men would know what it all meant.

In 1974, Sridar, the proprietor of a local health food store and an impresario for all sorts of gurus, succeeded in getting Muktananda to visit Topanga. During the visit, Sridar had arranged a private audience with Muktananda for a few of his friends. Donna and I were invited. After listening to several questions and Muktananda's sensible replies, I thought I would bring out my Guru Tester. Through an interpreter, I told him the story recounted here. When I was finished, he looked at me a long time, then said, "What Shiva gives, no monkey can take away." What a monkey can do is succeed in making you think he has taken it away.

*11 * * (–10)*

Following the 1958 meeting in Moscow, the next general assembly of the International Astronomical Union was held in Berkeley in 1961. The United States had to show the world's astronomers that it could be as hospitable as the Soviets had been in 1958. Their's was not an easy act to follow because the State-funded Soviet Academy of Sciences had picked up the tab for all expenses of every delegate—transportation, lodging, meals—from the time they had entered the Soviet Union until they had departed. The cold war had taken the form of a Potlatch ritual. When this situation was explained to top executives of several major U.S. corporations, it was gratifying that they came through with corporate donations that allowed the free enterprise system, on the basis of voluntary contributions, to hold its own and even 'one-up' the Soviet challenge. The Berkeley meeting was a complete success; to add to the official hospitality, many American astronomers privately entertained foreign guests afterwards.

Donna and I wanted to do our part and had several house guests and gave parties in Topanga for visiting scientists from many lands. On one occasion, a discussion developed among the scientists on the efficacy of ESP and the merits of ESP research. To phase out a heated discussion, Carl Sagan proposed to conduct an ESP game he had engaged in. Two persons were to stand a few feet apart facing away from each other so that neither could see the other. They were not to talk nor in any other way communicate. On a signal from the referee, Sagan in this case, each person was to raise a number of fingers from zero to ten, with the idea that the total number of fingers raised between the two partners was to equal exactly ten. The chances of success on a single trial were one in eleven, for two successes in two trials, one in $(11)^2$, etc.

We all went outside where it was completely dark, and various pairs of people tried by ESP to raise between them exactly ten fingers. Now and then, there was a success, but the laws of probability allowed for that. Finally, everyone felt that the host and hostess should try, so Donna and I took our positions and, on signal from Sagan, raised some fingers. The total was 10—success on the first trial! A wave of excitement swept the group. The second trial—again the total was 10! This time, a wave of suspicion swept the group. How were we signalling? No one could see how we could. Then the third trial—also a success. Here, Sagan and others felt that we had arranged a sequence of fingers to be raised. They were a bit agitated. The fourth, fifth, and sixth trials were all successes. They had been writing down the numbers we had each been raising and could detect no pattern. Either the sequence idea was wrong or we had a very subtle one. In the seventh, eighth, ninth, and tenth trials, each time exactly ten fingers! Uncanny! Impossible! What were we doing? How were we cheating? Was there a sequence? Was there some undetected signal?

The probability that we could succeed ten times in raising the proper number of fingers was $(11)^{-10}$, less than 0.0000000001! To this day, Carl Sagan has not been able to figure out how we were cheating. The fact was, we were not.

The Young Man at the Door

One October morning in 1972, as Donna and I were sitting in the kitchen having our breakfast, I was startled to see someone walk by the door. It was only 7:00 A.M., so who on earth could be in our patio? I could not clearly see the face, but it was a young man with straight brown shoulder-length hair; he was wearing a white peasant-style shirt. He walked past our kitchen going from the patio toward the street. I ran outside and looked all about, but no one was there. Donna had not seen the young man go by, and she questioned whether I was sure. I was sure and described the shirt in more detail—loose, tail out, needlework on the front.

About an hour later, at 8:00 A.M. to be exact, the phone rang. It was Donna's aunt; she was the bearer of distressful news. Her nephew, Mike, Donna's cousin and only 23 years old, had died yesterday. Mike lived in Livermore but had been visiting his cousin Rick and his uncle Dick in Van Nuys. The night before last, the three had gone out to dinner. Dick had returned home, but the two boys, Mike and Rick, had decided to go out on the town. Rick was working the next day, so he came home about midnight, leaving Mike in Hollywood. Mike did not show up until about 9:00 the next morning, carrying a big hangover, and Rick put him to bed. Before Rick left to go to work, he went in to check on Mike and found him dead.

Neither Donna nor I had seen Mike since he was about 10 years old, and we began to recall some visits. In our reminiscing, we suddenly were struck by the thought that the young man I had seen at the door that morning was Mike. Donna then called Dotty, Mike's mother, and offered her condolences. Dotty was glad that Donna called and told her that, a few days before, Mike had been visiting his grandparents in Hemet and was very depressed about everything. He was disillusioned with materialistic society and felt he would like to go to Arizona and work with the Indians. His grandmother had told him, "You ought to go and see Donna and Al in Topanga. They are crazy just like you, they think the world is upside down and are interested in Indians and all kinds of way-out stuff." Dotty went on to say that Rick had told her that he and Mike had actually planned to hitchhike up to Topanga to see us on the day Mike died.

Donna then told Dotty that perhaps Mike had come to Topanga after all and that Al had seen him walking by outside the kitchen door. Dotty was taken back by that statement and said the description fitted Mike, but it definitely could not have been Mike because he did not own a white shirt, peasant or any other kind.

A few weeks later, Donna and I were visiting Dotty in Livermore, and I saw a picture of Mike. I said that the young man I had seen on that morning after Mike's death looked quite a bit like the picture. Dotty said, "You know, when Donna told me that story, I dismissed the whole thing because Mike had no white shirts. But later I found out that he and Rick had been to Olvera Street

in L.A. just two days before Mike's death, and he had bought a white Mexican shirt. He like it very much and was wearing it at the time of his death. In fact, he was buried in it."

The experiences recounted in these five stories, as well as a few others of similar nature, have made it very difficult for me to continue to subscribe to the scientific worldview. I have become increasingly skeptical of the mechanistic and materialistic ontological base dominant in Western thought since the Enlightenment. While most of my schooling has been in science and technology and for years I pursued a career as a research scientist, I find I am no longer sympathetic to the tenets of positivistic and reductionistic philosophy. I further feel that the epistemological assumptions of science are too restrictive to allow science to cope successfully with many important parts of human experience. Much of our experience is ignored or even denied by scientists because they are epistemologically restricted to the treatment of phenomena that are repeatable, predictable (i.e., deterministic), ubiquitous and measurable. There is increasing evidence that the discontinuities—the unique, the free, the unpredictable—are more important in the evolution of the world than the continuities—the repeatable and the determined.

But one does not criticize an epistemology simply because it has limitations; every epistemology has a limited domain of applicability. My chief criticism is directed at the positivist dogma that holds that those phenomena that slip through the net of scientific epistemology are devoid of significance and therefore justifiably ignored. The epistemology of science is successful as far as it goes, but to attempt to bound the world by the limits of a particular epistemology is to echo the historical futilities of attempts to define the nature of God by particular creeds. I, consequently, see as one of the most important tasks for the years immediately ahead the design of new epistemologies that will allow us to explore those domains of experience for which the scientific approach is weak. But even within those areas traditionally amenable to scientific study, limits have been reached. Einstein himself felt that the next great step forward in physics could only follow an epistemological revolution.

Since there is a definite relation between the assumptions and tests used by an epistemology and the phenomena it can admit and process, two approaches are open to us: 1) We may proceed by expressly designing a net to catch fish whose existence is known—design, for example, an epistemology that will enable us to explore such nonubiquitous and unrepeatable phenomena as precognition, telepathy, telekinesis and synchronicity. 2) We may experiment with different net designs and see what unknown species of fish they will catch—design completely different epistemologies that will enable us to extend the domain of what we call 'reality.' The first approach may

Every man takes the limits of his own vision for the limits of the world.

Schopenhauer

be called the modeling approach, the second the exploratory approach. I feel that we must use both of these approaches. We must never solely model nor solely explore; we must always do both simultaneously.

This is not an ivory tower problem. We have not been able to find solutions to our social, economic and political problems within the frameworks in which we have placed them. Hazel Henderson traces the cause of our difficulties to our having made economics a substitute for thought and to the adopting of politics to replace philosophy as our root discipline. When the only alternatives open to us are stepped-up applications of procedures that have not been working, then our option space has become too small. But we shall not find new perceptions so long as we stay inside our habitual halls of thought. We have not reached our end, we have only outgrown our worldview. The serpent must shed its skin. We must return to the roots of Western Thought and discover our limiting assumptions and explore their alternatives.

I have briefly sketched where I am in my thinking at the age of sixty and have given a glimpse or two of the path I have taken to get here. I have been working for some years on alternative epistemologies and their concomitants, alternative ontologies and cosmologies. While I do not possess near the genius adequate for this project, I do relish its challenge and intensely feel its importance.

In the pages that follow, I have selected some items that have proved useful useful guides in my "Path to 60." I feel many of these can be carried into the New World, their 'domain of applicability' extending beyond this time and place.

Many view our moving toward the 21st century as sailing with Columbus toward the cliff edge of the world. But this model is wrong. We shall not fall over the edge, we shall not even reach the "Indies" as others predict—what we shall do is discover a new world.

5 Heroes

The symbolic end of the age of heroes occurred on that night in April of 1912 when the Titanic slipped beneath the waves, carrying with it not only 1513 souls, but the traditions of chivalry and noblesse oblige and the last of that race called gentlemen. While vestiges of this classical age still surface now and then—as when a handful of knights again founded a brief Camelot riding to the jousts in the crude biplanes that flew over the Western Front in 1914-1918—in our march toward total egalitarianism, we are out to destroy all elites, heroes among them. For this reason, it may seem somewhat anachronistic for me to hold heroes as items to be put into the Ark to take into the New World. But I believe they shall have an important place there, regardless of the antihero orientation of the present transitional period.

I shall list here five of my personal heroes and profess my hope to see them all enshrined in the 'once and future' Valhalla of the New Age.

- Aristides, 530-468 B.C. Plutarch tells us that a controversy between the Athenian statesmen Aristides and Themistocles was to be resolved by exiling one of them. A vote was to be taken by having each citizen write on a sherd the name of the man he wished to be ostracized. On the day of the writing of the names, an illiterate not knowing who Aristides was gave him his sherd and asked him to write on it the name 'Aristides.' Aristides was surprised and asked the illiterate whether Aristides had ever done him any wrong. "None at all, neither know I the man, but I am tired of hearing him everywhere called Aristides the Just." Hearing this, Aristides marked the sherd with his name and returned it to the illiterate to cast his vote.
- Cincinnatus, 519-439 B.C. In 458 B.C., the Aequians threatened Rome, and there was no leadership for defense. The Senate sent a delegation to the former Tribune, Lucius Quintus Cincinnatus, to entreat him to return to Rome and assume dictatorial powers in the crisis. The delegates found Cincinnatus behind the plow on his small farm. Responding to the urgency of the situation, he hurried to Rome and took command. In the ensuing battle, he routed the Aequians in one day and removed the threat. Returning to Rome in triumph, he was implored to be Dictator and was offered great rewards, but he declined and, after a total absence of 21 days, returned to his fields.
- Johannes Kepler, 1517-1630. While the scientific work of Kepler stands as the watershed between ancient and modern times, and Kepler's Third Law ranks as the initial discovery leading to our deeper understanding of the structure of the world, Kepler also emerges as a hero. Not only because of his 17 years of involved hand calculations, which no one of the computer age can really appreciate, but because he gives us a rare paradigm, showing that persistence can be as successfully married to flexibility as to single-mindedness. Even after he disproved the results he had so fervently sought, he could continue his labors. He achieved the ultimate in open-endedness by sub-ordinating his goals to his processes and accepting the unexpected and unsought.

- Cyrus Harding, 1827-1904. Since the heroics of our heroes are in most cases at least part fiction, it should be permissible to elect a character of fiction as hero so long as his heroics ring true for us. In Jules Verne's *The Mysterious Island,* Captain Cyrus Harding, the leader of a small band of Union prisoners of war marooned on a remote island, evokes from me the same wish that Churchill expressed concerning the King Arthur Legend, "Even if it were not true, it ought to have been." Harding and his friends, with no facilities but the clothes on their backs and the know-how in their heads, create a utopian monument to what dedicated, faith-inspired men can do. The island symbolizes America, Harding and his companions are the embodiment of the American spirit of self-reliance, and their accomplishments are the harmonic symbiosis of reverence for the land and the American Dream.
- The Confederate Soldier—or just as well—The Defenders of the Alamo or of Chapultepec, the Beseiged at Corregidor or at Leningrad, the Crews of the Jervis Bay or the Variag—all those who in defeat did not default their trust nor sacrifice their honor. These were those who knew they had persisted to the limits of their strength. They had fought the good fight and, though their cause was lost, they never betrayed it, and though pained by defeat, they could not be humiliated. It is only in such a defeat that we can discover the true extent of our strength and weakness—something the victor does not know. It is only in such a defeat that we can find the seeds of our transformation—a treasure the victor can never have.

Courage will not save you, but it will show your souls are still alive.

George Bernard Shaw

5 SAGES

The art of being wise is the art of knowing what to overlook.

William James

A Hero is a person whose deeds are worth emulating; a Sage is a person whose words are worth planting.

Today we tend to regard great sages, such as Confucius, Lao Tze, Pythagoras and Socrates, as wise men by profession. But wisdom never comes from the direct pursuit of wisdom, it comes from the quiet mixing of mellowed experiences. Here I present five sages—not necessarily professionals—whose words I feel may now be profitably harvested.

- Lao Tze, 604-531 B.C. On Leadership.
  To lead the people, walk behind them.
  As for the best leaders, the people do not notice their existence;
  The next best, the people honor and praise;
  The next, the people fear; and
  The next, the people hate.
  When the best leader's work is done the people say,
  "We did it ourselves."
- Miyamoto Musashi, 1584-1645. On Strategy.
  In strategy it is important to see distant things as if they were close and to take a distant view of close things.
  You should not have a favorite weapon. To become overly familiar with one weapon is as much a fault as not knowing it sufficiently well.
  You can never successfully give a fatal blow unless at the moment of delivery you fully expose yourself to the risk of your own death.
- Werner Heisenberg, 1901-1976. On Truth.
  The greatest truths are those whose opposite is also true.
- St. Vincent de Paul, 1581-1660. On Giving.
  When you give bread to the poor,
  Ask them to forgive you your gift.
  True giving is always an exchange.
  The greatest gift that you can give to anyone
  Is an opportunity for them to give.
- Siddhartha Gautama, 563-483 B.C. On Belief.
  Believe nothing on hearsay.
  Do not believe traditions because they are old.
  Do not believe anything on the mere authority of myself or any other teacher.

There is wisdom in the selection of wisdom.

Bergen Evans

5 principles

Five of the great principles that govern the formation, evolution and destiny of the universe and its contents are given here in a very general form. The universality of these principles may only be postulated, but they appear to be operating in all known systems. Whether taken into the New Age or not, these principles will be there.

- The Second Law of Thermodynamics. One of the most important functions in an ecological complex is performed by the scavengers—the vultures who devour carrion, the bacteria who break down feces. For living structures to endure, dead structures must be demolished. The great scavenger of the universe is the Second Law of Thermodynamics. It fragments structures, diffuses energy and reduces order to chaos. The Second Law acting by itself, in the absence of any countering morphogenetic principle, assures that the ultimate destiny of the world is maximum diffusion in extension space and maximum homogeneity in similarity space.
- The Principle of Plenitude. Above the level of organization at which systems are capable of self-replication, they seek to convert as much of the matter of the universe as possible into their own likeness. They do this not only through replication itself but through creating environmental conditions favorable to the survival of themselves and disadvantageous to their competitors. This activity has been observed on every level from molecules in interstellar space to aggregates of human beings. This Principle of Plenitude is a facet of a deeper and more general presently unformulated morphogenetic principle.
- Deutsch's Theorems. There are two: The first applies to existing hierarchical systems in which a malfunction occurs at level i. The theorem states that correction or healing can be effected only by establishing an alternate channel of communication that bypasses level i, placing levels $(i - 1)$ and $(i + 1)$ in direct contact.

  The second theorem applies to the emergence or transformation of a system with i levels to one with $(i + 1)$ levels. The theorem states that a system of level $(i + 1)$ cannot be created out of systems of level i, except by blocking out the ith or top level. The emergent system must be synthesized from the $(i - 1)$ or lower levels. This means that, in all transformational or emergent change, the top echelon is irrelevant or counterproductive and must be bypassed.

- Departure and Return. Among the great number of cyclical processes occurring in the universe, the cyclical isolation of systems—called here, departure and return—is of foremost importance as a morphogenetic process. It serves both to increase variety and optimize survivability. Genotype/phenotype, sleep/waking, dark age/renaissance are all examples of cyclical isolation. An alternative high level/low level of interaction manifests itself as concentration/diffusion in extension space and as homogenization/heterogenization in similarity space.
- Mach's Principle. This is the great antireductionist principle that holds that the total system imposes its nature on each of its parts. The constants of nature, the properties of particles, atoms, molecules, the laws of physics and chemistry are what they are because of the properties of the universe as a whole.

  In a less restrictive way, the traditional ideas of similarities or isomorphisms between parts and whole, microcosmos and macrocosmos, 'as below, so above,' etc., are forms of Mach's Principle, but with neither a bottom-up (reductionist) nor top-down (machian) direction of causality.

5 WATERSHEDS . . .

In Colorado, the Great Divide assumes dramatic configurations. As a boy, I was always impressed when standing on a summit of the divide with the idea that the melting ice on one side would flow into the Atlantic Ocean and that but a few inches away would end up thousands of miles from the other in the Pacific Ocean. Divides or watersheds, which may be razor thin but result in inexorable separations, play an important role in the structure of the world. Five watersheds (whose razor thinness may not always be perceptible) are given here.

- The Sonic Barrier. An alteration in the equations of aerodynamics occurs at the speed of sound, requiring totally different design approaches to wings and fuselages of aircraft.
- The Point of Economic Takeoff. The level of income at which not everything produced is consumed and at which savings become possible separates those who may acquire and create wealth from those who must only subsist.
- The Inflection Point of a Growth Curve. Prior to this point, growth is accelerating, suffusing a feeling of optimism, security and an unlimited future; after this point is passed, growth is decelerating, giving a feeling of pessimism, uncertainty and the necessity for a zero-growth future.
- The Point of Optimum Size. The larger an organization, the more efficient, the more effective, the more savings possible—up to a point. Beyond this point, an increase in size results in a decrease in efficiency, effectiveness, and savings. No one seems to know how to locate this point.
- The Optimum Level of Knowledge (A Special Case of Optimum Size). Richard Feynman once said that the reason productivity in theoretical physics falls off after a certain age may be because the physicist knows too much. His imagination has been displaced by facts. This could happen to a culture as well as to an individual.

AND 5 LIMITS

Limits are watersheds having only one drainage—probably because we have not yet discovered the other one. Until recently, Absolute Zero has been regarded as a limit. Now virtual temperatures below zero are seen not only to be consistent with thermodynamic theory but essential to describe the state of some systems. Perhaps in time we shall discover the 'other drainage' to the following limits.

- The Velocity of Light. According to the theory of relativity, the maximum possible velocity for any physical entity is $c = 2.9979250 \times 10^{10}$ cm/sec.
- The Schwarzschild Limit. Another relativistic limit states that the ratio of mass to radius for all gravitating bodies (i.e., all material bodies) is bounded.
- The Instant of the Cosmic Big Bang. The first moment in the evolution of the universe constitutes an informational barrier. We have no way of penetrating to what happened before that time.
- The Black Hole. Another informational barrier penetrable only by mathematical surmises.
- Death. The most familiar of all information barriers.

In reply to the question, "What was God doing before he created the Heavens and the Earth?" St. Augustine said, "He was creating Hell for those who asked this question."

5 discriminations

Human cognition proceeds through the interplay of two operations: The perception of differences—discrimination, and the assessing of similarities—equating. For centuries, extensive use has been made of the sign, "=," to designate that two objects, A and B, are to be regarded in the light of their similarities or identities: A = B. But a sign to designate that two objects are to be regarded in the light of their differences is also needed: A vis-a-vis B, or A ⩛ B, for short.

The recognition or emphasis of a difference may be as important as the recognition of an equivalence. I give here five discriminations, having important consequences for how we think about the world.

- Absolute ⩛ Invariant. The idea of the existence of 'absolutes' has been in disrepute since the theory of relativity. However, that theory does not abolish the essence of the concept as many interpreters think. It replaces 'absolute' with 'invariant.' In a general way, we may discriminate between the two concepts as follows: An absolute is universally one and the same everywhere for all time, while an invariant is the same under a set of allowable transformations. If one views the world from only one position, many things may appear to be absolute; but when things are viewed from many positions and moving states, they may change and lose their absoluteness. Only what remains unchanged when viewed from every position and state of motion is allowed to be called invariant. We may postulate absolutes, but we must search for invariants.
- Genotype ⩛ Phenotype. Each organism exists in two forms: First, in the visible physical form we call the body—the phenotype; and, second, in the form of a DNA molecule that is a recipe for making that body—the genotype. Evolutionary modifications occur in the genotype; testing of the modification occurs in the phenotype.

- Legal ⩛ Legitimate. Jefferson held that ultimate sovereignty resided in each person. We form states by delegating to a government a portion of our individual sovereignty. Government passes laws, which—through this covenant of delegation—we agree to abide by. When we disregard these laws, we act illegally. However, when government violates the covenant by appropriating to itself more than has been delegated to it, government acts illegitimately. The double direction of the covenant is the basis of the state, with legality ceasing when legitimacy ceases.
- Master Race ⩛ Chosen People. Some historians have pointed to a strong similarity between Nazi views of Germans as a Master Race and Jewish views of Jews as a Chosen People. This is a case where the difference, not the similarity, is what is important. The Master Race is an elite of privilege, with rights to dominate and domineer; The Chosen People is an elite of responsibility, with obligations to serve God's purpose for the world.
- Monotheism ⩛ Hinotheism. Monotheism: There exists but one God. Him only shalt thou worship and serve. Hinotheism: There exist many gods, among them God, who alone is worthy of thy worship and service. The paths of cultural evolution greatly diverge according to the choice between these views.

There is only one essential function of government—all others could best be performed by other institutions—that function is to protect its citizens from other governments.

5 TRADE-OFFS

Analytical understanding must always be a basilisk which kills what it sees and only sees by killing.

C.S. Lewis

Many games are of necessity zero-sum games. One party can win only at the expense of another party. Such inverse relations or trade-offs are frequently due to the finiteness of the system, but in other cases, they derive from mathematical or physical principles.

- The Uncertainty Principle. It is impossible to know both the momentum and position of a particle with unlimited precision. We must sacrifice knowledge of the position to acquire knowledge of the momentum and vice versa.
- Energy Efficiency ≁ Time Efficiency. Other parameters being equal, an increase in time efficiency will cost more energy, while a saving in energy will require slower operation of the system.
- Field ≁ Resolving Power. In systems with bounded information channels, enhanced definition of detail can be purchased only with sacrifice of field of view and vice versa.
- Completeness ≁ Perfection. An inference from Godel's Theorem tells us that completeness requires a sacrifice of perfection and vice versa. If a file is to be complete, it must contain the imperfection of an unclassifiable miscellaneous section. If, on the other hand, we desire a perfect file with every item classified, then we must sacrifice completeness by throwing out the miscellany file.
- Notariety ≁ Autonomy. The price of renown is the loss of freedom. The celebrity is a prisoner to his fame. Autonomy is only possible with anonymity.

5 PERSPECTIVES

The most incomprehensible thing about the world is that it is comprehensible.

Albert Einstein

Here I compare five ways of viewing the world, each of which we sometimes use, but one of which—depending on our psychological type—we tend to favor.

- The Scientist's Perspective: Is. He sees what is and describes the world in terms of probabilities, based on causal and stochastic relations. The future is to be predicted.
- The Planner's Perspective: Can be. He takes the world as it is for his point of departure, plans within the realm of the possible—making use of the scientist's descriptions, and implements his plans. The future is to be shaped.
- The Lawgiver's Perspective: Should be. He considers what would be a preferable state for the world, based on moral or aesthetic values. He prescribes the mores, the fashions, and what is important. The future is to be prescribed and proscribed.
- The Artist's Perspective: Might be. He is concerned with what is conceivable, with the totality of alternatives that can be imagined or dreamed of and what further images can be derived from them. The future is to be imagined.
- The Deity's Perspective: Is/Is not. In the void is naught but in the void is all. Thought elects from the void but once elected is delimited until it returns to the void. The future is to be believed.

To imagine is an act which gives human beings the chance to engage in something akin to Creation.

Rene Dubos

5 QUESTS

Human life is driven forward by yearnings too vague for articulation. We are impelled on a great quest for we know not exactly what; we proceed, feeling that something we shall discover along the way will reveal to us the object of our search. What we do discover along the way, guiding us toward the true object of our search, are a *succession* of guiding quests.

- At the first stage of life, our quest is for *identity,* to discover who we are and who we are not, to define an I and a NOT-I.
- Second, we seek *understanding,* answers to the what's, the when's, the where's, the how's, viewing the world 'out there' as IT.
- Then, we seek *meaning,* answers to the why's, beholding the I in the context of the world as IT.
- Penultimately, we cease to regard the world as IT and begin to see it like ourself. We then seek *relationship* between the I and the world, now seen as THOU.
- Finally, our quest for relationship leads to the realization that the notion of I is itself a barrier to our further progress. Our quest then is to seek *wholeness.* The I merges with the NOT-I, the IT, the THOU and becomes ONE—completeness.

5 NEGATIVE QUESTS

Sometimes in our great quest, we find we are not sustained by the process of the search itself and cannot endure the tension of the lack of definition of the goal. We then introduce some surrogate goal to symbolize the one we cannot articulate. Once this is done, the possibility that the surrogate replaces that which it symbolized is great. Five surrogate searches whose pursuit leads us from our prime quest:

- The search for security.
- The search for renown.
- The search for riches.
- The search for power.
- The search for success.

5 PATHS

We have found a strange footprint on the shores of the unknown. We have devised profound theories, one after another, to account for its origin. At last we have succeeded in reconstructing the creature that made the footprint. And Lo! It is our own.

Arthur Stanley Eddington

In Life's great Quests—for Identity, for Understanding, for Meaning, for Relationship and for Completeness, we elect one of five paths according to our image of the nature of the object of our search: The Other. The Other may be symbolized for us by Eldorado, Little Green Men, the Transcendent Self, the Holy Grail, or God, according to our backgrounds. We may quest either actively or passively, according to our natures. The five paths may be characterized as follows:

- There is no Other and we need no Other. Even if an Other should exist, it is so different from us as to be unknowable, and any communication between us is forever impossible. It is futile to search, it is fatuous to wait.
- There is no Other, but we need an Other so we will create it. Since we are entirely on our own, let our dream be the Other. Let us go forth to build a colony at L-5, then go on to the stars and to the uttermost corners of the galaxy—and even beyond. Even though alone, we shall prevail.
- The Other is in the heavens. "Let us build a tower whose top may reach unto heaven and let us make us a name." Let us build a vast array of radio telescopes that we may listen to the Other and capture his great wisdom and bring to Earth his fire so that we may put our world in order. The Other is in our own image, and we shall know him because he too is a radio engineer and builds vast arrays, sending and receiving signals across space.
- The Other is in the heavens, but it is vain to seek him, he will come to us in his good time. We need only wait. When he comes, he will save us with his great wisdom. He has been here before. There are traces of his handiwork in the caves, on the rocks and in the ancient temples. Even today he visits us briefly in his flying wheels. When we shall prove ourselves worthy, we shall win his favor, then shall he land and bring us great gifts.
- The Other is already here—has always been here. We need not search, we need only listen. But unless we have ears to hear, we shall hear nothing. Nor until we have faces can we meet face to face.

5 prophecies

While it is oftimes a straightforward matter to trace a trend to its logical conclusion and thereby make a specific prediction, discontinuities may intervene, giving substance to Dubos' epigram, "Trend is not Destiny." The aphorism, 'history repeats itself,' is the foundation of a more reliable approach to forecasting the future. Great cyclical patterns are discernable and suggest some useful surmises about what will happen. In every method of forecast, however, the predictions of *what* are much more successful than the predictions of *when.* My images of the future given here derive from a combination of trends, patterns, and beliefs. Because of the latter, I label them prophecies rather than forecasts. I give them here in a broad form with no time table.

- A General Fragmentation of Political and Social Aggregations. On the basis of the principle of cyclical isolation of systems, I feel we are approaching a period in which the forces of diffusion and decentralization will soon overcome those of monopoly and centralization. Ahead will be secessions, establishment of autonomous regions and a general dismembering of large political units. In particular, the years of the nation state and the urban metropolis are numbered.
- Emergence of Leagues of Cooperating Communities. Self-reliant communities will ally to form global leagues. Multinational corporations will evolve from purely business organizations to full communities for their employees (cf. business organizations in Japan). The World Political Organization's direct membership will consist of the global leagues, which evolve either from cooperating communities that have also become businesses or from multinationals that have established communities.
- The End of the Age of Science. The growth of scientific knowledge will slacken and stagnate. Technical education for the public will cease. Machinery, computers, etc., will be tended by a specially trained 'technical priesthood,' as elite and specialized as historical priesthoods. Knowledge, like other institutions, will fragment. It will become highly proprietory, with portions being held by one league and other portions by another league. The 'cultural DNA' of civilization will be preserved by enclaves of scholars living largely in the interstices of the global leagues.

- Emergence of Higher Consciousness. In matters of intelligence, consciousness, soundness of body, health, vitality, longevity, etc., present gaussian distributions will become bimodal. A radiant point in evolution lies ahead. Freed by a new worldview from the prisons of ego, men will form the first joint or merged consciousness—the Omega Point.
- Space will be Explored. The abortive venture into outer space that occurred in the second half of the 20th century will be redeemed. Instituted on a global foundation, humanity will find in the physical task of the exploration of space a vehicle for its spiritual growth.

5 QUESTIONS . . .

All experience teaches us that no one has yet asked too much.

Sir Fred Hoyle

The growth of our knowledge through the dynamics of the question/answer approach restricts us to moving into the future by looking into McLuhan's rear view mirror. But it is too soon for most of us to abandon questions and questioning as our process of increasing understanding. Therefore, without apology (after all, I am only sixty), I offer five questions which I would like to see explored (and even explore myself):

- What is the optimum size of a system in terms of its function, environment, and gestalt context—or whatever other parameters are required for the proper formulation of the question? (A general system question)
- What are the generalized laws of 'addition' in the aggregation of systems? How do the characteristics of components combine to give the characteristics of the whole? Can emergence be accounted for through certain types of combinatorial aggregation? In other words, if reductionism works, how? (A general system question)
- Isaac Asimov says, "Magic does not work, but belief in magic does" (e.g., placebos). While belief as opinion may be but illustion, and belief as hope can possibly have internal effectiveness, to what extent is belief as faith effective? In other words, what systems are alterable per what levels of belief? And to what extent does or can thought alter the material universe?
- Under what circumstances is it wise to think about the unthinkable (in Herman Kahn's sense), and under what circumstances is this best not done? (This question is related to the preceding one, but thinking and believing must be held to be different.)
- What are the alternative dynamics to question/answer for the acquisition of understanding? (A paradox)

AND 5 INJUNCTIONS

I close my collection of 60 items for the Ark with five conclusions in the form of injunctions.

- Combine commitment with open-endedness.
- Regard alternatives as facets, and resolve ambiguities with emergence.
- Restrict elites to the bearing of responsibilities.
- Abandon the guiding quests behind you.
- Regard all limits as watersheds.

A conclusion is where you got tired of thinking.

Never try to tell everything you know.
It may take too short a time.

Norman Ford

epilog

Till now, you have been reading the words of the head. Only a small space remains for the words of the heart. But the heart does not need many words—only enough to mark off the silences that play accompaniment to its song.

We have stood on Mt. Nebo and in the distance seen the Promised Land. It is there, and though night descends, it will remain.

But the darkness is not to be feared, for out of darkness, God made the Light. Let us then search in the shadows, work in the interstices and listen to the stillness. The nothingness is not empty. It is the container of all possibilities. From it, we shall lift the learning with which we shall create the cosmic destiny of all mankind.

Only when it is dark enough can you see the stars.

The last of life, for which the first
was made, is yet to come.

Robert Browning