What Quality of Environment Do We Want?

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EDDINGTON defined science as "the earnest attempt to set in order the facts of experience." In attempting earnestly to think about our environment we realize gradually that it is not a static stage set. It is the continually changing sum of all our external experiences. It is omnidynamic. It is a complex of events. Environment is all else of universe but self. Sometimes it feels superbly synchronous—at others, discordant; 99.999% of the events which constitute the physical and metaphysical universe are undetectable directly by our senses.

Considering and reconsidering clues which may permit our setting the complexedly compounding facts of our environment in order requires (unfortunately not too obviously) that we first remind ourselves that many experiences have shown us the ease with which all our perceptual faculties can be deceived. We have also experienced the persistent and lightening-like contagion of misinformation. For instance, it is difficult to intercept and rationalize the two-year-old-to-two-year-old children's innocently relayed infusion of the artificial concept of "that is mine"—at first mimicked from adults but having such excitingly abrupt effect on other children as to induce attitude-forming repetition.

We are also reminded of the fact that our spontaneously developed shortsightedness and frequently deliberate exclusion from consideration of a large proportion of the environmental events have most often precluded discovery of the fundamental evolutionary trends implicit in the nonsimultaneous continuity of our total experiences. Our vision is limited to the tiny, red, orange, yellow, green, blue, violet bands of frequency tunabilities representing far less than one thousandth of 1% of the great electromagnetic spectrum of the thus far discovered vast range of the physical universe realities. Our *after-image overlapping* which results in our *sense of motion* is even more limited in its perceptual range. We cannot see the hands of the clock move. We cannot see life growing. We cannot see either the stars or the atomic components move though they move at fantastic speeds. We can only see the ultra-slow motions of the clouds, locally running waters, human beings, and other creatures and their parts. No wonder that little man who within his average lifetime has seen only about one millionth of the surface of his planet and has lived but a split second of the astronomical ages does not see and cope spontaneously with the larger evolutionary patternings and life aboard the planet earth. Only through memory plus thought—greatly aided by instruments does man discover the ultra- and infra-motion effects.

Sum totally, we discover that the many different and equally erroneous opinions of humanity regaraing life and the world—and how to get along in it—gradually merge into often lethally divergent religions and ideologies—every one of them based on fundamental misconceptions and incomprehensions of the realities of universe—and the universally complex integrity of generalized principles, including for instance, the principles of *irreversibility* and *entropy* which together result in *inexorable evolution* and its myriad of constant local transformations.

The more we learn the more we realize how little we know. That little seems to say: We humans have been successful thus far in history only by virtue of the supreme intellectual capability manifest in the harmoniously scientific design of the *minimum perpetual motion machine*, the infinitely regenerative universe.

But humanity now everywhere around earth is intuitively aware of the increasing threat to human survival—around our planet—that is bound to follow the further promulgation of our egotistically ignorant and illogically opposed individual and group viewpoints.

Let us therefore be as scientifically orderly as is at present feasible in dealing intellectually and practically with that complex scenario of transformations called "environment." To do so, let us first examine our *subjective* macrocosmic and microcosmic experience apprehending processes and then our deliberate experimental explorations toward comprehending the macro- and micro-environmental event complex. Finally let us scientifically reconsider our intuitively objective formulations for the objective employment of the generalized principles which we seem to have winnowed from our experiences with the environment which in turn may permit us to make life-favoring alterations of the environment scenario.

For a microcosmic example of our spontaneous and superficial misapprehending and miscomprehending the environmental events we must concede that both theoretically and experimentally we have now learned and "know" that there are no "solids," no continuous surfaces, only "milky way-like" aggregations of remotely interdistanced atomic events. There are no "things"—no particles—only energetic events. Nonetheless society keeps right on "seeing," dealing, and superficially cerebrating in respect to "things" called "solid."

There are over a quadrillion times a quadrillion atoms dynamically intercoordinating in each of our brains, of whose successful local intercoursings within microcosmic dimensions, at 700,000,000 miles an hour, we have no conscious awareness. Nor may we claim any conscious design responsibility for their fantastically successful electromagnetic performances which altogether result in our consciously cerebrating the sensations and thoughts which integrate as our seemingly simple *awareness* of just *being alive*—here and now—and evolving and considering these self-emergent "thoughts." It is not surprising that so exquisitely designed an apparatus can be carelessly and imperfectly tuned in by us, with superficially misleading results.

And as an example of the inadequacy of our *macrocosmic* apprehending I think of students who say to me, "I wonder what it would be like to be on a spaceship." (Oldsters have for so long assumed that such events were impossible they no longer tend spontaneously to think of participating personally in space travel.)

I always answer the students by saying, What does it feel like? That's all you have ever been experiencing. You are all astronauts, for you live aboard a very little spaceship, illogically called 'Earth.' I say illogically because of the relative meagerness of its exquisitely superficial stardust and radiation supplied, biologically photosynthesised, and chemically composed 'top soil'—ie, the very complex variety of fine particle aggregates generally identified as the substance *earth*.

Once in a while we launch a little spaceship at a velocity of fifteen thousand miles an hour from our bigger, sixty-thousand miles per hour speeding spherical Spaceship Earth which is only 8,000 miles in diameter. We launch our little ships from our bigger Spaceship Earth at only one quarter the speed of our own sun orbiting travel. Our 8,000 mile diameter may seem big to the only-one-thousandth-of-a-mile-high *you* or *me* but our spaceship's size is negligible in respect to the macro distances of the sky. The nearest space 'gas station' (or energy station) from which we get energy to regenerate life aboard our spherical spaceship is the Sun which is flying in formation with us at 92 million miles distance. As our Spaceship Earth flies formation in annual circles around the Sun it rotates 365 times per orbit and thereby exposes all of its surface to the Sun's radiation, thus permitting optimum impoundment of this prime life supporting energy. Our next nearest energy supply skyship 'Star' maintains space flight position with us at 100 thousand times greater distance than the Sun as we altogether fly formation through the vast reaches of the ever transforming Galactic Nebula.

I am a constant traveler around our spaceship's spherical deck. Together with several million others I have now in my lifetime—walked, run, ridden, floated, or flown over 3,000,000 miles around the spherical surface of the earth. My travel is one hundred-fold the average distance around the surface of our Spaceship Earth heretofore accomplished in an average lifetime by any one of the generations before our time.

Lots of people say to me, "You know, I don't like travel, I don't like motion. I couldn't stand your kind of life." And I reply, "You apparently don't know what you are doing!" My lifetime's traveling around our Spaceship Earth's surface is but a negligible mileage addition to our mutually accomplished nine million miles annual spinning around our polar axis, plus our six and one-half billion miles annual orbiting around the Sun and our multi-quadrillions of annual miles of milky-way peregrinating and inter-nebulae deploying. Therefore my

total lifetime's to and froing around our Spaceship Earth's surface of only three million miles is only one-millionth of one percent of yours and my simultaneously accomplished macrocosmic traveling of *one hundred and forty quadrillion miles* which enormous total is however only one-third of the distance simultaneously accomplished in the microcosmos by each of the six trillion of atoms comprising each of our individual human organic systems.

I then repeat to my unwitting and involuntary co-travelers aboard our Spaceship Earth the admonishment of our once-upon-a-time Harvard cross-country running coach Al Schrub who used to say "Take it easy and go faster."

The utter unreality of our conscious preoccupations is manifest by the foregoing macrophysical-microphysical event reconsiderations. Our misconceptioning is occasioned by the fact that most changes that occur in our entirely dynamic environment do so faster or slower than may be tuned in by our sensory faculties. We cannot see the hands of the clock move. We cannot see the airplane propellers when they are in motion. We cannot actually see humans, trees and plants growing. As with the clocks hands, we only become conscious in due course that their pattern aspect has changed. We can't see the stars or the atoms "move."

I am going to review a few more of those imperceptible events of our environmental evolution which most people acknowledge only in retrospect. For instance, one of my own experience "scenarios."

I was born in 1895; the airplane was not invented until I was 9 years old. With a lot of other young people, I thought that our parents were wrong when they said "man can't fly." But many 10-year-olders like myself kept on making and throwing paper glider-darts while also trying to make little experimental models of full size man-carrying flying machines and sent them gliding out the attic windows. When flying did come, we expected it while our parents found it almost unbelievable.

The year I was born, the automobile was also born in America. Even though I lived and was brought up in Boston, I didn't see an automobile until I was 7 years old. That is how scarce autos were. The cranking of the car was quite a job and every few minutes some item failed. I grew up thinking of gasoline engines, pneumatic tires, automobile brakes, and storage batteries as being very unreliable. It has, therefore, been quite a change in the enviromental verities of my life for motors and brakes to become generally reliable and for man to attain everyday mastery over larger blocks of energy than that of our own muscle or of the muscle of hundreds of horses. How then in contrast to myself and my contemporaries did the 21-year-older of 1967 come to think spontaneously of the automobile as organically reliable. It happened as follows.

At the beginning of World War II, before the United States came officially into the conflict, generally unknown to the public, the US Air Force began using the DC4, as the first transoceanic airplane, to carry all kinds of cargoes overseas, for instance, to the Burma Road. We sent these great skyships outbound around the world—full of various war items. These DC4's were however returning to the United States empty. The air force decided to take scientific advantage of all the homebound cargo space by shipping to Wright-Patterson Field at Dayton, Ohio, the airplane engines from any of our aircraft that had crashed in foreign operation. At Wright-Patterson they took those engines apart. They didn't have inventors looking them over to see "How do we design a better engine?" They simply wanted to know which part had failed and caused the accident.

The aeronautical world maintains not only logs of *all* its flight activities but also detailed, hour by hour records by qualified mechanics of the case histories of every airplane engine. Thus, it was learned at what hour and minute this spark plug or that connecting rod had failed. Thus it was also learned what the *earliest time* was, at which any connecting rod or any category of engine part had ever failed,—say for instance —that the earliest time a connecting rod in a specific type of engine had ever been known to fail was on the 37th hour of use. "Therefore," the air force said,

"inasmuch as we have routine overhauls every so many hours, if we always replace each part at the nearest routine overhaul occurring immediately before the earliest known failure for that type part of that special model engine then the probability of such failures will be approximately eliminated."

That proved to be true. Thus, it happens today that when you fly around the world your engines are extremely reliable. Though many as yet feel that flying is hazardous, air travel is far safer than railroading and automobiling. But even the automobile's component technology has been vastly improved as a consequence of the general improvement in design which ensued.

A mechanic will not falsely certify that he has made an airplane repair. If he did, he could not sleep. The imminence of death is too dramatically imaginable to be subconsciously avoided. But the same mechanic working in an auto repair shop might falsely certify that he has fixed an automobile because his subconscious knows well that automobile users are not going to fall out of the sky. But even the automobile technology has improved—in lesser degree—sufficiently to give the youth of today spontaneous confidence in its functioning for reasonably long periods between servicing. Thus, the transportation aspects of our ever evolving environment have greatly altered and with them the spontaneous human reflexing which they condition.

Lindberg's conquest of the Atlantic with cloth-covered wings occurred in 1927. The first night flight air mail did not start until 1929. The aluminum air transport did not appear until 1930. When our second daughter was born in 1927, I was pushing her in her baby carriage in Lincoln Park in Chicago and a little airplane went overhead. Though I myself had been flying for ten years, to me at that time, the experience of seeing an airplane in flight over Chicago was as yet an exceptional experience. However, airplanes became, at that initial stage of her life, an a priori part of my daughter's *everyday* environment events—that is to say they became to her what humans speak of as a *natural* everyday phenomenon. To each human, "natural" means the state of the environment as he first encountered and continues to experience it in his youth.

My daughter's daughter—ie, my granddaughter—was born in New York 13 years ago. Her parents lived in an apartment on the top floor of an old three-story wooden house situated at the highest point of the hill section of Riverdale just north of Manhattan. Their house stood directly below the westward flight paths of all the planes landing and taking off from both LaGuardia and Idlewild Airports. By now jets were coming into use. Over the roof of the house several times a minute went the roaring airplanes. As she cocked her head to listen someone would usually say, "an airplane!" It was not surprising that the first word my granddaughter said was not "Mummie" or "Daddy" but "air"—her sound expression for *airplane;* people took her to the window to see those roaring machines fly by overhead.

She was born in the late fall of the year when there were no leaves on the trees. As a consequence she saw thousands of airplanes before she saw one bird. Airplanes became much more "natural" inhabitants of her sky than birds.

My granddaughter also saw hundreds of thousands of automobiles coming up the Westside Expressway of New York City. Friends of the family sent her the same children's books that they themselves had received in their childhood. The books were full of pictures of cows and pigs and other of yesterday's "natural," everyday items and events none of which, however, my granddaughter had ever seen. She was as unfamiliar with their appearance as she was with the appearance of a polio virus; but sensing the grown-up's expectant pleasure she accommodated them by laughing at such absurdly "unnatural" pictures.

In other words, the so-called "natural" environment is constantly changing and consists not only of constantly accelerating rates of performance of man's ever-changing everyday tool functions but consists also of progressively occurring, inadvertently negative, by-products of the change, such as the pollutions not only of air and water, but of the whole mental, spiritual, and emotional environment which deteriorates the meanings of our expediently abused vocabularies. Thus, fallacial concepts, superstitions, customs, and shortsighted exploitations frequently pollute the environmental information and, therefore, "common sense," and its frequent stimulations of "practical" but shortsighted and worse than worthless decisions or permissions. Thus, the young world

has now come to look upon both new events and yesterdays conditioned reflexes quite differently from the way older people do.

Because of the alteration of fundamental meanings and trend implications, it is difficult for the older people to realize what is motivating the young, for instance at Berkeley, Calif, in 1964 to 1965. The "Berkeley" group—whose predominant numbers graduated in 1966—any may thus be thought of as the world around "class of 1966"—are the first generation in history to have been "brought up" with television. Television is of major importance to them. The "Berkeley Event" age group throughout the United States, as well as their contemporaries in many countries where TV is in operation, have averaged 1,000 hours each year looking at and listening to the TV—more time than they have spent listening to or looking at their "natural" parents. Though the parents know only the well-known movie and TV stars, the children know all the minor actors as well as the famous ones who appear on TV.

We have learned from behavioral science research that the speech patterning of the parents—the way in which the parents employ words—is of greatest importance to the IQ development of children between the ages of 4 and 7. If the parents using their minds seek to formulate their own thoughts and develop a good vocabulary and pronounce their words well, the children also are inspired to do so. If the parents don't trust their own thoughts and use only other peoples clichés, and echo only other peoples judgments the children are inclined to forsake their highest intellectual capabilities and revert to muscle and cunning.

When I was young, in addition to the family voices and personalities with which all children are familiar, there were also the speech patterns of the postman, the grocer, our family's cousins, uncles and aunts, and the friends who from time to time came from outside into our home. Television now provides the most prominent of all of these outside speech influences. But the TV personalities, thought of by the grown-ups as coming "from outside," seem to the new generation to reside realistically inside the home, usually in the children's own room. I, therefore, combine all the TV personalities into one which I call the "Third Parent."

The children sense much more spontaneously than do the grown-ups that the people appearing on television in various roles and functions are just playing games which include their attempts to sell some product. The children too can all play games. They play "shoot grandmother" and don't mean it seriously. Nor do they take the TV stories and plays seriously as the parents fear they will.

What the children really sense about the TV actors which appeals to their fundamental survival senses is that those human beings are earning their living by *playing* their roles and the children sense spontaneously that TV actors get their jobs through good diction and verbal versatility. Often the television personalities have much better diction and vocabularies than have the TV viewing children's parents.

Parents are often away at work. The Third Parent—the TV—stays at home. When the blood parents come home, though they may be dearly loved and a welcome sight, their conversation is frequently of little or no informative or inspirational interest to the children who turn to their "Third Parent," who tells them all the major news about the world and not just about local trivia. Thus the "Third Parent" becomes both the most authoritative as well as *most interesting* and best spoken parent.

Lots of people were shocked when the Berkeley students said they felt no sense of loyalty to their college or to the United States. But further inquiry shows that they are not lacking in idealism or in compassion. The young people simply feel loyal to the whole human family. They refuse to accept yesterday's "you-and-me" cultivated biases. They feel that the whole world should be made successful for everybody. The TV bred youth also learn from their "Third Parent" all about the inventions of which men are capable—such as voyaging for thousands of miles under the polar ice and soft landings on the moon. They feel—quite reasonably—that man can produce *anything* he needs and wants.

Learning from the "Third Parent" that the majority of the human family is in trouble, the TV generation feels that its parents are much too locally preoccupied with irrelevant ideas and obsolete customs and are blinded by misinformedly conditioned reflexes. The young people see that we cannot correct such negatives as air and water pollution by local means for obviously the air and water flow everywhere around our planet and affect everybody, and thus, if anything may "belong" to anybody, they realize that the Spaceship Earth's prime resources belong to everybody. The young people see clearly that we cannot control our environment until we gain enough confidence both in ourselves and others to permit us to use both our physical resources and our higher faculties to induce each one of us to deal as intelligently with all the world and all people as we would with our most trusted and beloved friends.

To be able to coordinate and take the initiative, the TV generation see that they must face up to these facts of the organic, omniinterdependence of our whole Spaceship Earth's component resources and people. The young feel the older ones are no longer capable of such realistic farsightedness. The older generation has been frustrated too long. It is too slavish and lacks fundamental confidence that technoscientific innovations can be made to work and that man can be both physically and metaphysically successful. The older generation is wrong in its axiomatic assumption that all history teaches us that there is not enough for both of us and that it has to be "you or me to the death as there is not enough for us both to live." This assumption automatically induces cunning and the conclusion that it is foolhardy to trust the other fellow.

The European people who first settled in North America put up little wooden houses to permit their survival in the rainy days and cold months. To live they had to employ nature's progressively disclosed biological regeneration scheme for maintaining life aboard Spaceship Earth. The heart of this scheme is to obtain energy from the sun by the photosynthetic chemistry of the green vegetation on the land and the algae in the water. Men and animals cannot impound sufficient sun energy directly through their skins to both survive and regenerate. Nor can man eat the energy-capturing trees and grasses. He can eat some of the fruits, a few leaves, nuts, and roots. The vegetation is consumed primarily by insects and animals which in a complex chemical energy relaying system—culminating in animal flesh—can eventually be eaten by man. In his early farmsteading, man had to spend all his daylight time *cultivating* high-bred vegetables, animals, and fruits; his pioneer housing was minimally conceived with just a few windows to enable the wife to see whereabouts in the fields her man might be so that she could find him quickly in an emergency.

As time went on man developed tools to improve and speed his work so that he had more time to spend around his house. He built a front porch to keep off the rain so that he could have a chance to sit, look around, think, and plan. Then with even more time saved by even better tools he found time to screen his front porch. Later with even more time, he glazed it. At first his young people used the parlor to do their courting. Later they resorted preferrably to the new palm-, rubber-tree-, and geranium-filled, glassed-in porch—the "conservatory." Gradually, evolution, in effect, "put wheels" under the glassed-in front porch concept and. like a hydra's spawned new life, the front porch broke off and went rolling along the road in the form of the "automobile." The automobile, thus, became today's young people's parlor. That is where they do their courting—parked at the drive-in theater or elsewhere in their mini-sized mobile home.

The old farmsteads of a half century and more ago had a great many buildings, each of which employed associative or disassociative phases of energy as positive or negative heat to produce and maintain certain environmental conditions—of dryness, wetness, heat, or cold within which to preserve or process foods, fodder, and materials. The windmill, the woodshed, the icehouse, cowbarn, corncrib, hen house, hayloft, cold frame, and warm cellars, etc, were used to establish and sustain these preferred energy phase conditions. The subsequent development of electric refrigeration brought refrigeration into the house and obviated the wintertime's cutting of ice and its storage in a large separate icehouse from which cut-up cakes were brought progressively indoors

and put piece by piece into the ice box. Thus, we were inadvertently innovating mechanizations for no one realized that those *buildings* were indeed machines and as all machines, they converted energy into work which in turn produced and maintained preferred environmental conditions—the environment itself always consisting of a complex interaction of different energy phase events.

Now I would like to get a little more scientific about what I've been saying: in 1927 I began to feel that in this total evolutionary process, man was extremely ignorant and vain. For instance, though our leading scientists have had 500 years opportunity to adjust themselves to their own theoretical knowledge and scientifically disciplined experimental findings they have always realistically "seen" and as yet "see" the sun going "down." All scientists continually use the words *up* and *down* although we know that no unique direction of the universe may be identified as either up or down. These words up and down were invented when mankind admittedly thought the earth was flat and that all perpendiculars to it were parallel to one another with one set of ends pointing up toward the heavens and with the other set of ends pointing in the opposite direction, ie, down toward hell. Today, the aviator finds as he flies around our spherical spaceship to China that his plane is up-side down in respect to the United States but not upside-down to himself or anyone else in the vicinity. Therefore, he has to formulate new terminology to accommodate his experience and eliminate the misconception. As a consequence he now says that: he "*comes in* for a landing" and "*goes out*" when he "takes off." When people say up they really mean *out*, and when they say down they mean *in*—toward the center—the center of some specific, focal, unitary mass in the universe. Each individual *in*wardness is *unique* and specifically directional. The *out*wardness is *common* to *all* the individual *in*'s and is omnidirectional. On televised programs of our manned satellites we frequently hear the ground control scientists and doctors saying to the astronauts in orbit, "How are things *up* there this morning, boys?" often asking this as the astronaut's around-the-earth zooming capsule is at the moment of querying in the direction of the inquiring scientist's feet.

All the foregoing is just to remind us how we are cerebrally booby-trapped by yesterday's misinformation-polluted mental stimulus enviroment. Possibly the most lethal pollution we have is the information pollution the effect of which is blinding us from seeing the costly eventualities of the more familiarly recognized water and atmosphere pollutions.

Young people have a very great advantage over us oldsters because they have so much less to unlearn. Much of my life has been of necessity invested in unlearning all the erroneous information that has been given to me as both curriculums and extracurriculums *education*, albeit often with the most loving motivations.

In 1927 I decided that all our hope for humanity's survival and possible prosperity lies in the young, because the older people in general are so preconditioned with error and are, conceptually, so statically and locally preoccupied that they are unable to deal competently with our Spaceship Earth as a complex life-regenerating energy processing system. They cannot break away to think and operate in the terms of our whole earth as an organic and entropic machine equipped and continually "refueled" by radiation from our mother spaceship, the Sun.

I had good reason to think that children may have clearer and less damaged brains and minds than grown-ups. Our first child died just before her fourth birthday. She was born at the end of World War I and in rapid succession caught the flu, infantile paralysis, spinal meningitis, and finally a fatal case of pneumonia. She was not able to run around like other children, so she used her brain and mind in most extraordinary ways in order to acquire the environment-comprehending information obtained by the physical experiments of normal children. She often spoke out anticipatorily the sentences about to be spoken by people around her, thus disclosing a degree of sensitivity otherwise unrevealed. I concluded that I was experiencing direct proof that the young are born with a much greater brain capacity information-tuning range and mind capability than any of us have been accrediting to them. This made me feel, in 1927, when our second child was born five years after our first daughter died, that we had the unbelievable renewed opportunity and vital responsibility of trying to protect these higher capabilities and giving them a chance to develop. At that time, I committed the rest of my life to working on ways of reforming the environment—instead of trying to reform man—intent thereby to accommodate and protect humanity's probably much higher intellectual and productive potentials.

For too long we have been working under the false assumption that the young child's brain is in effect an empty receptable into which we may pour our precautions and know-how. The behavioral sciences are now disclosing that the young have innate faculties of comprehension and wisdom frequently surpassing the damaged cerebral equipment of the nonetheless "acceptably normal" older people.

I have tried to fashion an environment within which it is possible for the young to experiment without getting hurt and within which they can get the information they really need without their parents having to say "Don't" for fear the children may be hurt in one way or another. Within such a completely designed patterning of environmental events the children may experiment without something falling on their heads, when the parents don't say "don't" or are not around to "don't" them. When such accidents happen, the child subconsciously questions: "Why is the home environment so ignorantly organized that when I make experiments I must get hit on the head and be constrained spontaneously or be commanded to abandon my efforts to find out what I need to know regarding successful employment and enjoyment of my faculties and the resources about me?"

The environment is entirely dynamic that is to say it is a complex interaction of physical and metaphysical experiences of varying frequencies and quantam magnitudes. To each of us the environment is *everything that is not "me."*

It is essentially significant that, despite our having learned theoretically about the speed of light and the new thinking of Einstein, very few of us as yet think realistically in those supracomprehensible speed terms. Most people as yet think of universe as a single static, instantaneous, geometrical system whereas our universe is an aggregate of nonsimultaneous and only meagerly overlapping events each of which is continually transforming, disassociating, and reassociating in new ways. We now realize on deeper reconsideration that the *combined physical and metaphysical universe*, as the aggregate of all humanity's consciously apprehended experiences, must also be taken to be a *complex aggregate of nonsimultaneous and only partially overlapping transformation* events with complementary, positive and negative, non-mirrorimaged, maximum and minimum, microcosmic and macrocosmic, associating and disassociating, compressive vs tensional, concave vs convex, inside-out vs outside-out, etc, limits.

We can clarify that accurate but formidably complex definition. A moving picture scenario is an aggregate of nonsimultaneous and only partially overlapping events. One single picture—one "frame"—does not tell the story. The single picture of a caterpillar does not tell or imply the transformation of that creature first into the chrysalis stage and much later into the butterfly phase of its life.

When people say of universe, "I wonder what is outside its outside?" they are trying to conjure a unitary conception and are asking for a single picture of an infinitely transforming nonsimultaneous scenario. Therefore, their question is not only unanswerable but unrealistic and indicates that they have not listened seriously to Einstein and are only disclosing their ignorance of its significance when they boastfully tell you that the speed of light is 186,000 miles per second.

Realizing that both the inside and outside environmental influences impinging upon man all originate with atoms, and are omnidirectional, I started off by thinking of how all the heretofore unrecognized, or unwelcomed micro-macro events might be turned to advantage. Instead of trying to insulate man against them, it seemed that I should try to learn what must be intercepted, how to intercept them, and how to turn them to human advantage?

Man needs lots of water but he can't use all the water while it rains so we must learn how to intercept that rain and shunt it into holding patterns—in cisterns or reservoirs—and then pipe it and valve it so that it may become controllably available in the increments and at the times most favorable to

humanity's schedule of metabolic regeneration processing.

The total environment interaction going on is as beautifully designed as is the Spaceship Earth itself—aboard whose spherical hull men have been able to live for 2,000,000 years unaware that they were aboard ship—simply because they were so physically tiny that they rarely lived to see more than one millionth of its total surface.

Intent upon designing the most effective means of valving the environmental events to humanity's maximum advantage—in 1927 I set out to catalog all the things I could think of that ever happened to man. I thought this inventory might take months but it took only a few weeks. Later on I published this list. On looking at it sometime afterwards, in neatly compressed print, my eye saw new patterning that I had not seen before. My eye happened to fall on a part of the list where "tornadoes" were listed next to "mosquitoes." This seemed suddenly to be so incongruous that I rearranged all the items in order of *relative severity* of hazard to human survival. This order ranged from "lethal" through "disastrous," "very dangerous," "fairly dangerous," "bothersome," to "innocuous," to "pleasant."

When all the items were arranged in strict order of relative severity a new pattern of surprising significance emerged. *It became apparent that the larger and more severe the event, the less frequently it occurred.* This is because in the expanding diffusion of ever moving, transforming, disassociating, and newly associating energy islands of universe the number of times that there will be large amounts of energy in one given place to bring about large transformations is inherently less frequent than the number of times there will be small amounts of energy in any one specific place to bring about relatively minute or meager transformations. We have "bugs" much more frequently than we have "earthquakes." Suddenly I realized that what we speak exactly of as "tornadoes" and "mosquitoes" may be very specifically identified in the hierarchy of energy events which form the Quantum Laws of relative *frequency* and *magnitude* of "waves" and "particles." Thus, an environment can really be analyzed and treated in powerfully selective scientific terms and predictable frequencies, magnitudes, and specific longevities of effectiveness. I began to realize that we can scientifically control these omniorginating and self-convergent energy event factors—to high human advantage.

It also became retrospectively visible that the universe is a dynamic continually evolving process within which man himself is continually evolving. Dr. Waddington, the famous animal geneticist of Edinburg University, points this out when he speaks of what he calls the "epigenetic landscape" in which we have all of the biologicals continually altering the environment and the altered environment continually realtering the biologicals. There is manifest a chain reaction of extraordinary pattern interactions whose consequently progressive intertransforming we recognize as "evolution." Evolution is both you and I *and* the comprehensively dynamic, macro-micro environment—ie, universe. Due to entropy, the physical evolution of universe is irreversible. There are cyclic patterns which are repeated but not reversed. Only the metaphysical abstract thoughts can review and reconsider the evolutionary transformations, individually or collectively, but cannot "turn back the clock."

In view of all the foregoing we learn that the planning of new cities embodies possibilities for progressive attainment of highly favorable stages of ever more effective environmental event controlling.

I have been retained to develop a large city in Japan (up to possibly a million) and am also on the steering committee of an "Experimental City" to be situated in Minnesota. In studying these two projects, it has become evident that the basic concepts, drives, decisions, and actions of humans, which produced all the *great cities* around our Spaceship Earth occurred long before man had thought of electricity or telephone or any of the present technological advancements which are so greatly changing our lives. Cities developed around yesterday's patterns of caravan and ship trading. These points of exchange generated wealth not as much for the prime producers of the goods and services as for the entrepreneurs and for those who by prowess of physical might "protected" the trading with their swords and thus also sustained their sovereignity claims and deeds to the right to the land.

To sustain their fundamental economic advantage the land manipulating entrepreneurs enacted property laws as arbitrary accessories, only after the fact, of the anarchistic ways of permissive favoring of the independent uncoordinated enterprise multiplication of strategic land exploitations which result in the coral reef like random growths which we call cities.

City planners at university schools learn how to make good theoretical plans, but as practicing professionals they have no power to do anything but suggest. Their plans are continually disrupted and overridden by those who exploit our highly prized rights of free enterprise for exclusively selfish reasons. However, too shortsighted enterprise often takes advantage of society in thoughtless ways. In order to safeguard enterprise which also has many favorable evolutionary transformation advantages for all of humanity, it is not necessary to allow some men to trespass shortsightedly on the evolutionary developments of their fellowmen. The almost totally anarchistic piecemeal development and remodification of cities exclusively for the benefit of the prime investors and without comprehensive consideration of the total welfare of all mankind for all future time is getting us into ever greater trouble.

In a very realistic sense all of society is beginning to realize that this is so and there is a powerful trend in basic drives of human consciousness towards the swiftest corrections which will not be too disruptive of the total evolutionary welfare of all humanity. In view of that evolutionarily emerging propulsion of human consciousness toward discovery of any other alternative courses of action, which may have hope of fulfillment, it is encouraging to discover at least one other realistic and much more socially promising way of looking at future city designing. This alternative derives from the observation that the *Queen Mary* is of course an extraordinarily beautiful and comprehensively organized small city. This lecture was given to the American Medical Association, April, 1967. Six months later Los Angeles decided to purchase the now competitively obsolete *Queen Mary* for a convention facility.

Such mammoth ships are not only the competent products of, comprehensively anticipatory, design science but are also the prime demonstration of the effectiveness of the general systems theory. General systems theory originated in the design and operation of world encompassing and commanding fleets of navy and merchant ships. For a few centuries the general system theory commanded and operated the world but only as anarchistic exploitation systems whose immediate and directly perceived profits went exclusively to the benefit of less than 1% of humanity.

I found in 1927 that one of the New York hotels happened to have the same number of passengers or occupants and the same amount of private and public space as the Cunard Line steamship, the *Mauretania*. I made a critical general systems theory analysis of their relative performance characteristics which were as follows: the hotel was able to get its supplies of food, linen, power, heat, and light daily for the local suppliers situated in the city—outside the hotel—and therefore did not have to include these capabilities within their structural design, while on the other hand the *Mauretania* did have to store on board a 30-day supply, had to generate its own power and light, and had to structurally support and float the weight of the engines and fuel to drive it through the sea at 30 knots. I found that if I turned the hotel over on its side in a horizontal position like the *Mauretania*, just one of the little waves that the *Mauretania* had to handle would break the hotel into pieces. Yet the hotel weighed 18 times as much per usable cubit foot than the ship. This was fairly typical of the difference between the fundamental technologies of the sea and the superficial and inefficient building contrivances of the land.

On land, men have thought in terms of fortresses and guarding their positions and of hoarding their supplies so the heavier and more durable the building, the more secure they feel. They thought of buildings as permanent while ships were designed for relatively short service.

The ship has first of all to float. Each more useful ship has to do more with less, have greater and greater strength, and be able to continually increase power without increasing its weight. The competition advantage goes always to the latest ship to do even more with less. Therefore, the design evolution is in constant acceleration on the sea and in the air but not on the dry land building.

The foregoing explains why it is possible

for a whole organic city to be floated. It is also evident that in an organic floating city—which unlike the *Queen Mary* need not cross the ocean at 30 knots—but can remain anchored at a desirable location—the amount of weight which must be invested per each organic function can be decreased greatly.

We are actually undertaking this in Japan. Since this lecture was given the Japanese patrons have changed their plans and are now going in for a high tower community on the land. Fortunately, the idea of the floating city has been espoused by others and the project is going forward but in other waters than those of Japan.

The Japanese as island people think in terms of the sea so we are planning our first city to float on the ocean. Its floating hollow reenforced triangularly shaped concrete base will reach 100 feet below the water surface. This is well below the ocean turbulence depths. This means that the floating city will not rise and lower with the waves but will hold its "altitude" as does an island or iceberg. The waves will "break" against the floating base as they do on any breakwater. Inside the deep floating triangular base a vast lagoon will act as a large seagoing-ship's harbor.

Ships that must be driven economically and swiftly through the seas must be long and sleek and therefore are subject to "beam" and "cantilever" stresses as they first span between waves and a moment later mount one big wave at their mid-length, their ends being partially out of the water. Such stress alternations twist and rack the ships. However bell buoys which remain anchored have no such asymmetric conformation and float integrally with but little redundant stressing even in great storms. The triangular base conformation of our organic floating city is similar to the bell buoy and will not permit any redundant stressing—and will therefore have maximum structural stability with minimum effort and therefore greatest economy.

The organic, floating city starts off with its prime power and water requirements at hand for it can combine atomic power reactor cooling and desalinization of the sea around it—by use of the by-product heat. Therefore, as practical experiment has now shown both water and electricity can be produced at lower costs than in any other known way for producing either independently of one another. The Japanese are not even mildly adverse to using dry packaging toilets instead of liquid "splash-back" toilets, which continually later pollute the conveying waters as the latter are shunted through the plumbing systems, enroute their passage from the sky as rain down the mountain sides, toward and into the sea system. Inasmuch as it is economical and desirable to have the food supplies inbound to our digestive system plastic packed, it becomes equally economical and desirable for the outgoing products to be electronically sealed in plastic packages for dry conveyance to chemical resource collection points, subsequently to chemical processing works, and finally to valuable by-products distribution uses.

I would like to point out here that, in relation to all our pollution problems of the air or water, very valuable chemical products are continually lost. For example, the stack fumes of one nonferrous metals refinery disgourges somewhere around $500 worth of chemical substances a day, but the cost of the precipitation would be about $500 so the company does not attempt to recover it for the cost of the installation could not be amortized. If air pollution control were really enforced, a lot of very valuable products could be salvaged at a real profit if we consider the far more gargantuan costs of society's ultimately coping with the physical ills resulting directly, and much later indirectly, from the fume-polluted atmosphere.

I mention this because, as you doctors begin to study environmental health problems in depth, if you apply general systems analysis—as the computers will now permit you to do—you will begin to know the overall profit and loss to society of doing or not doing thus and so. You also will inevitably encounter much inertia and shortsighted thinking which can be overcome only by education regarding the overall costs or profits to all human society—all of which must be inexorably paid for by some large numbers of humans sometime and somewhere about our Spaceship Earth's surface. It is therefore extremely important for you to be able to point out the ways in which atmospheric control will pay off magnificently and *that* you can now do with the computer's aid.

Dr. Benjamin Bloom, an educator in Chicago, author of the book *Stability and Change in Human Characteristics*, sets forth the results of his investigations of the critical effects of environment on the brains and minds of the young. These results were arrived at by a significant number of periodic tests under controlled conditions. Combining Bloom's observations and those of geneticists, neurologists, and the electromagnetic probers of the brain, we discern that the various apprehending and coordinating capabilities of the brain—as scheduled and actuated in the children by the unique chromosome "ticker-tapes" of each individual—are measurably affected by the environment of the individual. As far as we know by any experiments neither the environment nor anything else can produce a better intellect and brain than that with which we are born—but an unfavorable environment can very greatly impair the functioning of the innate faculties.

I have found that the ability of man to use his highest faculties to cope with his environment is more favorably affected by design science reformation of the inanimate environment than by direct legalistic, punitive, physiological, or psychological attempts to reform human beings. I am convinced that 90% of humanity's problems can be solved only by comprehensively anticipatory design science reformations of the environment.

I have made many experiments with measurably improved environmental controls in over 5,000 structures in more than 50 countries. Concurrently, over a period of 50 years I have continually undertaken to solve those design problems by use of the most advanced technologies for doing ever more with ever less fundamental resource investment per each unit of functional performance. It has, thus, been experimentally evidenced that by such ever more economical and more effective environment reforming means we have the greatest hope of achieving both physiological and economic prosperity for all humanity. Furthermore, this environmental reformation strategy now seems to be both scientifically feasible as well as economically desirable.

In substantiation of that statement I find that my geodesic prime environment valving controls (this is my scientific identification of structural "dwelling machines." ie, geodesic buildings) are running only about 3% of the weight per enclosed cubic foot of the best known alternative engineering strategies for coping with the same given magnitude of the omni-hazard events of nature. Furthermore, my geodesic structures can be put in place and in operation in fractions of the time for alternative structural strategies and unlike any other previous buildings are both 100% demountable as well as economically deliverable around the world by air transport.

The US building for Expo 67 was a very large energetic environment-controlling device. I am its architect. I can tell you, therefore, that it was not put up there to be pretty or novel but simply to be the most economical tool for coping to advantage with all weather, and earthquake events. It is an effective energetic valve. It lets in what humanity needs and wants, when they most need and want those services in the most acceptable, useful, and necessary quantities, for instance, of light, air, and other chemical conditions of the atmosphere, sound, and olfactoral conditions, and as tuned most compatibly with man's complex variety of frequencies and chemical energy increments.

Our Expo 67 geodesic environment valve is 20 stories high and 250 feet in diameter. Istambul's Santa Sophia Mosque or the enclosed volumes of any one of the great cathedrals of the world could be put inside it, for instance, Seville Cathedral in Spain, St. Peter's in Rome, or Notre Dame in Paris. The total US geodesic pavilion building weighs only 800 tons. This is approximately the weight of just one of the many internal stone columns in Seville Cathedral—the second largest such edifice in the world.

I find that I have improved thirtyfold the environment valving capabilities of humanity as measured in terms of units of weight of structure per given performance schedule capabilities of that structure. Therefore the aerospace type of building technology which I employed in the Expo geodesic holds real promise to humanity of doing so much more with so much less in all branches of technology as to attain total success for all of Earth's inhabitants. The young world, seeing it, will feel encouraged. This is the first time at a world's fair that we have had a building designed specifically for its scientifically de-

monstrable high performance per units of invested weight, time, and energy. It is the first time in history that architecture has been presented exclusively in terms of efficiency of weight, energy, and time units of resource investment. The aesthetics of such an undertaking take care of themselves. Not an ounce of weight goes into the design, building, and outfitting of an America's Cup defender. That boat's beauty, as with a snowflake or a human being, is inherent in the exquisite economy of an exactly adequate performance capability.

Inasmuch as humanity on the land has not been thinking of what buildings weigh, it certainly has not been operating its construction industry on a performance per pound basis. Architecture has been superimposing millions of tons of superficial appeals to aesthetic applause to that already overbuilt land structuring.

Between 1900 and 1967 world society has inadvertently and all unpredictedly gone from taking care of less than 1% of humanity to taking care of 40% of humanity at a higher standard of living than that known or dreamed of by any king before the 20th century. During the same period the metal resources of the earth, both mined and unmined, have continually decreased per each world human. Therefore the sudden advancement of 40% of humanity's living standards to an unprecedented and previously undreamed of degree has not resulted from finding more resources, but, paradoxically, from the development of weaponry where the inherent design requirements of the waterborne and the airborne and the space-borne weapon carriers—as the evolutionary products of the great international armaments race—have continually been accomplished by doing more with less. It is the unexpected fallout of that more-with-less technology into the domestic economy which alone has brought about the politically and commercially unpredicted improvement of the living standards for an ever increasing proportion of all humanity. This standard of living augmentation for ever larger numbers occurs every time an armaments producing contractor is displaced by a producer of newer and more efficient weapons technology. The displaced contractor then looks around in the domestic market for an outlet for this technologically high productive capability. Thus, for instance, refrigeration which developed in the ships of the navy 30 years earlier was brought ashore to land-based homes. This fallout is specifically responsible for all the great advances in our home technology.

The time has come when you, as medical men for all the people on the land must realize that what we are all faced with is the necessity for a revolution in our education which in turn will result swiftly in an around-the-world design revolution which will progressively rework our environment to favor humanity's innate potentials.

You are faced with the challenge of helping society to know what its problems are. You are going to be implemented by new educational technology which will make it possible to do much more accurate informing with so much less that your admonitions can be heeded. We have the technical wealth capabilities to carry out your suggestions so do not be inhibited or deterred from forthright suggestion as to what we now should do if we wish humanity to succeed as Spaceship Earth's passengers. Science now says for the first time in history that Malthus is wrong. It is not normal for the majority of humanity to be, both or either, physical or economic failures. Science now realizes that it is normal for all of humanity to be a success. Failure is abnormal. That abnormality is wrought by the unnecessarily hostile conditions of the everyday environment on the majority of humanity.

But all the great ideologies of all the powerful nations are predicated upon Malthus and his assumptions that there is not enough to sustain both you and me. He assumed, erroneously, that eventually one of us must perish—far short of our potential lifespan—wherefore it seems popularly expedient for large sovereign country groups to implement themselves with big guns in preference to individuals seeking to survive independently with their separate little guns. Because of the foregoing all the ideologies on earth mistakenly assume and give highest wealth investment priority toward preparing for an inexorable Armageddon.

Because each department head of every industry in both the socialistic and private enterprise economies must make a "profit" of one kind or another, "this year" industry and commerce are inherently shortsighted. The politician's vision also cannot look beyond the next election. The only long distance-sighted activity of humanity is that which is focused upon Armageddon. Your own medical science has been underwritten first to ward off eventual death. It is toward this assumed eventuality that science has been almost exclusively fostered. Science has never had a mandate to make all of humanity a living success. This is because neither the great dictatorships nor the democratic electorate knew that comprehensive success was feasible. Science now says, however, that physical and economic success for all is feasible but that it cannot be accomplished with continuation of the political sovereignties which inherently frustrate the industrially essential integration of all the world's resources. Only a politically transcendental design science revolution can provide enough for all. The world's resources as now designedly employed can take care of only 44% of humanity. No strictly political act or revolution can per se correct that condition. And that condition attended to only by political leaderships means inevitable war.

Keep all the world's political systems in force and all the world's politicians and political workers at work, and at the same time take all the machinery of industrialization, all the tracks, pipes, and wires and dump them in the oceans away from all the countries of the earth, and within six months 2,000,000,000 people—half of humanity—will die of starvation. Lacking the industrial tooling no political system could alter that result. Contrariwise, leave all the machinery, wires, pipes, and tracks in place and all the humans, who now operate them, at their daily tasks, but take away all the world's politicians of any and all ideologies and send them and their party workers on a trip around the sun by a slow speed rocket ship and all those who are now eating will go on eating and with all the sovereign nation's barriers unmanned the foods will begin to cross the borders and the resources will be integrated and soon all of humanity will be eating and prospering.

Quite clearly world literacy of all the world's people regarding what the survival problems are must be placed on highest priority of educational undertaking if we are to avoid blowing outselves up or so polluting our biosphere that the energetic regeneration of life on Spaceship Earth will soon become impossible.

As the body of professionals having the highest initiative potential your challenge is clear. Is it to be an environment of life or death? Is our Spaceship Earth's biosphere to be an *omnihumanity-sustaining environment* or an omnilethal one?

This is the imperative challenge to all of humanity's intellectual integrity.

It is not your challenge exclusively, but your potential contribution is of the magnitude of the highest order.

Will we muster our self-disciplining capabilities to transcend our ill-conditioned reflexes? Having done so will we go on to cooperate with our fellow men in the realization of our mutually successful potential?

If the design revolution is initiated by a few capable humans—just as Marconi, Edison, and the Wright brothers altered man's environmental advantage to a marked degree—then the inevitable emergencies ahead for humanity may bring the new tools into use which in turn will bring about the physical welfare of all.

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DESIGN STRATEGY

BY R. BUCKMINSTER FULLER

Statement to a Leading Figure in the World Building Industry – 1966
(Reprinted from World Design Science Decade Document 5 by R. Buckminster Fuller)

Programmed to seek a weather protected building site a worker wasp will sometimes fly in through open windows of human habitats. Failing to find the programmed requirements for a site, the wasp flies as programmed,back toward the light. Very frequently it runs into invisible window glass whose atoms are far enough apart to permit light and radio waves to pass through, but not wasps. The wasp crashes against the glass but its soft landing-gear readjusts its mechanisms whose arrested wing foils, having lost their "lift", stall and allow the wasp to be pulled by gravity to a second crash on the window sill. From here it takes off on a spiral climb back into the room for a second and many successive flights outward toward the light. Only the "probability" statistics governing the chances of success with a half open window and x numbers of flights, initiated from below the glazed portion of the window opening, can hold any hope for the wasp's avoiding ultimately lethal re-encounters with the unprogrammed contingency—an invisible barrier.

Eddington said, "Science is the earnest and sustained intellectual attempt to set in order the facts of experience". Humans' intellects subjectively comprehend the wasp's problem but the wasp's sting is also a fact of human experience and despite a compassionate urge few humans are objective, energetic and scientifically ingenious enough to invent safe ways of helping the wasp to escape. They think of the wasp instead of the window whose open half could be shifted from the top to the bottom- or whose glass portion could be covered opaquely with a newspaper, so that the wasp's light seeking mechanism would steer safely only for the brightly illuminated, free, outward passage into the open air.

In short the humans spontaneously try to "shoo" the wasp, i.e. to reform the wasp's behavioral pattern instead of spontaneously thinking of how to reform the environment so that the wasp would be spontaneously stimulated by the reformed environment to escape and thus terminate the interference episode between man and wasp.

The unprogrammed lethal frustration of wasps lends insights into many of humanity's present day frustrated behaviors. The human's same fear frozen, subconscious reflexes—usually mistakenly identified as apathy–plus their ineptitude in not "seeing" what to do about the wasps—is often redisplayed in their apathy and ineptitude in dealing with humanity's owns sensorially inexplicable dilemmas.

Better than 99% of humanity's frustrations are occasioned by surprise encounters with the almost completely invisible evolutionary transformation trendings of human ecology and the latter's environmental transformings. Also invisible and inaudible are the universal evolution's information generating and distribution systems which if adequately tuned in and integrated could warn mankind of such trendings as may be negative or even lethal to future human existence on Earth.

We may bring thousands of wide-band radio sets into any room in any building anywhere around Earth and tune each one in on different radio programs all of which thousands of simultaneous programs are always invisibly permeating and present everywhere within vast distances

of space outward around Earth. However, humanity's technical discovery and use of some of nature's invisible communication systems does not mean that he comprehends the universal evolution. Half the messages sent by humanity contradict the other half in respect to transpiring history.

During World War I—for the first time in history—industrial man's ecological transformation processes entered into a comprehensively operating program which went predominantly beyond the sensorially apprehended ranges of human experience, experiments, communications and realizations. In 1914-1918, humanity went from wire to wireless communications, from tracked to trackless transportation, from two-dimensional transport to four-dimensional, from visible structuring and mechanical techniques to invisible—atomic and molecular—structuring and mechanics.

As with airplane pilots operating instrumentally in night and fog, so today (1966) do humanity's myriad of specialized experts subjectively read, or objectively program exquisitely differentiated, sub- or supra-visible electromagnetic functions within the complex of routine or exploratory events of world embracing industrio-economic, ecological revolution. The latter in turn—but altogether inadvertently—gives inexorable birth to a supra-political and supra-geographical identity—that of: World Man.

The essence of all the foregoing is that ninety-nine percent of all important evolutionary trends are invisible. Ninety-nine percent are either unapprehended or uncomprehended by society. The invisible, inexorable evolution will soon convert all nationally and subnationally identified humanity into Worldians, Earthians or just plain, omni-spontaneously universally coordinate, individual "people". The inexorable trending to one world citizenship is ignorantly and expeditiously opposed by the sovereign nations' self-perpetuating proclivities. The sovereign nations own or control the communication systems and preoccupy the systems with disintegrative news of the disintegrative actions taken by the sovereign political entities.

Up to a century ago, 27 years was the average life span of humanity—despite that a few exceptional humans of history lived beyond their "four score years and ten" i.e. 90 years. Up to a half century ago, it was assumed that only one human in one hundred could be economically successful and even then would only survive to an average age of 42 years. Now in the nineteen-sixties, average expectancy of North American industrialized man has reached 70 years, with two out of five men an economic success as well. By 1970, the majority (i.e. more than 50% of all humans around Earth) will be both physically and economically successful—or there won't be any humanity—save possibly a few hapless short-lived survivors of the atomic holocaust.

For only the last decade of all history has total physical and economic success for all humanity been conceded by science to be feasible. Realization of this extraordinary potential is importantly frustrated, however, by several factors.

First it is frustrated by the, as yet, rigid geographical and political partitioning of humanity under devisive and competitive ideological concepts, each purported to cope most effectively, only on a political bias basis, with locally sovereigned groups of yesterday's on foot to-and-fro-ing humans and their heretofore only but-one-in-one-hundred survival probability. This self-entrapment by man in political straight jackets came about through pyschological and physiological events which may be explained as follows.

Biology's two main branches—Zoology and Botany—disclose two main and clearly differentiated modes of survival - static and mobile—with the giant trees and the world around voyaging whales at the two size extremes.

The biologically static are subjectively advantaged. The environment brings them what they need. The mobiles are objectively advantaged to "go" and get what they need or want.

After hunting fruits, nuts, herbs, as well as fish and other zoological game, fairly successfully for thousands of millenia, man discovered that he could tame some of the game which spontaneously performed its own regeneration. From this lesson man discovered that he could plant

the vegetation's seeds and thus man started about eight millenia ago to cease his wandering and to remain to guard the territories he found most favorable for his locally regenerative animal husbandry and agriculture.

Because man's legs are so short and the planet Earth so big and because the few areas around it where he could find immediate vital support in his early days on the planet amounted totally to less than five percent of the Earth's surface, man has mistakenly identified himself during the last eight millenia with the rooted vegetation rather than with the mobile vertebrates of which type he is a member. Those few humans who found a local "good thing", "DUG-IN" and the multitude of others hung hopefully and hungrily around the successful few's exclusive "property" which the economically successful, successfully enacted as a concept into—strong-arm enforced– laws of men.

Physical or "natural" law has no inherent static "property" law—only behavorial properties. Nature's laws of evolution defy all static patterns. Entropy breaks them up. "Ownership" is not immoral, amoral or ethically unsound. Physical "ownership" is antientropic—ergo, eventually unsustainable. Metaphysical conceptualizations now are identifiable with individuals, which, in turn, are unique behavioral integrities. Democritus' concept of—and sound pattern identification of—the phenomenon "Atom", are forever identifiable as Democritus—i.e., as his intellect functioning. These individual metaphysical discoveries are not ownership identities. Democritus did not and does not own any Atoms, but he is irrevocably identifiable with their conceptioning and naming.

Ergo: "Ownership" of physical entities by man are untenable in natural law and are inherently obstructive to evolution and realization of the comprehensive emancipation of man—from his ignorance ·rooted failures, and from his imminently potential physical and economic success. However, unique service behaviors are identifiable with individuals and their respective creative capabilities. Only one's own "personality" and life are ownable. Only one's own inherently unique, chromosomically monitored, and experience modified patterning integrity is ownable.

Secondly, the physical, omni-success of all humanity is frustrated by the fact that scientific evolution—by which it could be accomplished—is almost entirely invisible and its integrated significances are too difficult for total and effective comprehension by society.

One reason for the latter frustration is that the language of science has been up to now almost exclusively mathematical—i.e. non-conceptual.

A second reason is that scientists altogether constitute less than one percent of the world population. Their thoughts are popularly unknown.

A third reason is that most scientists operate exclusively on a subjective basis—as "pure" scientists. They also operate non-conceptually. Most of the objective technologists—or "applied" scientists—are specialists and are unaware of the comprehensively integrated significance, to society, of the tasks they perform.

A fourth reason is that world society is frustrated by the communication barriers between the many languages of mankind.

For the foregoing reasons, there are only a very few humans whose experience and operative faculties permit and inspire them to inform society regarding the significance of the evolutionary trending and of mankind's now potential physical and economic success.

What could be done and up to now has been done in a big way—as a consequence of man's access to the vast energy wealth of universe, discovered by "purely" operating scientists—has not been determined by the technologists, but by their economic masters who see only the immediate profits—in, for instance, the exploitability of the fossil fuels—or "savings accounts" energy wealth—which can bring the highest profits in the most wholesale manner through national governments' commitments, most swiftly realizable in anticipation of the emergencies of total war. Science and technology operate economically and socially only as slaves of the most powerfully short-sighted cashiers of humanity's needs and weaknesses. The latter see less profit in organizing the business of humanity to survive on the energy income of the environment.

Realization of mutual success by all mankind is frustrated also by the now entirely irrelevant

and invalid "inferiority" or "failure" complex of world around behaviors of humans, conditioned exclusively by two millions of years of experience with major failures of mankind, as well as with vital inadequacies of vital necessities; plus the ages long, seemingly obvious and seemingly inevitable fact that the vast majority must die at a relatively early age—either through starvation, disease, superstitiously governed human sacrifice, capital punishment, war or duelling—as physical evolution whittled down the numbers surviving—to match the numbers supportable by the ignorantly and only opportunistically exploited—ergo, only short-sightedly and meagerly organized world resources.

The analogy to the wasp's dilemma occurs in humanity's long conditioned, reflexively superstitious assumption that man is (with only "divine" exceptions) designed to be a failure. The "normal" human has always been a potential and probable failure. At an early age, the average human acquires a powerful inferiority complex from his exposure to his parents and his childhood community's deeply inhibited culture of misinformation and misfortune. The deep-seated proclivity of humans to gamble their monies is founded on the working assumption of human consciousness that individuals are inherently programmed for failure and that only cultivated luck can divert the individual from his negative plight.

One reason why humanity in general loves, admires and worships human babies is that all physically normal babies are both unblemished and are designed to be physically successful. They are swiftly blemished by man's ignorantly served love. If, despite his millenniums-conditioned, failure prone complex, man is to survive on the planet Earth he must be educated to assume a new "norm" for humanity. Because of the facts world society must now assume that: normal man is designed to be a success and the universe designed to support that success—for as we shall presently see, man is essential to the success of universe itself. If humanity on Earth "flunks out" humanity on other planets will probably "carry-on" to perform the uniquely human, antientropic functions essential to the total regenerative evolution of universe.

To effect the successful transition of world society to the new "norm" of man as a physical and intellectual success can, and we hope will, be realized on space ship Earth through the idealism of youth, as implemented by the educational process revolution which is beginning to take place around the planet. If so, the reality of the new norm of success will be progressively fortified by the incorruptibility of the cybernated participation of man in evolutionary transformations of human ecology and on a continuous, instead of a short term, expediency basis.

And it is not a matter of being a little more far-sighted and looking out for one or two more generations of man on Earth. It is a matter of making man on Earth a continuing success—forever.

It may be assumed that scientific and humanistic literacy must and will be popularly developed at the earliest moment in order to spontaneously obtain scientifically generalized comprehension and systematically and conceptually formulated socio-technological answers to any and all moral economic, aesthetic and ethic questions, as well as objective answers regarding the relative harmonic desirability, feasibility and economic practicality of any and all human preoccupations and capability commitments.

We must now ask, "What will emancipate science from her century of unnecessary 'Blind Flying' exclusively on instruments—as a slave profession—with lethal consequences—and without any sense of long distance economic success objectives for all of posterity?"

We must also ask, "From whence will come the tools of conceptuality which will emancipate science and permit its assumption of the prime, social, direct, conscious, sensorial responsibility?"

What can and will bring world society's leaders and world society itself to comprehend its economic potential and its essential function in universe and to its successful performance of that function—in time to permit the continuance in universe of the Earthian team of human's?

It seems to me that our commitment to mutual examination of our respective functioning leads abruptly to these fundamental questions. I assume this to be so. I also assume that neither of us has innate characteristics making us uniquely fitter than others to address these questions. I

assume, however, that both of us have come independently to the realization of the tasks to be done by world society and by individual men operating with integrity on their own initiative on behalf of their fellow humans. I assume that both of us has now unique experiences and organized information and accredited effort which provide us with some measurable degree of intellectual, technical, and economic advantage in addressing these prime questions. On my part, I would like to contribute the following thoughts.

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First, it seems to me that unless we have experimentally demonstrable and scientifically definable meaning in our words, we cannot communicate effectively with words. Communication is with self, as well as with others. Ergo: we may say—the degree of effectiveness of communication is proportional to the degree of exactness of commonly accepted definition of meanings of the words used. This statement is a corollary of my long held working assumption that:-a problem adequately stated is a problem fundamentally ripe and potential of solution.

In seeking definitive meanings I recognize, of course, that Heisenberg's principle of indeterminism, forestalls absolute exactness. However, the tolerance of error is reducible. Ergo: we may approach exactitude in progressive degree. Ergo: what I mean by mutual comprehension of meanings is stateable only in terms of approximately exact meanings.

It is also my working assumption that lacking the approximately exact meaning of the most profound generalized concepts there is little meaning and approximately no direct teleologic effectiveness, in any and all special case, local experience communications. For instance, it is impossible to understand the previous sentence without a fundamental comprehension of the concept teleology. It is also fundamentally impossible for us to make conscious solution of the greatest and prime problems and their secondary technical challenges without use of the phenomenon teleology.

It is my working assumption that the following 40 questions must be definitively answered before we may realistically discuss our respective philosophies and grand strategies.

STRATEGIC QUESTIONS

1. What do we mean by universe?
2. Has man a function in universe?
3. What is thinking?
4. What are experiences?
5. What are experiments?
6. What is subjective?
7. What is objective?
8. What is apprehension?
9. What is comprehension?
10. What is positive? Why?
11. What is negative? Why?
12. What is physical?
13. What is metaphysical?
14. What is synergy?
15. What is energy?
16. What is brain?
17. What is intellect?
18. What is science?
19. What is a system?
20. What is consciousness?
21. What is subconsciousness?
22. What is teleology?
23. What is automation?
24. What is a tool?
25. What is industry?
26. What is animate?
27. What is inanimate?
28. What are metabolics?
29. What is wealth?
30. What is intuition?
31. What are aesthetics?
32. What is harmonic?
33. What is prosaic?
34. What are the senses?
35. What are mathematics?
36. What is structure?
37. What is differentiation?
38. What is integration?
39. What is integrity?
40. What is truth?

If we first accept mutually agreed upon, experimentally based definitions and answers to these questions as a priori to our dialogue, we may then also observe the following to be pertinent and useful to the initiation of our mutual search for the definitive answers to the immediately foregoing set of prime questions.

First, I refer you to my own attempts to make experience founded—ergo scientifically definitive—answers to all 40 of the questions. (see appendix "B") Most of my attempts have been published in books, essay and lectures. I do not assume that I have found the answers. I do assume that I have addressed the problems on a scientific basis for I have as Eddington put it, "made a sincere attempt to set in order the facts of experience". I have progressively included and refined the experience basis of those meanings and have progressively refined their verbalization. I have thus discovered—for instance—that there are no nouns for physics has found no things (static, solid phenomena)—Ergo there are only verbs.

Though there are many special concepts which constantly reoccur in my day to day deliberations, I find that there are fourteen which dominate. All of them overlap integratingly. Part of the content of one will of necessity often reappear under other concepts due to the synergetic interactions. I will group and discuss all the secondary concepts, unique to my philosophy, under the following main concepts in 14 concept chapters thumb-indexed below.

DOMINANT CONCEPTS

1. UNIVERSE
2. HUMANITY
3. CHILDREN
4. TELEOLOGY
5. REFORM THE ENVIRONMENT
6. GENERAL SYSTEMS THEORY
7. INDUSTRIALIZATION
8. DESIGN SCIENCE
9. WORLD SERVICE INDUSTRIES
10. EPHERMERALIZATION AND INVISIBLE COMMONWEALTH
11. PRIME DESIGN INITIATIVE
12. SELF DISCIPLINES
13. COMPREHENSIVE COORDINATION
14. WORLD COMMUNITY AND SUB COMMUNITIES OF WORLD MAN

Concept One — UNIVERSE

non-instantaneity
non-simultaneity
physical and metaphysical regeneration
irreversibility of evolution
irreversibility of metaphysical comprehension of physical

I start with my own definition. Universe is the aggregate of all humanity's all time, consciously apprehended and communicated experiences. (The communication may be to self or others—it is the apprehending formulation of the information regarding the experiences that constitutes original consciousness).

The physicists' Law of Conservation of Energy which states that energy may be neither created nor destroyed—ergo is finite- embraces only the physical aspects of experience. It excludes all metaphysical aspects of experience.

I have defined Universe in such a manner that none may present experimental proof of its inadequacy for my definition includes both the objective and subjective: i.e. all voluntary experiences—i.e. experiments—as well as all involuntary experiences—i.e. all happenings.

My definition embraces both the physical and the metaphysical, the latter being all the weightless experiences of thought which includes all the mathematics and the organization of the data regarding all physical experiments; science, both first and last, being metaphysical.

The metaphysical includes the mind extracted, refiningly concentrated and consciously formulated anti-entropic generalizations, in a hierarchy of progressively contracting degree, which most economically describe the workings of the metaphysical subdivision of universe (See Vision '65 summary address, pages 79-86).

My definition of universe inherently includes all the ponderable—i.e. weighable, instrumentally detectable, associative and disassociative, material and radiational, energy behaviors of the physical subdivision of universe.

Concept Two—HUMANITY
human function in universe.
entropy and anti-entropy

Is the human an accidental "theater goer" who happened in on the "Play of Life"—to like it or not:—or does humanity perform an essential function in universe? We find that latter to be true. The discovery develops as follows.

By entropy, I refer to the experimentally demonstrated physical behaviors covered by the Second Law of Thermodynamics and the latter's disclosure of the omni-accelerating-acceleration of the diffusion of physical energy patternings of universe—spoken of by the mathematical physicist as the "Law of Increase of the Random Element", which may also be called the "Law of the Expanding Universe". As the stars are all in complex motions, the radiations given off by them are ever more diffusely dispatched.

By entropy, I refer to the experimentally demonstrated physical behaviors covered by the Second Law of Thermodynamics and the latter's disclosure that every local system is always releasing or giving off energy and every local system being in complex interior and exterior transformative motions the energies given off are given off diffusedly and confusedly ergo there results an omni-accelerating-acceleration of the diffusion of physical energy patternings of universe—spoken of by the mathematical physicist as the "Law of Increase of the Random Element", which may also be called the "Law of the Expanding Universe". As the stars are all in complex motions, the radiations given off by them are ever more diffusely dispatched.

By anti-entropy, I refer to the omni-accelerating-acceleration of the clarifyingly differentiated and inter-communicated, experience derived, pattern cognitions of the human mind which progressively disclose the orderly complex of omni-interactive, pure, weightless and apparently eternal principles governing the intellectual design and operation of the—seemingly and "suggestively" only—infinitely self-regenerative universe.

We may call this metaphysical phenomenon—which continually simplifies and contracts the generalized description of principles apparently operative in all special case experiences—"The Law of Decreasing Confusion"; or the "Law of Intellectual Conservation"; or the "Law of the Contracting Universe"; or the "Law of Diminishing Chaos"; or the "Law of Progressive Order"; or the "Law of Contractively Orderly Generalizations".

Radiation is physical, entropic, incoherent, propelling, disassociative, pushing. The logical questions arise: —Is gravity metaphysical, anti-entropic coherent and tensive? Are gravity and order wrested and collected intellectually from chaos? Is intellect a priori to both physical and metaphysical universe? Is the tensional integrity of universe exclusively an intellectual integrity phenomenon and a consequence only of intellectual exploration and measurements?

While gravity's effects are physically measurable, the concept of gravity is in itself unweighable. Likewise the effects of electromagnetism are physically weighable. The physicists have ruled intellectually that all that is imponderable is metaphysical. Clearly it is seen that the metaphysical is to the physical as anti-matter is to matter, i.e. as the electron is to the positron.

Metaphysics and physics are thus seen to co-function, to progressively conserve the self-regeneration of non-simultaneously and overlappingly evolving universe. Man's function in universe is that of the metaphysical, anti-entropic function. He is essential to the conservation of universe which is in itself an intellectual conception. In 1951 I published my conclusion that man is the anti-entropy of universe. Norbert Weiner published the same statement at the same time. Both of us

arrived at our conclusions by different routes and without knowledge of the other's discovery. I will now expand on the human's anti-entropic functioning.

In the above statements I am giving precise meaning to the word "metaphysics". By metaphysical I mean no more nor less than is implicit in my definition of universe. Since magic has never been experimentally demonstrated, my use of the word "metaphysics" does not contain overtones of magic or mysticism.

"Why Universe?"—is at present an unanswerable inquiry into the mystical. Though mystical sounds like a contraction of metaphysical, they are not the same. For this reason, I consider all time spent in speculation regarding the inherently unanswerable to be inherently profitless and a squandering of the opportunity to answer those questions which are answerable by man. It is, however, experienced by us that the unanswerables provoke a sensation in us to which we allude—only intuitively—as "Mysterious".

By the same reasoning, I discredit all the speculations which suggest or persuade the concept of a "beginning or ending" of universe. The most recent statements of the leading scientists hold that the concept of original chaos is untenable because the physical composition of universe may not be reduced to less than the orderly intertransformability of the neutron and the proton and their respective weak effect leftness and rightness adjuncts the electron, positron; neutrino, anti-neutrino—the positive and negative counterparts including both their negatives as well as positive weights, ergo: —the average of all weight of all physical phenomena is zero.

This is to say that the universe, both physical and metaphysical, is resolvable into a set of principles which are ever more accurately (but never exactly) described by the scientists' weightless intellectual generalizations. And generalized principles which are weightless cognitions of intellect have no inherent beginning or ending (nothing in human experience has ever suggested the beginning or ending of a generalized principle)—ergo the 'beginning' of universe concepts together with all axioms are experimentally unproven and only illusionarily obvious, ergo: fictions. Before the measurements of the speed of radiations, all phenomena seemed (erroneously) to be visually "INSTANT". This gave rise to the superstitiously invented legend of a genie or god creating an instant universe. A physicist said to me a few days ago: "I have become bored with the nonsense concept of infinity—with one end closed by a 'beginning' and the other end open to infinity".

Universe and its derivative concepts are by definition synergetic. Synergy as you know, means: Unique behaviors of whole systems unpredicted by any behaviors of their component functions taken separately.

Some of ancient Greece's natural philosophers and geometers took effective advantage of Synergy when they recognized that the sum of the angles of a plane triangle is always 180 degrees, or exactly one-half of cyclic unity—with unity taken as 360 degrees—ergo unity equals two triangles. I assumed in 1917 that "unity is plural and at minimum two".

The stable structural behavior of a whole triangle, which consists of three edges and three individually and independently unstable angles or a total of six components is not predicted by any one or two of its angles or edges taken by themselves. The six edges of the two triangles can and frequently do associate with one another, one as a left helix and the other as a right helix, to form the six-edged tetrahedron which having four triangular faces gives synergetic demonstration of four triangles occurring as the result of associating only two triangles. Incidentally, the right and left helixes formed of the two triangles' respective sets of three edges constitute the vectorial modeling in conceptual array of the positive and negative "half spins" or "half quanta" corresponding respectively with the proton set and the neutron set consisting of neutron and neutrino on the left hand and the proton, electron and antineutrino on the right hand. Together these six make one quantum unit—which is identified as the tetrahedron.

Triangles as conceived by the Greeks are synergetic. The Greeks went on to demonstrate the corollary of Synergy, to wit: that the known behavior of the whole and the known behavior of some of the components makes possible predictions of the behavior of each and all of the other, previously, unknown components.

The Arabs' algebraic formulations and all their modern derivatives, including the calculus, are synergetic strategies.

This synergetic strategy of proceeding from the whole to discover discrete local particulars within the whole was demonstrated powerfully once again a century ago in Euler's Topology which reduced all patterning of universe to LINES, intersections of lines—called "VERTEXES"—and the AREAS bound by three or more intersecting lines. Euler found a constant mathematical relationship of all these three fundamental aspects of pattern i.e. V + A = L + 2.

The power of synergy was demonstrated once again by physicists in the modern quantum mechanics—in which latter the assumption of a finite physical energy universe always requires a 100% accountability of all energy transactions. Synergetic accounting of the finite system plays a major part in the success of modern nuclear physics.

Kepler's Third Law and Newton's theory of gravity provided synergetic advantage for astronomy.

Willard Gibb's Phase Rule- akin to Euler's topological equation of the relative abundance of basic mathematical pattern aspects—provided synergetic advantage in chemistry.

Synergetic behavior is omni-manifest in bio-chemistry and metallurgy. Synergy alone explains, for instance, why the tensile strength of chrome nickel steel is 50% stronger than the sum of all its constituent alloys' respective tensile strengths. Synergy is the "back bone" of general systems theory.

Despite the powerful capabilities demonstrated historically by Synergetic Strategy today's primary educational systems, all around the world, start the children's would-be education only with elementary parts of subdivisions which never explain the wholistic behaviors and thus imply that science and technology may only be successful as a myriad of separate intricate specializations which may never be subject to unified comprehension by one mind.

Specialization and therefrom today's chain reaction of the self-accelerating fractionation of all thinking into exploding categoritis followed by today's increasing social incoherence—resulted from the old master pirates', pre-World War One's synergetic strategy by which they required that all the bright lieutenants and experts must confine their labor and inquiry to differentiation, and that each must mind his own business and must eschew all integration which they must concede to be the old "master pirates" exclusive prerogative.

Thus, the elementary educational system which in contrast to synergy starts exclusively with a few parts or elements, leads at best only to differentiated statistical probability based entirely on the separate behaviors of those elementary parts. Probability, the strongest tool of statistics which deal only with parts, at its best is a weak tool. Were probability strong it would predict the stock market behavior with precision and would foretell horse race results with reliability. Contrariwise, Synergy and General Systems Theory are powerful forecasting tools and have been the back bone of modern physics, astronomy and chemistry.

My Fourteen Concepts—taken one by one and considered only in the "separate", elementary educational, manner might seem too special and too diffuse to be effective. Taken altogether, synergetically, I hope you will find them as promising as I have already found them to be.

If I had not been consciously and deliberately pursuing all fourteen concepts synergetically and teleologically for the last 38 years and if I had not obtained innumerable practical results, I would not be in a position now to know you and to be asked to exchange grand strategy information with you.

Within the last 14 years, thousands of my structures have gone to 50 countries around S.S. (space ship) Earth. They were most frequently transported to their sites by air, fully assembled or in systematically coded and tightly packaged parts. I have succeeded therefore within only thirty-eight years in demonstrating the validity of my proposal—published in 1927—to commence in twenty-five years—1952--the air delivery of high performance environment controls for those of mankind's activities most advantageously performed under scientifically protected and valved conditions. In 1953 the U.S. Marine Corps made the first air delivery of my geodesic dome, fully assembled and skinned, flying it to its site by helicopter at 60 nautical miles per hour. I prophesied this in 25 years. It took 26.

The year in which I first made this proposal—1927—was that in which Lindberg made his epochal non-stop New York City to Paris flight in an airplane with cloth-covered wingfoils. International airplane passenger service was not as yet even seriously discussed. Jet propulsion, rocketry, television, fission, transistors, cellophane tape, computers, highway cloverleafs, staplers, stainless steel, high strength aluminum, uranium, the Great Crash, The Depression, Hitler, World War Two, juvenile delinquency and atomic bombs were unanticipated, unthought of or held to be only fantastic possibilities realizable, if at all, one thousand years hence. Discussions of rocket trips to the moon were engaged in only by lunatics in mental institutions. Only twenty-three years ago when I attended World War Two meetings in Washington, D.C., I was often greeted by someone saying, "Please don't ruin this meeting by once again introducing your preposterous, mass--produced, scientifically designed air-deliverable houses."

As a consequence of my finding both the metaphysical and physical subdivisions of Universe to be finite I have also discovered the finite, arithmetical, geometrical, energetical, rationally coordinate comprehensive mensuration system employed by nature to rationally integrate the physical and metaphysical and have thereby also provided a conceptual and definitive bridge of understanding between the humanities and the sciences. I am confident that the comprehensiveness of my fourteen concepts rather than being over-ambitious, represent the "minmaxfamfax" (minimum and maximum family of prime variable factors) uniquely governing general system theory.

Such (only intellectually discovered and only intellectually employable) principles are apparently amongst the most powerful thus far to have become available to man. The a priori (and only intellectually conceivable) complex of self-regenerative, intertransformative (macro-micro), cosmic ranging scale of generalized principles governing non-simultaneous universe—thus far discovered by man only in "piecemeal" isolations—is now disclosing a comprehensive inter-relatedness unanticipated by man at the time of the individual explorations. This total inter-relatedness and its orderliness and mathematical elegance are obviously transcendental to the inventive capabilities of individual man. For these reasons, taken synergetically, there is evidenced to science an a priori, omni-functioning intellection greater than that demonstrated or demonstrable by humans.

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Are we not most intimate, i.e. closest with those furthest away from us physically, ergo closest metaphysically. No rapport between individuals "sardine packed" in subways and buses. Intimacy of those writing to one another halfway around the world. This relative intimacy may be plotted in terms of time, history and geography. All those who influence us daily by love, wisdom, conceptual stimulation and understanding are most often relatively remote both in time and space. Most of the time the powerful influences are the immortal influences, i.e. "most remote".

The Human Function in Universe and its individually, fleetingly, sensed responsibilities—heeded or unheeded by the individual- occur as the consequence of "built-in" driving forces, the metabolic, physical regeneration drives of hunger and procreation. The most prominent of the metaphysical regeneration drives are human curiosity and the drive to demonstrate competence, i.e.—to employ the abilities to subjectively differentiate and thereafter to objectively integrate in preferred patterns or to organize events in such a manner as to obtain answers to the questions which curiosity asks—metaphysical drives—to understand and be understood.

The dual and regenerative human functioning as successive, high frequency, subjective and objective, (subconscious and conscious) which altogether provide angular range finding and the teleologic irreversibility of human articulations are implemented exclusively by two principles with which humanity modifies his forward experiences in Universe in preferred ways. The two physical principles by which alone man may alter his ever evolving environment are those of angular and

frequency modulations. Angular modulation (c.f. ruddering) is erroneously spoken of by man as Spatial modification. Frequency of event modulation is erroneously spoken of by humanity as Time modification. These capabilities of man's senses, brain and mind, provide the basis for his strategically selective differentiations of experience. The humans' subjective experiences are teleologically and spontaneously transformed into objective alterations of the evolutionary environment—to most effectively support man's unique brain and mind functioning in Universe in the anti-entropic role.

It is the intent of my concept No. 2 to bring about most effective employment of those built-in drives of individuals in such a manner as to bring about the physical success and happiness of all humanity in the shortest time with the least effort.

It is my intent to employ the built-in capabilities to accomplish all the foregoing without ever advantaging one by deprivation of another.

It is the purpose of my Concept No. 2 to so design or control the angles and frequencies of the evolving environment events that the spontaneous reflexing of society will result in all men enjoying all of Earth—and the progressive reaches of the universe about it—without mutual interference with one another's degrees of subjective and objective freedoms.

Concept Three – CHILDREN

Focus of human effort on the critical, first 13 years of life—wherein 98% of brain function is progressively and automatically "tuned-on", "tuned-in", "tuned-out" or shut-off in direct response to the positives or negatives of the individuals' environmental experiences and potentials.

Focus on new life. Recognizing that humanity consists of all ages, it is obvious that before any of the objectives of one have become fulfilled many human individuals and particularly the aged will have died. As a consequence, it becomes necessary to set up time and beneficiary priorities within the total scheme.

The behavioral sciences have disclosed the direct effects of the environment on new life. These are so great as to make it clear that the environment (including all the dynamic events and humsn operative within the "scenery") is more than 99% responsible for the lives becoming capable and happy or frustrated and confounded. And the most profound effects on human life have been completed within the first 17 years. Ninety-eight percent of the environment's positive or negative effects have been wrought upon the new life by age 13. Eighty percent have been wrought by age of 8, and fifty percent by age of 4. It is obvious that effective work that can be done in advantaging life through favorable environment transformation can be realized within the first 13 years of human life and particularly in the first 4 years of life.

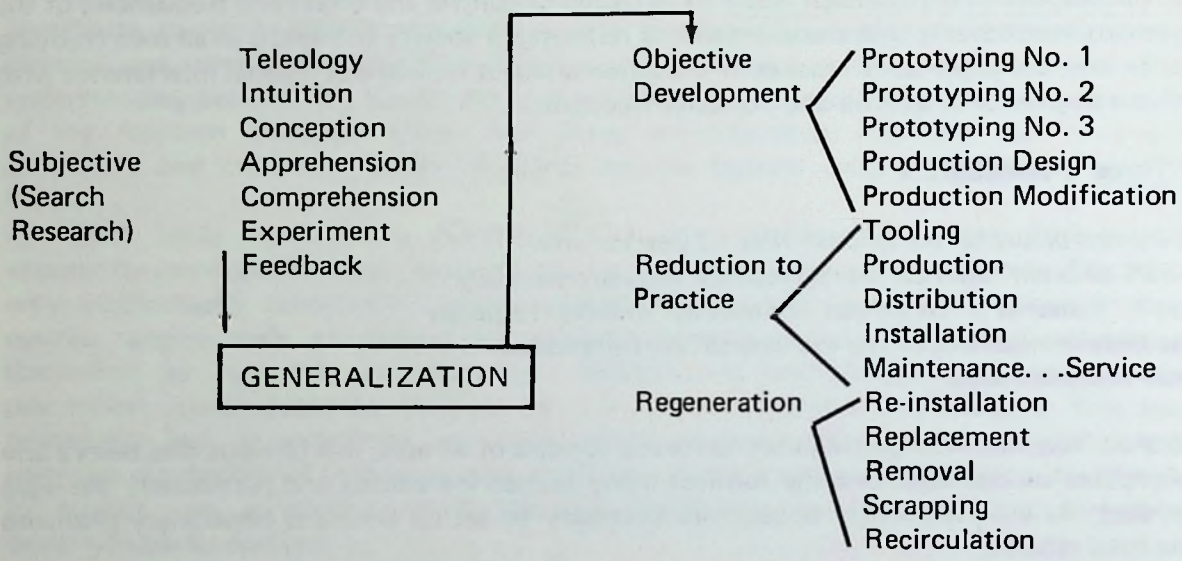
In order for the individual to be objectively effective as a design scientist in altering the environment on behalf of his fellow man, it is necessary for him to organize his efforts so that they may become operative a sufficient number of years ahead of his original initiating to be able to transcend any frustration of his efforts by the momentum of already invested interests. This period has been discovered to be one generation, or 25 years. My work was initiated in 1927 and was designed to become effective in 1952. This proved to be a realistic forecast. In 1952, Ford Motors bought a large geodesic dome.

Combining the concept of the time lags and most effective period for advantaging life, my concept number three came to focus on advantaging the new life—to protect the new life prominently from 1 to 40; secondarily on 4 to 7; thirdly on 7 to 13; and lives of the parents to be advantaged. See Dr. Benjamin Bloom's book "Stability and Change in Human Characteristics" published by John Wiley and Son.

Concept Four – TELEOLOGY

The conscious deliberations and decisions of the human mind which reorganize the subconsciously fed-back informations. The philosophic reduction of a plurality of subjectively experienced pattern cognitions into conceptually recognized (imagined) patterns of generalized principles to forwardly control specifically anticipated events by designed modifications of environment patterns.
Generalized, comprehensive and anticipatory, design science.

Design Science Event Flow



The philosophy of my fourteen point strategy derives from my intuition that all experiences may be progressively generalized and that man thus discovers that only a few principles govern all the multirate, non-simultaneous, transformative interstructuring transformations of non-simultaneous universe. It becomes obvious that the subjectively apprehended data and the intellectually recognized data inter-relationships concerning the abstracted principles—governing evoluting universe—provides the individual with high potential for the objective realization of advantages for humanity. Teleology means: –"the intuitive conversion by brain and mind of special case, subjective experiences into generalized principles and their subsequent objective employment in special case undertakings."

The discovered principles governing the inter-transformative structuring of universe permit the subconsciously teleological and conscious design initiating individual to reform the environment in such a manner as to provide ultimately higher advantage for men in such a manner as to regenerate in other individuals the drive to further transform the environment to even higher advantage for all. The design may increase the degrees of freedom of individuals by reducing environmental interferences or it may decrease freedoms as with traps and prisons.

C.H. Waddington, University of Edinburgh Geneticist, speaks of the Epi-genetic landscape in identifying the powerful effects on human behavior played by environmental factors. Waddington shows how man and other factors alter the environment and how the altered environment alters the human and other biological behaviors and how the whole process becomes regenerative and continually inter-accelerates. He does not show or suggest that the environment alters man's

physical organism nor that the environment adds capabilities to the human's innate capabilities, but does indicate the way in which arbitrarily favorable changes in the environment may permit a higher percentum of realizations and development of the innate human brain, body and mind capabilities, theretofore inactive—only because frustrated by unfavorable regenerative alterations of the environment. Thus we see that human evolution is not confined to organic life alone, but also consists of reciprocal interactions of all the combined transformations of the environment and all it contains. This combined regenerative evolution has now attained a 'chain reaction rate' around the surface of the spherical space ship Earth.

Concept Five – REFORM THE ENVIRONMENT

Don't attempt to reform man. An adequately organized environment will permit humanity's original, innate capabilities to become successful. Politics and conventionalized education have sought erroneously to mold or reform humanity, i.e. the collective individual. See Universal Requirements Checklist – Volume 3 Design Decade.

Reform the Environment—Not man. Each of my fourteen concepts and their teleologically engendered strategies tend to illumine the interdependence of all the items; for instance, my item number five is taken in consideration of all the first four but goes on to make the distinct point that my philosophy and strategy confine the design initiative to reforming only the environment in contradistinction to the almost universal attempts of humans to reform and restrain other humans by political actions, laws and codes. This restraining begins with the earliest parental attempts to reform their childrens' spontaneous behaviors in order to conform them to "accepted" standards and codes. The reforming of others is subsequently manifest in attempts of grown ups to reform other grown ups' patterns through politically enacted law.

My experience teaches me that all philosophic concepts which are translated only into "bright ideas" as voiced or written suggestions or criticisms are abortions of intellects higher potentials. My experience teaches me that philosophic conclusions which are always teleologically derived may always be reduced to design science changes of the environment which can permit other individuals' spontaneous realizations of higher destiny, i.e. to behave unconsciously in more effective manner. For instance, a turn in the highway may be banked angularly so that poor drivers or drunken drivers will negotiate even sharp radius turns subconsciously due to the fact that the banked angles and gravity together effect the motor cars steering wheel linkages in such a manner that the cars steer themselves around the turns. In the same way, highway overpasses allow automobilists to subconsciously avoid crossing collisions.

In speaking of reforming the environment of man, I include a surgeon's operations on the human body for the latter is mobile environment of the brain. I contrast the reform of the integral or deployed physical environment in contradistinction to legal or verbal attempts to reform man's behavior patterns. I find that there are two ways in which the environment may be altered to effect man, one positive and the other negative—i.e. one may decrease the degrees of freedom of humanity, negatively by prisons, traps and straight jackets and positively by inventing better shoes for men's feet. The normal speed of universal formulations and transformative events is seven hundred million miles per hour. Man's thus far attained top speed of physical self transport is fifteen thousand miles per hour. Normal speed is 46,000 times man's rocket speed. Therefore, man is—relatively speaking—almost as immobile as death. On the other hand his environment facilities may be so ordered by design science as to give him some appreciably large percentage communication advantage by radio which operates normally at seven hundred million miles per hour. Summarizing:—Positive design science reformations of the environment must be undertaken

with the intent of permitting man's innate faculties and facilities to be realized with subconscious coordinations of his organic process. Reform of the environment is undertaken with purpose of de-frustrating man's innate capabilities whether the frustration be by the inadequacies of the physical environment or by the coordinated reflexes of other humans induced in those humans by the inadequacies of the environmental advantages as, for instance, mothers' unreasonable punishing of children, not for the children's direct act, but because of the mother's ever subconsciously present fear of the future, or of the all history experienced approximately complete poverty which compounded the parents drudge weariness and failure of the physical environment to provide any hope of the parents opportunity to protect the new life that has inadvertently been placed in their care.

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See "Universal Requirements Check List", Volume 3, Design Science Decade and Design Initiative, Volumes 2 and 3. Design Science Decade for basic environment control seive—See also *Ideas and Integrities,* Prentice Hall Publishing Company.

Concept Six – GENERAL SYSTEMS THEORY

Mind vs. Brain, Generalization as constituting the thinking of mind vs. the information storage and feed-back functioning of the brain. Topology of systems. The topological hierarchy of systems. Triangulated topological—Quantum coordination of generalized systems. Open and closed systems.

Comprehensivity—Theory of General Systems. As with the preceding items, we again find each and all items to induce considerations of their integrated comprehensivity. We find all the non-simultaneous events of universe tending to effect all other events in degrees ranging from powerful to insignificant.

My own generalizations—from the total of my own special case experiences as well as from other scientists and mathematicians—especially my experience on the sea and in the air—brought me to a clear cut discovery of twelve fundamental degrees of freedom governing the external and internal motions and transformations of all independent systems in universe. Six of these freedoms are positive and six are negative; therefore, there are only six sets of fundamental freedoms. These cover all variable inter-relationships of universe. They become the controlling facts governing general systems and thereby such supercomplex systems as the design of a nation's navy. General system's design science includes the navy's progressive fabrication and evolutionary replacement, its manning, its operation, establishment of its naval bases; repair, maintenance, evolutionary modification, support, logistics, ballistics and industrial tools-to-make-tools to make tools. All these functionings are comprehensively and anticipatorily undertaken—under a system of time controls and priorities which in turn are governed by fundamental resource programs and the political mandate for its existence. I have developed a completely workable, generalized systems approach—starting with the differentiation of universe, including both the metaphysical and physical—which has not only held up but permitted progressive subdivisions in cybernetical "bits" to bring any local pattern of any problem into its identification within the total scheme of generalized systems events. This means that I always start all problem solving with universe and thereafter subdivide progressively to identify a special local problem within the total of problems.

Concept Seven – INDUSTRIALIZATION

Definition in terms of tools. Differentiation of the tools of Industrialization in contradistinction to Craft tools. Industrialization only operates as a world around system. Its inherent economic accountability as energy M (matter) x energy R (radiation) x intellect, I x frequency, F of evolutionary design advancements. Industrialization is the externalized complementation of man's interiormetabolic regeneration organism.

I define industrialization as the extra corporeal, organic, metabolic regeneration of humanity. Industrialization consists of tools. All the tools are externalizations of originally integral functions of humans. I divide all tools into two main classes. Craft tools and industrial tools. The craft tools consist of all the tools that can be invented and produced by one man starting and operating alone nakedly in the wilderness. I define the industrial tools as: –all the tools which cannot be produced by one man. The steamship Queen Mary, the giant dynamo, the concrete highway, New York City, or even the lowly but modern forged alloy steel carpenter's hammer, with electro-insulated plastic handles, whose alloy components and manufacturing operations involve thousands of men and the unique resources of several countries of the Earth.

By my definition, the spoken word which can only be invented by two or more men, was the first industrial tool. This is reminiscent of the biblical account "In the beginning was the word." In my experience appraised concepts the scriptural statement needs to be modified to read "In the beginning of Industrialization was the word." Crafts are limited to a single man and involve only very local resources and very limited fragments of Earth and time. Industrialization, through the relayed experience of all men–permitted through the individualization of the spoken and written word–involves all experiences of all men everywhere in history.

The fundamental material resources of industry consist of 92 regenerative chemical elements–91 of which occur randomly around the Earth. They are randomly disposed around the Earth at an average distance of half-way around the Earth from any given resource marshalling point. The processes of industrialization take the resources from where they occur and progressively separate them from their gross ore matrix and forward them half-way around the world for further refinement and distribution. Half-way around the Earth the resources attain maximum separation. Thereafter, they are re-assembled in preferred alloys and in preferred machines and structures. They are also associated and invested in progressively major tool complexes. The vast initial total cost of industrialization has to be amortized by those who need the products. Therefore, the products and services of industrialization must be mass produced and distributed to people all around Earth to widely distribute the capital and overhead costs. The latter thus became almost negligible sums–simply the cost per pound of the product. In order to obtain enough customers to subdivide the cost it is necessary to go all around the Earth which means that the centrally produced machine, mechanics, structures, etc. must now be distributed half-way around the Earth again. The logistics of industrialization therefore involves both inbound and outbound transportation half-way around the world, twice per each unit of industrial accounting. Industrialization is inherently comprehensive and omni-inter-related in respect to all humanity and all of humanity's ecological environment. This includes the sun and moon and all physical phenomena. Industrialization embraces many alternate systems of technical solutions ranging all the way from electrical to mechanical. All of the systems and their operators which range from private businesses to sovereign nations work inadvertently towards ultimately providing all men with higher standards of living. Although total industrialization's, often negatively competitive, sub-systems may be motivated locally by short-sighted monetary or political profits and ambitions the total inadvertently results, in evolutionarily changing the total environment to ever higher advantage of all men and works

toward the ultimate enjoyment of all Earth by all men—all both economically and physically successful, without any mutual self-interferences or deprivations.

Though popularly unrealized—in industry there is a residual, high premium, function of the crafts as basic tool and model makers which permit the original realization of individuals inventive conceptions and their translation into mass advantage gains for society. Crafts are ever less efficiently employed in the production of consumer goods, tools and services.

Having established for our first seven basic concepts it becomes clear that there is a completely separate design science activity which is concerned with the anticipatory scheduling of all the complex interaction of the foregoing general systems events of industrialization. Design science deals in studies of the gestation rates operative in the many different constituent patterns of general world systems. For instance, it has been learned that inventions reach industrial acceptance at very different rates. Inventions in electronics are usually employed industrially within two years after invention. Aeronautical inventions are generally employed (after thorough testing) within five years. There is a lag of 15 years between railroad inventions and general use. There is a forty-two year lag between invention and use in the craft-bogged building arts. There was a fifty year lag between the first blast furnace production of steel for ships and the use of steel in a "sky-scraper". There was a forty-two year lag between the steel companies' byproduction of portland cement in their subsidiary companies and the time when a piece of steel fell into the setting cement to disclose accidentally the principle of steel reinforcing of concrete.

The going economics accredits the merger of a dozen economic "failures" to produce a "success". The American automobile industry was compounded out of many thousands of "failures" whose managements lost their credit authority but whose energy processing real machinery assets had never failed. The accounting and the speculative funding, and promotional shortsightedness and the economic accrediting failed but not the evoluting machinery of industrialization. Industrialization is physical evolution and channeled energy transformations which by the law of energy conservation can never fail. Through traffic in interest paying debt increases, present day economics exploits the failure of debt crops to support the increasing numbers of humanity displaced as automatons by automation. We are in for a world economic accounting revision of first magnitude. We will switch from a negative to a positive world economic accounting.

Because energy is wealth, the integrating world industrial networks mean ultimate access of all humanity everywhere to the total operative commonwealth of Earth.

What do we know about wealth stated rigorously and only in the terms of experimental science?

Wealth cannot alter yesterday. It can only alter today and tomorrow.

Multiplication of craft wealth began, as we have noted earlier, when man stepped on the long end of a log lying across another log with its short end under another big log and saw the big log which was too heavy for him to life with his muscles, lifted easily by gravity pulling his miniscule weight against the high advantage, long arm of the lever. Multiplication of industrial wealth began when man fastened a set of levers radially around the hub of a wheel and put the wheel under a waterfall and connected the wheel with a grinding mill. Thus, he learned to stand aside from the work and, gaining perspective, to use only his brain to rearrange inanimate energy patterns, external to his own integral bodily energies to do more and more fundamental, man advantaging work. He did so by shunting energy patterns to impinge upon his machine levers.

Humans found that the vast associative (gravity, matter) and disassociative (radiation) energy patternings of universe can be harnessed, shunted and valved by them to impinge at preferred time and quality rates upon the long ends of levers to be led through trains of gears and electric generators and conductors and motors to do preferred work for man ad infinitum.

Man is now learning through the repeated lessons of experimental science that wealth is explicitly the organized tool articulated energy capability to sustain his forward hours and days of metabolic regeneration; to physically protect him; to increase his knowledge and degrees of freedom

while decreasing his inter-frustrations. Wealth, he finds, is inherently regenerative, but because of comprehensive synergies the rate of regeneration of man's solo wealth is to his commonwealth regeneration rate only as X is to X^4 . As experimentally demonstrated—wealth is energy compounded with intellect's know-how.

Science's law of conservation of energy states that "energy cannot be created or destroyed." The first constituent of wealth—energy—is therefore irreducible. Science states that the entire physical universe is ENERGY. $E=MC^2$. Some of the energy is operative in associative patterns—as matter. The associative energy as matter is organized in leverage systems to do work. The other energy patterns disassociatively, as radiation which is transformed into free energy to be directed to impinge on the levers.

Every time man uses the second constituent of wealth—his know-how—this intellectual resource automatically increases. He learns more. Learning is only growthful. It is impossible to "learn less".

Energy cannot decrease. Know-how can only increase.

It is therefore scientifically clear that: —wealth which combines energy and intellect can only increase, and that wealth can increase only with use and that wealth increases as fast as it is used. The faster-the-more! Those are the facts of science. Those are the facts of life.

Because we have found: (A) that the metaphysical balances the physical; (B) that the metaphysical universe embraces the physical—both being finite, but the metaphysical being always one tetrahedron greater than the physical; (C) that the metaphysical's generalized "capture" and identification of the physical is an irreversible condition—e.g. Einstein as intellect (metaphysical) writing the identification of the physical universe $E=MC^2$ is irreversible—for the physical which is "disorderly" cannot "think" and make orderly statements. Energy cannot write what Einstein's intellect is. Therefore, we can say that the metaphysical is greater than and re-concentrates and coheres the physical.

Wealth is, therefore inherently irreversible. Wealth can only gain as in our proposition Q.E.D.

Concept Eight — DESIGN SCIENCE

Angle and frequency modulation of directions and sequence rates of least resistant event developments. Selections of progressive, one out of twelve, alternately equal, least resistant directions. i.e. the twelve fundamental degrees of freedom of inter-transformative transactions in physical universe. See Volumes 2 and 3, Design Science Decade.

My topic eight then isolates the objective and subjective design science activities relating to the total evolutionary events of man in universe, as for instance, when in 1969 the new generation of 700 passenger (or 125 ton cargo) airplanes will be able to fly nonstop across the Pacific Ocean to establish approximate ten-fold the present aeronautical transport capability within two years after their regular operations begin. Such events must be comprehensively integrated with all the other vastly accelerating environment relationships transformations. Mining on the moon will by this time become of challenging consideration.

The rental service industry—to be discussed in item 9—must be compounded with time designing doubling and possibly tripling the environmental control capabilities. World-around traveling man greatly accelerates the experience of seasonal changing between winter and summer. The regularity of days and nights will be almost obliterated by the ability to fly around the Earth at the rate of its turning. He will want, however, to sleep for 8 hours every 24 hours, independent of sunlight or shadow. This may often force him to the use of a hotel bedroom one hour after it has been vacated by others. A good standard hotel bedroom and all its equipment should be

indistinguishable from "brand new". Hotel rooms may be occupied successively by two or three different humans each 24 hours, just as the airport gates are progressively occupied by airplanes which receive their rehabilitating services and move on to be immediately replaced by another plane. This concept introduces a new concept to man on Earth which is to be spoken about as frequency modulated environment occupancies.

While this frequency modulated use of service industry products by humanity may seem extreme in terms of yesterday's experiences, the trends clearly indicate this mode of life will soon dominate world-around living pattern and will become the major mode of life within the next 25 years.

Lockheed Aircraft Company has a 10,000 (ten thousand) passenger airplane on the drawing boards. These new large ships, starting with the 700 passenger, can land in unprepared fields. Length of the 10,000 passenger ships' fuselage is in the magnitude of the Empire State Building's height or the Queen Mary's length. This means that within the next decade, or fifteen years, if man maintains evolutionary schedule, he will be able to fly a whole fleet of—automated-factory produced—skyscrapers into place and up-ended for immediate occupancy. This is analagous to a fleet of ocean liners coming into port and taking on a city-sized passenger population on the same day. Instant city! Static urban planning will be as obsolete and inappropriate in fifteen years as the attempt to build brick ships upon a stormy sea. With the computer storing and retrieving all the latest data on elevator shafting, electrical harnesses, plumbing, manifolds and doing the drawings—architecture and planning as now taught will be obsolete.

Concept Nine — WORLD SERVICE INDUSTRIES

To swiftly replace "ownership" with rentals of "new" equipment
maintained at constantly renewed higher standard of performance,
because more profitable and more satisfying to humanity.
Service industries on world-around and year-around,
automatedly accountable credit card basis.

The Service Industry. As world industrialization and transportation step-up increases, all humanity is gradually trending twoard being Worldians— all to enjoy total Earth—the static environment appurtenances of their earlier life will become progressively disused and cumbersome. Therefore, the trend to development of rental services industries will be vastly accelerated. After a half century of owning and operating 55 successive automobiles, I am now switching to rental cars. The general concept was pioneered by the telephone companies service-maintained contact instruments which are only incidental to the service. Service industries have now grown to include automobiles, typewriters, calculating machines and many other tools. There are a myriad of other industrial rental services. Despite the uses of the term "ownership'., only a minor fraction of home and car "owners" actually own these items free of encumbrances. The quasi-owners of yesterday and today make payments on mortgages of great length in which the underwriting funds are provided by banks, labor funds, insurance companies. All are underwritten in one way or another by federal governments. The fact is the telephone in the home, though clearly rented, is as clean and new as if purchased and "owned". It is swiftly replaced by superior sets because it is owned by the telephone company whose use-frequency pays dividends and use-frequency is predicated on the relative efficiency and its induced desirability of the constant improvement of the machines.

I assume that within another two decades, the exclusively geographic identity of humanity will have given way to a general world citizenship in which it will be practical only to operate on a rental service industry basis.

Concept Ten -- EPHEMERALIZATION AND INVISIBLE COMMONWEALTH

The progressive doing of more with less per each and every reinvested resource unit of energy M (matter), energy R (radiation) and I (Intellect). Wealth is intellect harnessed in animate energy, tooled anticipatorily to automatically produce the forward metabolic regneration of humanity.

Ephemeralization. A ship of the sea had first of all to float and stay on top of the water. A floating ship could and still can carry vastly larger and heavier cargoes than can be carried by men on their backs or on the backs of animals. Through shipping competition there developed swift evolution in ways of doing ever more important tasks with ever less material effort and time. This doing-more-with-less came into high magnitude of effectiveness in the development of steel steamships. Doing of ever more with ever less I identified in 1927 as "ephemeralization". It is the major control objective of design science in respect to development of airplane evolution.

As a total consequence of ephemeralization's paramount importance to the world's military efforts on the sea, in the air and in space, men are constantly doing so much more with so much less that within the last century we have witnessed the growth from less than 1% to a benefaction of 40% of humanity with a higher standard of living than had been realized in any previous century by any monarch.

The accelerating-acceleration of doing-more-with-less will, within the next 24 years, bring an even higher standard of living to the remaining 60% of humanity, while gaining the same higher standard for the already advantaged 40%—all to be realized out of the Earth's physical resources which are continually decreasing per each world man.

Ephemeralization, the comprehensive effect of more with lessing, is scientifically identifiable with anti-entropy. Ephemeralization, a product of the metaphysical conservation being more effective and coherent than physical entropy is the number one economic surprise of world man. Up to ten years ago, all world economists counselled the world political leaders that there never had been and never would be enough vital sustenance to support more than a very few.

The development of ephemeralization has been conducted by design scientists and technologists whose numbers have amounted to a small fraction of 1% of all humanity. And their work has been focused almost exlusively upon the weaponry or defense systems. Political men dealing with the great majority of humanity were utterly surprised ten years ago to discover that their destructive weapons system had inadvertently developed a constructive by-product. This occurred when the prime and secondary weaponry contractors were displaced by other contractors with superior devices. The socially constructive inadvertancies occurred when the displaced weapons contractors turned to the domestic market for outlets for their high performances per pound and per unit of time capabilities. So much ephemeralization drifted into the domestic economy between 1900-1966 as to have converted 40% of humanity from "have-nots" to "haves".

This ephemeralization developed by the technology which preoccupied less than 1% of humanity in weapons development had never been thought of as benefiting society. That is why its conversion of 40% of humanity from "have-nots" to "haves" in two-thirds of a century has come as an utter surprise to humanity. 99.99% of humanity don't know that this is why automobiles pack every highway and mechanical drudge-savers, iceboxes and a higher standard of living are appearing as a flood all around the Earth.

Because ephemeralization is accelerating it will complete the task of providing enough for all of humanity within another 34 years. This will occur despite the political systems which deliberately divide society and set one group against another. World man dis-embarrassed of political systems could accomplish universal success within twenty years. The fourteen-year difference might readily be the fatal difference within which a disgruntled man might touch off the atomic war head retaliatory systems which would destroy humanity on Earth.

Concept Eleven – PRIME DESIGN INITIATIVE

Strategy for attaining and sustaining the comprehensive design conception and realization initiatives by the individual in the era of the massive world corporations and massive, sovereign, geographical states which only "seemingly" overwhelm the individual with their economic advantages in respect to investment capital, working capital, credit capital and influence.

Economic Strategy of the Individual. Comprehensive ephemeralization involves original thought, invention, scientific calculations, technical drawings, scientific prototyping, testing production engineering. This brings us to the Economic Strategy of the Individual. I have had all manner of experience in initiating the reduction of inventions to industrial use. I have experienced owning, renting of shops, owning and renting tools, hiring of individuals, and dealing in the great complexes of accounting and maintenance of such high priority technology.

I have had all manner of experience in protecting of the individual initiative and I have learned some important lessons, though frequently just short of bankruptcy. I have been able to learn those lessons without going "broke" and have managed eventually to liquidate all indebtedness. I have learned that it is fatal for an invention developing pioneer to own his own shop and tools because it forces him to exploit his non-production tools with "paying" products involving repeat performances bound to vitiate experimental work. It is fatal for an inventor-explorer to build up any large staff dependent on any one economic product or focus.

The unique and superior advantage of the economic explorer maintaining his economic initiative in the face of the massive capital, staff and equipment advantages of the large corporations and great states—who seemingly have top-heavy advantage—is demonstrated by the lone individual's complete freedom of the checks and balances of bureaucracy. Walter Chrysler found that I could produce the full fleged operating prototype of a better, more advanced, automobile than could he and his Chrysler Corporation and that I could do so with 1/3 the time and 1/4 the money. The U.S. Navy wrote a report which showed that I was able, time and again, to produce satisfactorily working structural innovation prototypes in one month with an average of only $5,000 and with the help of 30 university students which were superior in every way to the results obtained by the Navy department when dealing exclusively with their prime industrial contractors which averaged them two years and 1/4 million dollars only to discover that such methods failed to produce any satisfactory results.

Quite clearly the individual initiative is at highest advantage with the least staff and property.

I have found it essential to take patents. This was proven as 50 large corporations applied to me to operate under my patents. On approximately all such occasions the attorney of the large corporation said to my attorney, "Of course, the first thing my client had me do was to try to get around your patents. The only reason we have come to you is because your patents are so well written". This was to say that the industrial corporation would have ridden over me "rough shod" if I had not protected my inventions with patents. I would never have been heard of if I had not taken patents. The monetary earnings from the patents have been negligible in proportion to the accreditation of my abilities and my theoretical activities accruing as a consequence of the economic and physical success of my geodesic domes. My accreditation as a pioneer trend navigator and environment transformer always concentrating on environment transformation was confirmed by the geogesic dome success. I have taken a large number of patents in every country in the world in which I am allowed as an American to apply. I find that the world is so integrated that patenting within only one nation provides inadequate protection.

Concept Twelve – SELF DISCIPLINES

Working assumptions, cautions, encouragements and restraints of intuitive formulations and spontaneous actions. My own rule: "Do not mind if I am not understood as long as I am not misunderstood."

Personal Self Disciplining. In 1927 I gave up forever the general economic dictum of society, i.e. that every individual who wants to survive must earn a living. I substituted, therefore, the finding made in concept one, i.e. the individual's antientropic responsibility in universe. I sought for the tasks that needed to be done that no one else was doing or attempting to do, which if done would physically and economically advantage society and eliminate pain.

As a consequence, it was necessary for me to discipline my faculties to develop technical and scientific capability to invent the physical innovations and their service industry logistics.

My Recommendations for a Curriculum of Design Science:

1. Synergetics
2. General Systems Theory
3. Theory of Games (Von Neumann)
4. Chemisty and Physics
5. Topology, Projective Geometry
6. Cybernetics
7. Communications
8. Meteorology
9. Geology
10. Biology
11. Sciences of Energy
12. Political Geography
13. Ergonomics
14. Production Engineering

Concept Thirteen – COMPREHENSIVE COORDINATION

Effected through discovery of nature's omni-rational vectorial, quantum arithmetical, geometrical, topological, equilibriously and dynamically coordinate intertransformative system. i.e. Synergetics—Energetic, Synergetic, vectorial and topological geometry.

Self development involved my re-establishing the self discipline in comprehensivity which I originally received at the U.S. Naval Academy, which training countered the almost complete trend to specialization in other universities and colleges. At the Naval Academy, the brightest were selected for the most comprehensive training. At the other colleges and universities the brightest were corralled and shunted into sharp specialization. It was evident to me specialization had been developed by the great, master world pirates as a means of dividing up all the bright ones, who might otherwise aspire to displace the great ones, and thus conquering society by keeping all powerful individuals compartmented by their specialization as the great master pirates reserved for themselves all the integrating of the wealth producing potentials accruing to the specialists' multitude of special detail accomplishments. I call them the great pirates, for they were the masters of the world commerce which took place on the oceans covering 3/4 of Earth. Three miles off shore, all man-made laws were nil. Only the laws of the universe were operative. The great masters were, therefore, inherently "Outlaws".

Only the chief naval officers who maintained the seas, high seas, world around fleets needed to have the comprehensive capability to be the pirates right-hand men.

Foremost of my personal disciplines is that: —I must never attempt to sell one of my ideas to others. I must confine myself entirely to the production and testing of the invention. I find that

there are always capable people who learn of my activity and ask, "What is it that you are doing?" When people ask me either for an explanation or my services, I give them the best I have. I, therefore, have no promotion and allow no promotion by any associates. I have learned that when you ask people to listen to you, they become defensive. On the other hand, when they ask you to speak to them and especially when they pay a high fee, they are highly receptive.

I have learned that all consideration of my inventions and developments by others have occurred in emergencies. In effect, my work emerges through emergencies. The U.S. Marine Corp, the U.S. Navy, the Air Force, the Department of State, the Ford Motor Corp. have all come to me in emergencies when everything else they had tried had failed. I represented the last and most remotely possible solution to their problem.

Because I have disciplined myself and have put into operation all the strategies listed under my fourteen topics, I have always had something awaiting their emergencies which I knew by experimental work would solve their problems—and do it under the circumstances which had created the dilemma. I have never had agents seeking to sell my ideas or my products. I have no agent seeking to sell my lecturing capability and have no agents trying to sell my patents.

Because I only go where I am asked to go, I am able to use the geographic and frequency of travels patterning as a trend indicator. I often gain important previews of coming events through study of my own trend patterning. Because I live in the frontiers, what happens to me usually happens to others later on. I have therefore powerful trend prognosticating experiences.

It is part of my personal discipline to continue to try making obsolete all the inventions which I have previously developed by designing ever more effective and efficient devices for solving the complex and comprehensive world problems. I consider my patents of no consequence except for their protection of my initiative.

I do not profess anything. I am not a professional. My own description of my own work with university students is: —the attempt to discipline myself to be an effective explorer in the realm of mastery of principles of comprehensive anticipatory design science.

I assumed in 1917 that nature did not have separate departments for chemistry, mathematics, physics, biology, history, etc. I decided nature had only one department and only one arithmetical, angle and frequency, modulating and coordinating system. I am quite confident that I have discovered an importantly large area of the arithmetical, geometrical, topological, crystalographic and energetically vectorial coordinate system employed by nature itself. It is a triangular and tetrahedronal system. It uses 60 degree coordination instead of 90 degree coordination. It permits kindergarten modeling of the 4th and 5th arithmetical powers, i.e. 4th and 5th dimensional aggregations of points and spheres, etc., in an entirely rational coordinate system. I have explored the fundamental logic of the structural mathematics strategies of nature which always employ the six sets of degrees of freedoms and most economical actions.

I have been able to develop structures which are shown by engineering publications and scientific papers to be able to cover very large clear span spaces more economically than by any known rectilinear or other shaped systems as for instance 1000 fold more economically weight-wise than accomplished in the dome of St. Peter's in Rome and 30 times more efficiently than this is to be accomplished by re-inforced concrete or by its 10 times more complex conventional steel trusses.

Scientists operating in the area of the viruses and many places elsewhere in the area of nature have found nature employing the mathematics and the structural strategems which have come by study from the mathematics which I have discovered most probably to be part of nature's own coordinate system.

I find that there are only two possible co-variables operative in all design in universe. They are modifications of angle and frequency.

Employing the coordinates employed by nature (which as yet are unemployed in any of the educational institutes of the Earth and are as yet unemployed by any professional engineer or architect other than myself) and employing the contents of my fourteen concepts I find I am able

to effect ephemeralization in so important a degree as to make it clear that when and if world society adopts and employs my fourteen strategies, mankind will always have more than adequate of everything with which to effect his physical success and intellectual satisfaction.

Concept Fourteen – WORLD COMMUNITY AND SUB COMMUNITIES OF WORLD MAN

City today must be world serving unit. The real urbanites of 1966 are world people like Constantinos Doxiadis. The whole of humanity is increasing not only its ecological ranging but also is accelerating its pace. The children of the Doxiadis family of Greece and the Gin Su family of Hong Kong all attend colleges and universities in America and all hands circle the world yearly as prototypes of all families of tomorrow. Yesterday only notable humans achieved travel abroad. Today anyone may expect to meet anyone else anywhere around the world (and some anywhere in space) with no more surprise than was caused by meeting one another "downtown" a half century ago. Humans are only hyperconsciously aware of themselves or their own parts—their tongues, eyes and fingers—as constituting separate items when those separate parts get damaged. Otherwise humans are aware only of the totality of being as a coordinate part of their total environment. At such times as they "feel great". When humans first acquired automobiles they were acutely aware of all the autos' separate parts because they had continually to repair, regulate and replace them. Only muscularly powerful amateur experts could drive early cars. A half century later almost any human can drive an auto, a coordinately whole extension of their integral organism. The outcry about automation in general and its emerging comprehensivity is for the moment only provoking, hyperconsciousness of society. All humans and biological phenomena have always been automated. There will be a gradual subsidence of humanity's consciousness and specific awareness of the separate tool parts of its complex world around network of industrialization which is in reality only the externalized automation of its originally only integrally operating, anatomical automation of its metabolic regeneration functions.

World Community and Its Sub Communities. Because synergy shows experimentally the behavior of whole systems unpredicted by behavior of the parts and because the known behavior of the whole and the known behavior of some of the parts (at least three) makes possible discovery of the required behavior of the other parts. I assume that all planning of humanity's economic, urban and other undertakings must start with world trendings and possible modifications of the total or world environment.

According to my speculative reconstruction, the ecological history of humanity around Earth has two chapters. In chapter one, humanity—whose bodies are better than 90% water—lived in huts on rafts beside the rivers, lakes, bays, and oceans, for fish were the most plentiful food and the raft kept the humans safe from wild animals on the shore. Some of these raft dwellers were blown out to sea and preponderantly eastward around Earth's surface, three quarters of which is water.

In the second chapter of all history, men learned to sail to windward. Following the sun, to which they intuitively attributed their metabolic regeneration, men worked westward fighting into the head wind seas.

In Japan the originally sea-faring people have an annual "Golden Boy Day". They celebrate by flying fish-shaped kites above the roofs of their homes—one for each of their male children. The kites symbolize the salmon, who swims and leaps upstream in order to regenerate. That is the Japanese ideal.

Approximately the whole of the last ten thousand years' span of recorded history takes place during chapter two's preponderantly westbound movement of humanity. In the Eurasian continent, where 76% of humanity exists, this westward motion finally funnels into Western Europe. As humanity converged it crossbred. Western Europe represented an amalgam of a myriad of previously isolated "nations". The "nations" had developed through milleniums of inland, inbred adaptations to unique local subsistence patterns. Along the waterfronts the sailors crossbred.

Crossbreeding Europe, intermingling with the Angles and Jutes, poured into the British Isles to crossbreed even more. West bound Indian Ocean people inhabited Africa in ever further westward, tribally inbreeding, inland isolations. Then crossbreeding Western European humanity jumped westward across the Atlantic to the Americas. For ten successive generations they have settled further westward. As they moved westward they crossbred acceleratingly, not only with their own west bound, chapter two Eurasian stocks but with the Eurasian stock of chapter one, which had drifted eastward to the American continents at least ten thousand years earlier. Into the north and South American continents and their islands there also flowed westward, both by slave trade and migration, a swiftly crossbreeding homoginization of the inbred African tribesmen.

In California, at the mid-point of the western shores of America, cross-breeding man has become so genetically integrated as to defy superficial identification with any of the earlier inbred national characteristics of Eurasia.

In California today—1966—we find an advanced phase of crossbred world man poised on an epochal springboard about to fly both skyward and into the seas' depths around the Earth, thus to open chapter three of history.

In logical consequence of this historical trending the United Nations was born on the West Coast of America a score of years ago. Logically the air and space vehicles of man's acceleration into world and universe citizenship are predominently produced on the West Coast of North America. Around the world we find nationally named airlines—the Ghana, Japan, and India airlines, etc.—but, the vast majority of their vehicles are California designed, developed, and produced, as are also a large proportion of the new space and sea penetrating vehicles.

California is in the center of the outermost jump-off pad of humanity's springboard. From this pad, humanity is taking off—from its flounder, snail, and crablike existence, only around the two dimensional bottom of the skyocean world—into its self-interference free, four dimensional occupancy of universe.

99.999 percent—not only of all the search, research and development, but of all the operating controls of man's entry into the one-town world and its surrounding skyocean—are conducted exclusively in the ranges of the electromagnetic spectrum, which are infra and ultra to humanity's sensorial apprehending. Only through mind conceived and brain operated instruments does humanity command the operations of its birth and entry into world and universe citizenship. Education is therefore essential and central to man's successful transformation.

The fundamental concepts of humanity are transforming overnight from the working assumption of man as a physical and economic failure—as inexorably demonstrated throughout the whole of past history wherein only one in a thousand lived out his days and one in one hundred thousand lived out his days in economic success.

For only the last twelve years of all history has it been scientifically acknowledged that all of humanity may now be physically and economically successful. Humanity's master of vast, inanimate, inexhaustible energy sources and the accelerated doing more with less of sea, air and space technology has proven Malthus to be wrong. Comprehensive physical and economic success for humanity may now be accomplished in one-fourth of a century. For the first time in history it is

to be assumed now and henceforth that it is normal for man to be a physical and economical success—as normal as it is for a hydrogen atom to demonstrate the success of its designed inter-patterning potentials. Now and henceforth it is not only normal for man to be a physical and economic success but to be so without endangering the success of any others and without interfering with the degrees of freedom of others. A design science revolution is underway.

In California I find a powerful latent awareness of the significance of this great moment of human transition. I find in this community a spontaneous desire to cease backing up into our future and enthusiasm for a general forward facing of society.

Typical of the power of this west coast springboard into the new chapter three relationship to universe is the initiative of San Jose State College in throwing off the semantic yoke of "Engineering", with all its tradition and professionally starched fabric, to re-identify the general engineering undergraduate major as the "Cybernated Systems Discipline", open to all undergraduates.

Such semantic reorientation is only the beginning. In my constant travel around the world I witness everywhere the swiftly accelerating birth of world man. Nowhere, in my seventy years, and in my many years of world travel, with oft-repeated visits at 174 world around universities and colleges, have I felt the final leap into universal citizenship from the springboard of local inertia to be as imminent as I intuit it to be in California, North America.

The U.S.A. as the theater of crossbred world man best discloses the patterns coming upon all men. In the U.S.A. the population census is taken every ten years. Two censuses ago, it was found that the average U.S.A. family moves out of town every five years. In the last census, they are moving out of town every 4 1/2 years. The pace is quickening. At the last (every four year) Presidential election, it was estimated that thirty million were unable to vote because they had not been in their new homes long enough to qualify for voting. Since sixty-five million did vote, those disqualified by the glacial speed reshuffling of society numbered 50% of those who did vote. Since the shift is accelerating, it is clear that within a few more national elections that the majority of American citizens will be unable to vote and democracy will have to find other than a static geographical base for qualifying man to have his voice heard.

What do we know and what can we see of Chapter Three. Nature has devised two main and fundamental organic designs for the systematic solution of life's metabolic regneration requirements—the zoologicals and the botanicals, the vegetation is designed with roots to receive its sustenance at first hand by photosyntheseis from the sun and sun-energized hydraulicly and pneumaticly regenerated chemical re-cyclings. The zoologicals are designed with high mobility to go after their sustenance and receive their sun energy indirectly by first feeding upon the vegetation. Some zoologicals feed on other zoologicals which latter first feed on vegetation. Man, though designed zoologically to go after his sustenance found few places where the vegetation gave him the fruits and palatable foods. Those who did find favorable vegetation conditions set about to guard that territory and to cultivate the most favorable types of vegetation and others hung hopefully about them. Thus, man with very short legs and a very big Earth came to confuse himself with the botanicals and pretended to himself that he had roots and that he owned the favorable pieces of the Earth. The swift evolutionary changes taking place invisibly are about to uproot him—all concepts of urbanization will become obsolete. Only the Earth and the solar system will be his temporary home.

The swift shift of humanity from an agricultural to an industrial world economy draws men from the agricultural lands into the city. The industrialized tools and industrialized planting, cultivating, and harvesting service industries sweep over the cultivated lands.

Urbanization is only temporary as the cities become the launching pads for each human's blast-off into world shuttling citizenship.

The centers of cities explode outwardly like volcanoes to deploy their super-market services to ever newer mobile traffic centers. The immobilized families and individuals begin to shuttle swiftly

between high concentrations and highly diffuse deployments. They converge for the metaphysical exchange— for the brain and mind activities—for cultural and commercial exchange for museums, theaters and university study, for broadcasting which is high velocity publishing. They deploy for their physical activities—for the muscular and energetic activities—for mountain and water skiing, for factories and physical archaeological and geological and ecological research.

The whole of the urbanism is a vast oscillating system—a world embracing, entropic, volcanic, physical explosion countered at increasingly high frequency with the world embracing, metaphysically contracting and information concentrating system which regenerates by broadcast and publishing its progressively generalized concepts for regeneration of man's anti-entropic functioning—that fulfills his universe functioning.

R. Buckminster Fuller
June 20, 1966

JAWAHARLAL NEHRU MEMORIAL FUND
जवाहरलाल नेहरू स्मारक निधि

Chairman : Shrimati Indira Gandhi
Secretary : Dr. Karan Singh

TEEN MURTI HOUSE,
NEW DELHI-11.

July 22, 1969

Dear Mr. Fuller,

After the passing away in 1964 of Pandit Jawaharlal Nehru, a Memorial Fund was created to perpetuate his memory. The Fund has undertaken a number of activities, one of which is to arrange every year on the eve of Jawaharlal's Birth Anniversary (14th November) a Jawaharlal Nehru Memorial Lecture in New Delhi. The first lecture in this series was delivered by Prof. P.M.S. Blackett in 1967 on "Science and Technology in an Unequal World", and the second in 1968 by the eminent Astro-Physicist Prof. S. Chandrasekhar on "Astronomy in Science and in Human Culture". I have pleasure, on behalf of the Jawaharlal Nehru Memorial Fund, in inviting you to deliver the lecture for this year on a subject of your own choice. We are aware of your outstanding achievement in the field of architecture and are sure that your lecture will be a stimulating and memorable experience.

The lecture will be held in New Delhi on the evening of the 13th November, and will be presided over by the Prime Minister, Shrimati Indira Gandhi. The Fund will be happy to meet the expenditure upon your air fare from New York-Delhi-New York on Air-India (Economy). In New Delhi you will, of course, be the guest of the Fund. I do hope that it will be possible for you to accept this invitation, and we await your confirmation at your earliest convenience. Meanwhile, I was told by Romesh Thapar that you are likely to visit India again next month. On your last visit I was out of town, but I look forward to seeing you when you are here in August.

With good wishes,

Yours sincerely,

Karan Singh

R. BUCKMINSTER FULLER ITINERARY

PROGRAM IN DELHI INDIA
JAWAHARLAL NEHRU MEMORIAL LECTURE

Wednesday 12 November 1969

4:45 AM	Arrive at Palam Airport.
6:00 AM	Reach Ashoka Hotel.
8:30 PM	Dinner with Romesh Thapar and Charles Correa.
10:30 PM	Isamu Noguchi arrives.

Thursday 13 November 1969

1:30 PM	Lunch with Mansing Rama and Noguchi at the Ashoka.
5:30 PM	Tea with Dr. Karan Singh at his residence.
6:30 PM	**Jawaharlal Nehru Memorial Lecture by Dr. Fuller at Vigyan Bhavan.**
8:30 PM	**Dinner with Prime Minister Indira Gandhi at her residence.**

Friday 14 November 1969

8:30 AM	Planting of Roses at Shanti Vana.
11:00 AM	Attend the Inauguration of the Jawaharlal Nehru University at Vigyan Bhavan.
4:00 PM	Visit Gandhi Museum and Memorial with Charles Correa and Isamu Noguchi.
5:45 PM	Ballet: Discovery of India – at Teen Murti House.
8:00 PM	Dinner with Vicerain Sarabar and Mrs. Sarabar, Isamu Noguchi and Charles Correa.

Saturday 15 November 1969

11:30 AM	Meeting with Minister Karan Singh – Re Airport system of India. Visit the Ministry of Tourism and Civil Aviation – Sardar Patel Bhavan, Parliament Street. Address group of 20 Arch. Execs. of aviation.
4:15 PM	Attend the presentation of the Jawaharlal Nehru Award for International Understanding to Khan Abdul Ghaffar Khan at Teen Murti House.

Sunday 16 November 1969

9:30 AM	**Breakfast with Prime Minister Indira Gandhi.**
12:30 Noon	Lunch with Arch. Stein.

Tuesday 18 November 1969

3:00 PM	Mr. Mitra at University Patel Bhaval.
5:30 PM	Reception at Mansing Rama's for the Indian Architects and R. B. Fuller.

Wednesday 19 November 1969

8:15 AM	To Prime Minister's House.
10:00 AM	Nehru Memorial Library visit.
11:00 AM	**Pay respects to Prime Minister on her birthday.** Meeting with Mr. Mitra and Mr. McTennel at the Air Ministry.
5:00 PM	Interview with HINDUSTAN TIMES.
6:00 PM	Meeting with Dr. Karan Singh and Ministry of Aviation Group and Architects at the home of Dr. Singh.

Thursday 20 November 1969

7:30 AM	Visit the Park with Mansing Rama.
5:00 PM	**Reception for R. B. Fuller at Miss Padmaja Naidu, Vice Chairman, Executive Committee, Jawaharlal Nehru Memorial Fund, Teen Murti House.**
7:15 PM	Dinner with Mrs. Jayakar.

Telegram from B. F. to publisher friend in United States the day before the Jawaharlal Nehru Memorial Lecture, November 13, 1969.

I am honored to deliver the 1969 Jawaharlal Nehru Memorial Lecture, New Delhi, tomorrow November thirteenth on the eve of Nehru's birthday. I am being introduced by Prime Minister Mrs. Indira Gandhi. The two previous Memorial lecturers were: in 1967 Professor P.M.S. Blackett, President Royal Society, London, and in 1968 Indian/American Astrophysicist S. Chandrasekhar. My subject is planetary planning; my discourse is much as outlined to you and earlier to Nehru. Towit: **don't try to reform humans but reform their physical environment by comprehensively considerate design science strategy which induces humanity's spontaneously enlightened logical behavior.** For instance providing bridges over rivers, telephones, etc., and doing so with ever increasing efficiency of designed use of each kilowatt of energy, pound of material, and second of time per accomplished unit of performance. For example the one quarter ton communication satellite out performing trans ocean communications capability in one hundred and seventy five thousand tons of copper cable. Thereby to accomplish high standard physical sustenance and metaphysical satisfaction of all humanity, all enjoying all earth without being advantaged at expense of another; progressively removing restraints while lessening conflicts and concomitant pollutions. All is now demonstrably feasible within two decades not for the sake of physical ends but to unblock the metaphysical by physical malaise. We are only aware of our tongues when we burn them. When we feel well it is because we don't feel anything and are metaphysically emancipated. See my latest book – Operating Manual for Spaceship Earth.

Buckminster Fuller

THE TRUSTEES

of

THE JAWAHARLAL NEHRU MEMORIAL FUND

request your presence

at

THE JAWAHARLAL NEHRU MEMORIAL LECTURE, 1969

by

R. BUCKMINSTER FULLER

on

PLANETARY PLANNING

Thursday, November 13, 1969 at 6.30 p.m.

at Vigyan Bhavan, New Delhi.

RASHTRAPATI V. V. GIRI HAS KINDLY AGREED TO PRESIDE.

R.S.V.P.
Teen Murti House
New Delhi 11 (Tel: 371102)

The Rashtrapati will arrive at 6.25 p.m.
You are requested to take your seat by 6.15 p.m.

The Prime Minister

requests the pleasure of the company of

Dr. Buckminister Fuller

at Dinner on Thursday, the 13th November, 1969

at 8.30 p.m. at 1, Safdarjung Road, New Delhi

"To remind"

RSVP
SOCIAL SECRETARY
PRIME MINISTER'S HOUSE
TEL.NO. 619970

To Celebrate

JAWAHARLAL NEHRU'S EIGHTIETH BIRTHDAY

The following functions are being organised

by the

JAWAHARLAL NEHRU MEMORIAL FUND

on

NOVEMBER 14, 1969

SHANTI VANA	Mass Planting of Roses *by*
8 to 8.45 a.m.	Girl Guides and Boy Scouts
TEEN MURTI HOUSE	Ballet: Discovery of India *by*
LAWNS, 5.45 to 7.30 p.m.	**RANGA-SRI** Little Ballet Troupe of Gwalior

Entrance Free

ALL ARE CORDIALLY INVITED

The Vice-Chancellor and the Executive Council

of the JAWAHARLAL NEHRU UNIVERSITY

request the presence of

Dr. R. Buckminster Fuller

at the Inauguration of the University by

Shri V. V. GIRI, PRESIDENT OF INDIA,

and at the First Annual Convocation

to be held on Friday, the 14th November, 1969

at 11 a. m. in the Vigyan Bhavan.

Shrimati INDIRA GANDHI, CHANCELLOR,

will preside.

R. S. V. P.
Vigyan Bhavan Annexe
Maulana Azad Road
New Delhi-11
Telephone : 386387

Guests are requested to present this card at the entrance and be in their seats by 10.30 a.m.

The President

Indian Council for Cultural Relations

requests your presence at the presentation of

The Jawaharlal Nehru Award for International Understanding

to

Khan Abdul Ghaffar Khan

by

The President of India

on Saturday, 15 November, 1969 at 4.30 p.m.

at Teen Murti House, New Delhi.

A reply is requested by 11 November 1969.
Secretary, ICCR,
Azad Bhavan, New Delhi-1
Phone: 27 21 14, 27 34 92

(Guests are requested to bring this invitation and to be in their seats by 4.15 p.m.)

TO MEET DR. BUCKMINSTER FULLER

MISS PADMAJA NAIDU

Vice-Chairman, Executive Committee

of the

JAWAHARLAL NEHRU MEMORIAL FUND

AT HOME

Thursday, November 20, 1969 at 5 p.m.

at Teen Murti Marg, New Delhi

RSVP
Jawaharlal Nehru Memorial Fund
New Delhi 11 (Tel: 371102)

THE NEW YORK TIMES, NEW YORK

SUNDAY, NOVEMBER 16, 1969

EARLY EDITION HEADLINE

Buckminster Fuller Confuses Indians With Talk on 'Synergetics'

LATE EDITION HEADLINE FOR THE SAME ARTICLE

Buckminster Fuller, in India, Lectures on 'Planetary Planning'

By KASTURI RANGAN
Special to The New York Times

NEW DELHI, Nov. 15—R. Buckminster Fuller, the American architect-scientist-inventor-philosopher, stood up this week before a gathering of intellectuals here to deliver a lecture on "planetary planning."

Mr. Fuller surveyed his audience of some 500, which included Prime Minister Indira Gandhi, President V. V. Giri and several diplomats, professors, scientists, philosophers, architects and students. He asked abruptly:

"Has anybody heard of the term 'synergetics'? Those who have, please raise your hands."

Most in the audience just blinked. One nervous young man hesitantly put up a hand, but seeing that no one else shared his knowledge he quickly put it down.

Few Know Meaning

"Just as I thought," the 74-year-old American scholar, whose bifocals were fixed tightly on his bald head with an elastic band, said with a chuckle. He said he was not disappointed, and assured his listeners that hardly 3 per cent of his audience at any given meeting knew the meaning of "synergetics."

Mr. Fuller—who was delivering the annual Jawaharlal Nehru Memorial Lecture — explained at great length his theory, called energetic-synergetic geometry, which he invented in 1917 and on which his subsequent achievements were based.

He is best known to Indians as the designer of the geodesic dome, the structure that can cover any amount of space without beams or pillars.

For the best part of the lecture the audience remained in fascinated confusion as Mr. Fuller advanced esoteric formulas and deductions. He described synergy as the

Art Shay
Buckminster Fuller

"behavior of whole system unpredicted by the behavior of any of its separate parts or the subassemblies of its parts."

One Plus Two Equals Four

Illustrating this, Mr. Fuller produced a formula that made one plus two equal four.

"Take three equi-edged triangles," he said. "Stack them together edge to edge as a three-sided tent. Inadvertently you have produced a fourth equi-edged triangle at their base. All together, they form a tetrahedron."

"This is synergy," he continued. "One plus two equal four. Take one away from the four and only two remain. The one that was lost was annihilated."

Again, the listeners just blinked.

Unconcerned, Mr. Fuller also reputiated Euclid's theory of plane geometry, saying it was based on a false belief that the universe is just one infinite plane.

The universe, Mr. Fuller said, is "closed system"—finite, not infinite. And, he said, the differences between all "open" and "closed" systems is 720 degrees, which is also the sum of the angles of all the corners of one tetrahedron.

'Fictions' Are Criticized

"We have been tolerating these fictions [that the universe is one infinite plane] only because they were included in yesterday's textbooks which we say, also ignorantly, we cannot afford to replace," he said. "The time has come, and there is little of it left, to effect entirely new educational strategies the world round."

"It is clearly to be utopia or oblivion," Mr. Fuller warned. "We must begin today to expose our youth and ourselves to the fundamental self-discipline of conceptioning, which is the only real educational process."

Mr. Fuller said the youth of today was intuitively revolting against all sovereignties—"closed area concepts" —and political ideologies. They are moving, he said toward an "utterly classless, omni-world humanity."

He described sovereignty as "an invention of powerfully armed ambitious men" and called upon India to renounce it and declare the country a"home for world men."

Life of 1970's Depicted

The geographical location called India naturally embraces one-sixth of all humanity, and it has more different languages—300—within the lands left to it by all the other sovereign claims than exist outside the borders closed in upon it," Mr. Fuller said.

Mr. Fuller, who is widely known for his "Dymaxion" houses — movable dwelling places whose rooms are suspended from a central mast —predicted that the nineteen-seventies "will see air deliveries all around the world of semi-autonomous dwelling machines, universal credit card-managed retail service systems which will air install, maintain and air-remove the dwelling machines within hours."

"The power to operate semi-autonomous sanitation automation and the equipment involved will be mass produced from the experience gained in the moon and outerspace programs and equipment prototyping," he said.

Mr. Fuller denounced "society's perverse fixation on specialization" and warned that it would lead to war between nations — over claims on new resources in earth, sea and space — and would "ultimately destroy all earthians."

"The more specialized society becomes, the less attention does it pay to the discoveries of the mind," he said.

Prime Minister Indira Gandhi greeting B. Fuller

B. Fuller conversing with Padmaja Naidu, Vice–Chairman of the Jawaharlal Nehru Memorial Fund

THE HINDUSTAN TIMES, NEW DELHI

TUESDAY, NOVEMBER 11, 1969

Nehru Memorial Lecture

THE Jawaharlal Nehru Memorial Lecture this year will be

delivered next Thursday by R. Buckminister Fuller who will speak on "Planetary Planning."

The first Nehru Memorial Lecture was delivered two years ago by the British scientist, Professor P. M. S. Blackett, and the second last year by the Indian-American astrophysicist, Dr S. Chandrasekhar.

Mr Buckminister Fuller is a prodigy who defies any single definition. A recent citation described him as a distinguished engineer, mathematician, inventor, designer, mechanic, writer and philosopher.

Bucky, as he is affectionately known to his friends, works on the basic premise of achieving the maximum gain advantage from the minimum energy output. For a man of 75 Mr Fuller is extraordinarily active, both physically and intellectually.

It is strange to think that this world celebrity was almost on the point of suicide in 1927. He decided to live and though success did not come early and easily it has come to him in enviable measure.

Buckminister Fuller is best known as the inventor of the geodesic dome. He once wrote a rhyme about it to the tune of "Home on the Range":

Let architects sing of aesthetics that bring
Rich clients in hordes to their knees;
Just give me a home, in a great circle dome,
Where stresses and strains are at ease.

B. Fuller and Prime Minister Indira Gandhi

B. Fuller and V. V. Giri, President of India

The Jawaharlal Nehru Memorial Lecture was attended by a distinguished gathering including Indira Gandhi; President of India, V. V. Giri, who presided; Padmaja Naidu and Y. B. Chavan

THE HINDUSTAN TIMES, NEW DELHI

FRIDAY, NOVEMBER 14, 1969

Fuller foresees omni-world utopia of liberated youth

Hindustan Times Correspondent

New Delhi, Nov. 13—Delivering the third Nehru Memorial Lecture, Mr Buckminster Fuller, noted American architect-philosopher, attacked the craze for "specialisation" and all the other false values and assumptions of "science" which had brought the world to the brink of "oblivion."

He foresaw the other option of a "utopia," a "bitterly classless, omni-co-operative, omni-world humanity," being built by the young, freed of the "ignorantly founded educational traditions" and exposed to their "spontaneously-summoned outflow of reliable, opinion-purged, experimentally verified data."

Mr Fuller took this opportunity to pay homage to Nehru who had "effectively dedicated" his life "to all humanity" and to formally present his comprehensive scheme of "Energetic Synergetic Geometry."

President V. V. Giri presided over the function which was attended by Prime Minister Indira Gandhi and other dignitaries.

Mr Fuller's concept of the term "geometry" relies on its original meaning, i.e. world measuring. Rejecting the traditionally accepted scientific base of a two dimensional world which stretches on the linear scale ad infinitum, he put forward his own scheme of "energetic synergetic geometry." In Mr Fuller's scheme, the universe is finite organically related units acting, inter-acting and influencing each other "energetically."

The present craze for scientific "specialisation" would lead the world to diasster for it meant only partial and not full knowledge of the interacting, dialectical "synergetic" phenomena which formed the prime moving force.

From his basis of a finite world, Mr Fuller pointed out the necessity for rethinking on the whole process of dwindling natural resources, which man, with his erroneous "infinity" concept, was fast erodinp.

For him knowledge basically was a collection of seen experience, and the organic world necessitated the tearing down of barriers of nations and superficiality.

President V. V. Giri said that the primary impulse generating the conflicts of today was the lack of reconciliation between science and the humanities. This conflict, he said, "was the primary threat to the orderly and peaceful establishment of a society based on goodwill among men and peace on earth"—a threat to Pandit Nehru's ideal.

The solution, according to Mr Giri, lay in harnessing the iscoveries of science to the ser vice of man. This could be done by developing a sense of values, whether they be called oral religious or spiritual.

Mr Giri pointed out that Mr Nehru laid emphasis on the scientific temper permeating society, and looked upon science as an instrument of liberation.

Mrs Gandhi said that our nation should not be merely content with begging or borrowing technology, but should initiate new methods, new ways, so that change became a companion to the nation.

India, she said, started her industrial revolution a century or two behind the West, but that should help to prevent the criminal wastage and exploitation of early industrialisation. Science was a necessary prerequisite for the modern mind, which looks to the future.

Odd man out

Hindustan Times Correspondent

New Delhi, Nov. 13—When Prof. Buckminster Fuller, delivering the Nehru Memorial lecture asked an audience of the cream of the Capital to raise their hands if they had heard of the term "synergetics", only one hand was seen.

Nevertheless, as Mr Fuller pointed out, we are not much worse off than the rest of the world. The number of people in his audiences all over the world who thought they knew the meaning of the word constituted a maximum of three per cent at any given meeting.

NATIONAL HERALD

FRIDAY, NOVEMBER 14, 1969

Nehru memorial lecture

Planning a home for 'world man'

By Our Staff Reporter

NEW DELHI, Nov. 13—A world living standard, far higher than anyone has enjoyed ever before, was well within the realm of possibility by 1985, according to Dr. R. Buckminster Fuller.

He called for a technological revolution by "comprehensive designers", who would coordinate resources and technology on a world-wide scale.

Dr. Fuller, widely known for his designs of the geodesic domes and dymaxion house, is more than an architect; he is a distinguished engineer, mathematician, inventor, designer, mechanic, writer and philosopher.

Dr. Fuller, an American, was delivering the Jawaharlal Nehru Memorial Lecture on "Planetary Planning" at Vigyan Bhavan here this evening. The President, Mr. V. V. Giri, presided. The Prime Minister, Mrs. Indira Gandhi, made introductory remarks.

Dr. Fuller described how society's perverse fixation on specialisation led to its extinction highlighted the need for a comprehensive switch from the narrow specialisation towards an ever more inclusive and refining comprehension by all humanity—regarding all the factors governing omni-continuing life aboard our speceship Earth.

Only this, he said, could bring about reorientation from the self-extinction-bound human trending. According to him, the predominant task was how to get all of humanity to educate itself swiftly enough to generate spontaneous social behaviours which will avoid extinction.

"We are in an age which assumes the narrowing trends of specialisation to be logical, natural and desirable", he said. According to him, this trend of specialisation bred feelings of isolation, futility and confusion in individuals "It breeds biases which ultimately aggregate as international and ideological discord which in turn, leads to war" Dr. Fuller added.

SPECIAL CASE EXPERIENCES

He distinguished between generalised principles and special case experiences. Specialisation tended to cut down on the discoveries of the mind and precluded further discovery of the all-powerful generalised principles—the very essence which runs through all special case experiences.

Speaking of the false concept of an utterly open, infinite flat slab world, Dr. Fuller said that in an 'infinitely extended' world, one could assume that when one exhausted the present familiar resources, one would, as in the past, keep on finding new and better alternative resources ad infinitum.

If this was the case, why all the worry and fuss and the thought of tomorrow? As Dr. Fuller put it, this line of thought accounted for the indifference for the other man and the ruthless selfishness of people.

The concern should be for the humanity's continuation upon this beautifully equipped and provisioned, close system, space vehicle Earth." "It is clearly to be Utopia or Oblivion—and no half measures; we must begin today to expose our youth and ourselves to the fundamental self-discipline conceptioning which is the only real educational process", said Dr.. Fuller.

He also touched on the concept of sovereignty, "an invention of powerfully armed ambitious men". Dr. Fuller held the view that the world's young people abhorred sovereign nationalism and bias of any kind.

OMNI-WORLD HUMANITY

"The youth of Earth are moving intuitively towards an utterly classless omni-cooperative, omni-world humanity", he said.

From this, he developed his idea of "world man" and a world that renounced sovereign claims. India should declare herself as the first inherent home of world man, said Dr. Fuller.

According to him, if India were to offer her passport to all who wished to be free world men, a billion young men around the world would apply for such passport. This did not necessarily mean that they had to come to India. They could live around the world with India's "world man passport".

"The geographical location called "India" naturally embraces one-sixth of all humanity; has more different languages (300) within the lands left to it by all the others' sovereign claims than exist outside the borders closed in upon it", said Dr. Fuller

In her welcome address, the Prime Minister, Mrs. Indira Gandhi said: "Let us not always think along the paths charted by others We should find new paths, instead of borrowing foreign know-how and technology'. This was how she justified the need for research in science and technology in developing countries.

The President, Mr. V. V. Giri, who presided, said that the basic conflict that had arisen in the world today was due to lack of reconciliation between science and humanities.

"It has been a primary threat to the orderly and peaceful march of the world towards the establishment of a society based on goodwill among men and peace on the earth."

PATRIOT, NEW DELHI

FRIDAY, NOVEMBER 14, 1969

Fuller's Nehru memorial lecture

'India victim of monetary mischief'

Our Staff Reporter

DELIVERING the third Nehru Memorial Lecture on Thursday, Dr Buckminster Fuller said those who had exploited India in the past had so organised the monetary exchange system that the country would remain the "most depressed of all the world's economies".

Dr Fuller, 74-year-old distinguished engineer, mathematician, inventor, designer, writer and philospher spoke on "Planetary Planning."

Presiding over the function, President V. V. Giri said if mankind was to surge forward "we have to see how best the fruits of science and technology are utilized in the practical fields."

Welcoming Dr Fuller, the Prime Minister said the guest was an "unusual person". He was described as an architect because "of his intense concern with living space. His obsession is with the architecture of the Universe."

She said Jawaharlal Nehru did more than setting the country on the path of economic development. "He set us on the course of scientific thought and of deliberate, self-directed technological change."

TOMORROW'S WORLD

Dr Fuller said the 1970s would see "air deliveries" all around the world of "semi-autonomous dwelling machines", computerised, universal, credit card managed rental service system which would "air-instal maintain and air-remove" the dwelling machines", computerised universal, credit card-managed rental service system which would "air-instal, maintain and air-remove" the dwelling machines within hours.

By 1985, Dr Fuller predicted, the world would be a utopia or a oblivion if science did not progress along rational lines.

Dr Fuller dealt at length with the "greatest discovery" of his life, the theory of "energetic-synergetic geometry."

He said there were no specific directions or localities in the Universe which might be opposingly designated as UP and DOWN. "In their place, we must use the words OUT and IN" he said.

The Universe he said was a "closed system"—finite not infinite. And the differences between all "open" and "closed" systems was 720 degrees, which was also the sum of the angles of all the corners of one tetrahedron.

INDIA'S EXPERIENCE

Agencies add:

Dr Fuller said India had within it the world's largest proportion of total population committed to integrity of thought, and also had within it experience with all the ramifications of science, technology, agriculture and animal husbandry from their very beginnings.

It had been exploited ruthlessly and selfishly by outsiders who had not only robbed it progressively of the cream of its 5,000 years of wealth production but, while doing so, also had organized the world's monetary exchange system to guarantee that India would remain the most depressed of all the world's economies.

YOUTH REVOLT

Dr Fuller said the youth of humanity all around the planet were intuitively revolting from all sovereignties and political ideologies. The youth were moving intuitively towards an utterly classless, omni-cooperative, omni-world humanity.

India as a self-willed and self-organized people could publicly affirm the ipso facto non-claimance to any sovereign lands. Such an act could catalyse the beginning of humanity's realistic, metaphysical validation of the prior worth of human life in universe.

President Giri said Dr Fuller was the right choice for the memorial lecture as nothing was dearer to Nehru than the application of science and technology to the welfare of mankind.

Mr Giri said Nehru laid emphasis on the scientific temper of mind permeating the whole strata of society. Nehru believed that science and technology would help to establish a free society based on economic justice and opportunities for all, a society which aimed at the cultivation of spiritual values, the spirit of service and of usefulness.

Prime Minister Indira Gandhi in conversation with Mr Buckminster Fuller just before he delivered his Nehru Memorial Lecture at Vigyan Bhawan on Thursday.—PATRIOT photo.

THE INDIAN EXPRESS, NEW DELHI

FRIDAY, NOVEMBER 14, 1969

'India exploited by outsiders'

By Our Staff Reporter

NEW DELHI, Nov 13.

Mr R. Buckminister Fuller, eminent American Engineer and Mathematician, said here today that India had been exploited "ruthlessly and selfishly" by outsiders who had not only "robbed it progressively" but had also "organised worlds monetary exchange system to guarantee that India will remain the most depressed of all the world's economies."

Mr Fuller, who was delivering the Nehru Memorial Lecture on "Planetary Planning" at Vigyan Bhawan, said India had all the world's different religions and political ideologies operative within it. It had pure and crossbred strans of all humanity and the longest sustained known years of cultural continuity.

He praised India's metal working craftsmen, who he said, were "as capable as any in the world." "I could take them to Detroit or Los Angeles where in the auto or air-space technology they could have jobs as tool-makers which would pay them each day as much as they earn in one half a year in India".

Revolt by youth

Mr Fuller, also a well-known writer and philosopher and described as "first poet of technology," said: "A large proportion of humanity's words were first formulated in India. The first known philosophy of humanity written in words was first found in India." India was also the last unclaimed homeland of a fundamentally inspired and intellectually dominated humanity.

Dealing with the subject of his lecture, Mr Buckminister said the scientists today ignored the comprehensive outlook in the midst of specialisation. He felt that to make real and effective progress they must inject a "substantial degree of dynamism" so that they could realise maximum results. "The large dividend of human advantage from the least investment of energy and materials was to be accomplished by an over-all consideration of technological means available and their most integrated employment."

Mr Fuller said the youth all around the planet were today intuitively revolting from all sovereignities and political ideologists. They were moving towards an "utterly classless, omnicreative, omni-world humanity." India as a self-willed and self-organised people could publicly affirm the "ipso facto nonclaimance to any sovereign lands. Such an act can catalyze the beginning of the beginning of humanity's realistic and human life in the universe."

Mr Fuller said children freed from the ignorantly founded educational traditions and exposed only to their "spontaneously summoned, computer stored and distributed, outflow of reliable, opinion purged, experimentally verfied data, "could lead society to its happy egress from all "lethally mis-informed, fearfully imposed and physically enforced customs of yesterday."

Speaking on "historical philosophic background," Mr Fuller said: "We may soon discover that all babies are born geniuses and only become de-geniused by the errosive effects of unthinkingingly maintained false assumptions of the grown-ups regarding their conventional ways of bringing up and educating their young."

He said since the dawning of the most meagerly revealed human history, there had been "ten importantly distinct periods of historical transformations" of both the physical and cosmological environments of society. "In each of these, the environment-reorganising Leonardo-types manifestly have played the leading roles." In the closing days of 20th century, humanity seemed to be returning into the Garden of Eden of an invisible "edifices," comprehensive integrity of an eternally self-transforming and regenerative Universe. By 1985 humanity might reach a Utopian stage or fall into oblivion, he added.

The lecture was attended by a distinguished gathering including the Prime Minister, Mrs Indira Gandhi, the Union Home Minister, Mr Y. B. Chavan, and several other Central Ministers, university teachers and scientists. The President, Mr V. V. Giri, who presided, thanked Mr Fuller for his illuminating lecutre. Earlier Mrs Gandhi welcomed Mr Fuller.

THE TIMES OF INDIA

FRIDAY, NOVEMBER 14, 1969

Utopia or oblivion by 1985, says scientist

By A Staff Reporter

NEW DELHI, November 13.

DELIVERING the Jawahar Lal Nehru Memorial lecture at Vigyan Bhavan here today, Mr. Buckminster Fuller, the eminent architect-scientist, said that human race in its progress had arrived at a point where by 1985 it would achieve either utopia or oblivion.

He predicted that in the 1970's skyscrappers would be mass-assembled. The buildings would be airlifted and then lowered on their anchored piling foundations.

"The 1970's will see air deliveries all around the world of semi-autonomous dwelling machines, universal credit card-managed rental service systems which will air install, maintain and air-remove the dwelling machines within hours. The power to operate semi-autonomous sanitation automation and the equipment involved will be mass produced from the experience gained in the moon and outer space programmes and equipment prototyping. The little black boxes that contain all the life regenerating systems will forever dispense with the Earthians' wasteful piped-in water supply and sewer systems. The slowly and meagerly decreasing. essential chemistries of such circulating systems will be replenished intermittently in small containers. Eenergy as sun power will be universally employed," he said.

Mr. Fuller saw humanity at the end of 20th century returning to garden of Eden of an "edificeless", comprehensive integrity of an eternally self-transforming and regenerative universe. All humanity will find itself empowered to teach itself through individual thought.

The great aesthetic which would inaugurate the 21st century would be utterly invisible quality of intellectual integrity;—the integrity of the individual in dealing with his scientific discoveries,—the integrity of the individual in dealing with conceptual realisation of the comprehensive inter-relatedness of all events; the integrity of the individual in dealing with the only experimentally arrived at information regarding invisible phenomena; and finally the integrity of all those who formulate invisibly within their respective minds and invisibly with the only mathematically dimensionable, advanced production technologies, on behalf of their fellow men.

"This aesthetic of integrity causes the new life now emerging aboard our Spaceship Earth to abhor any hypocracy," he said. "The god function in all humanity, of the capability to think and act with teleologic-integrity,—will ever approach but never quite attain the perfection of absolute integrity which we now identify in utter abstraction as truth or god. God as a verb, as an abstract love-momentumned gyrocompass, will intuit the emergent ' directional courses to be steered. Elsewise. there will be no more humans aboard Spaceship Earth and the metaphysical functions of orderly discernment and mastery of the physically disorderly behaviours of Universe will have to be carried on by minds operating elsewhere and otherwise in Universe."

Mr. Fuller pleaded that Indi. should declare itself to be the first inherent home of world man, "Because other States had declared their individual sovereignties, India is simply the remaining unclaimed region inadvertently identified by the others' sovereignty claiming.

The earth has no naturally sovereign countries. Sovereignty is only an invention of powerfully armed ambitious men. The geographical location called "India" naturally embraces one-sixth of all humanity. These people are there only because it is where they happened to be born. India has more different languages (300) within the lands left to it by all the others' sovereign claims than exist outside the borders closed in upon it. If India renouncing sovereign claims and affirming its position as the residual free lands of world man, were to offer its passport to all who wished to be free world men, I think it highly possible that a billion young people around all the earth would apply for such passports. They would not have to come to India but would live around the world with India's world man passport. Clearly the world's young people abhor sovereign nationalism and bias of any kind".

Mr. Buckminster Fuller

KEY TO PROGRESS

Mrs. Indira Gandhi, Prime Minister, speaking on the occasion recalled her father's belief that India would have to take to science and technology if it wished to progress.

Presiding over the function, the President, Mr. V. V. Giri, welcomed Mr. Fuller and said that Mr. Fuller had enriched many fields of human activities. The many prototypes of architectural buildings by Mr. Fuller had helped in the construction of houses which were functional as also cheap.

He agreed with Mr. Fuller that in the midst of specialisation man could not ignore importance of a comprehensive outlook.

THE STATESMAN, NEW DELHI

FRIDAY, NOVEMBER 14, 1969

Fuller Deplores Stress On Specialization

BY A STAFF REPORTER

Mr R. Buckmister Fuller, an eminent scientist, on Thursday warned that "society's perverse fixation on specialization" was leading only towards warring with such devastating tools visible and invisible as "ultimately to destroy all earthians".

Delivering the third Jawaharlal Nehru Memorial lecture on "Planetary Planning", Mr Fuller said that only a comprehensive switch from the narrowing specialization and toward an ever more inclusive and refining comprehension by all humanity—regarding all the factors governing "omni-continuing life".

The 75-year-old mathematician, architect, inventor and author among other things, said that it was on how humanity coped with the problem of specailization that its future depended. "By 1985 it can either be Utopia, or oblivion".

Coming back to specialization, he said that it ended to shut off the wide band tuning searches "and thus precluded further discovery of the all powerful generalized principles. The more specialized society becomes, the less attention does it pay to the discoveries of the mind which are intuitively beamed toward the brain, there to be received only if the swiches are 'on'."

Quite clearly Mr Fuller added, the task was predominantly metaphysical—how to get the humanity to educate itself swiftly enough to generate spontaneous social behaviours which will avoid extinction.

Referring to the fact that science has "found no solids, no continuous surfaces, no infinity no straight lines no 180 degree angular continuums", the scientist said that to the best of our experimentally informed knowledge, all such formerly accepted axiomatic concepts are false.

"We have been tolerating the fictions only because they were included in yesterday's textbooks which we say, also ignorantly we cannot afford to replace. The time has come and there is little of it left within which to effect entirely new, world around educational strategies", he explained.

In this connexion, he pointed out that the phrase all used while speaking of the "Sun coming up or going down", or even of the astronauts going "up" to the moon was actually not correct. "Science has found no up or down directions of universe yet scientists are personally so ill-coordinated that they see 'solids' going up or down".

Mr Fuller also dwelt at some length on the theory of energetic-synergetic geometry—a subject which has made him world famous, for it was applying this theory that he invented the geodesic dome. But as was evident from the looks on the faces of the audience, not many understood the theory.

"SYNERGY"

He described synergy as the behaviour of whole systems unpredicted by the behaviour of any of its separate parts of subassemblies of its parts. Elaborating on this theme he added: "Take three equi-edged triangles, stack them together edge to edge as a three-sided tent. Inadvertently you have produced a fourth equi-edged triangle at their base. Altogether they form a tetrahedron. This is synergy. One plus two equals four. Take one away from the four and only two remain. The one that was lost was annihilated".

There was much more in the lecture that left one breathless, for here, for the first time, one was hearing concepts that one could never even dream of. Speaking of the 1970's, Mr Fuller said that one would see skyscrapers mass-assembled, horizontally in the air space industry's controlled condition factories.

Though the lecture was prepared and printed, Mr Fuller chose to speak extempore, as this he felt would be time-saving (the lecture ran into 80 pages) and as a rule, he never read out a lecture.

BASIC CONFLICT

Mr Giri, presiding over the lecture, said that the basic conflict that had arisen in the world today was due to the lack of reconciliation between science and humanities, and this had been a primary threat to the orderly and peaceful march of the world towards the establishment of a society based on goodwill among men and peace on earth.

The President said that if mankind "is to surge forward, we have to see how best the fruits of science and technology are utilized in the practical fields. It is obvious that the only way to harness the discoveries of science into the service of man is by developing a sense of values, call it moral, religious or spiritual".

The Prime Minister, welcoming Mr Fuller, described him as an architect who was obsessed with the architecture of the universe. She said that through his research and experiments over the years he had shown how to get the maximum from the minimum material by making the most intelligent use of the resources available on earth.

The world must find answers to problems which were inherited from the past and at the same time it must anticipate future problems.

INDIA AS WORLD MAN'S HOME

By A Staff Reporter

Mr R. Buckmister Fuller, an eminent scientist, on Thursday urged India to declare itself to be the first inherent home of world man. "If India, renouncing sovereign claims and affirming its position as the residual free lands of world man, were to offer its passport to all who wished to be free world men, I think it highly possible that a billion young people would apply for such passports".

Delivering the third Jawaharlal Nehru Memorial lecture at Vigyan Bhavan, Mr Fuller explained that these people would not have to come to India but would live around the world with India's world man passport. "Clearly, the world's young people abhor sovereign nationalism and bias of any kind", he added.

Mr Fuller reiterated his feeling that India was the last unclaimed homeland of a fundamentally inspired intellectually dominated humanity.

B. Fuller and Indian dignitaries planting roses at Shant Vana

Indira Gandhi placing roses at Shant Vana

सत्यमेव जयते

No.2532/TCAM(I)/69.

पर्यटन तथा नागर विमानन मंत्री
MINISTER OF TOURISM & CIVIL AVIATION

New Delhi

December 2, 1969.

My dear Dr. Fuller,

I am sorry that I was not able to bid you farewell, as I was involved with Parliament. May I say what a real pleasure it has been to all of us to have had you in our midst, and how deeply your audiences have been impressed. For me personally it was a most rewarding experience to have met you, and I have been greatly enriched by coming into contact with your remarkable ideas. It seems to me that the destiny of mankind will be decided one way or the other by the close of this century. Either we continue in our outmoded and obsolete concepts, which can lead only to mass disaster, or we make a supreme effort to adjust our thinking to the requirements of the nuclear age. In this effort your concepts can play a key role, and I only hope that we in India will be able to make our contribution to this exciting and historic effort.

I am glad that our preliminary talks regarding airports were useful, and my Ministry will now be following up the matter. It may be necessary for your associate Mr. Sadao to come to India in order to finalise the arrangements.

With good wishes,

Yours sincerely,

Karan Singh

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WORD MEANINGS

R. Buckminster Fuller

Because of the experimentally demonstrable fact that the minimum complex of acts involved in measuring always alter that which is being measured we accept Heisenberg's principle of inherent "*indeterminism*" which concedes that *absolute exactitude* is unattainable; it is also experimentally demonstrable that the relative degree of inexactitude of measurement to be tolerated at any one moment is progressively reducible.*

In view of the foregoing (A) *indeterminism* and (B) *reducible tolerance* and subject to further modifying inclusions, exclusions, rearrangements and refinements, we may tentatively assume the following word meanings.

Design (Considered both subjectively and objectively, metaphysically or physically).

Contiguous angle and frequency modulation of event interactions in respect to the axis of any two specific event foci.

* *Foot Note:* The smallest increment of spacing between naked human eye perceiving physical event-center points is between 1/50 and 1/100 of an inch. In the buildings business the "tolerated error" varies between 1/2 and 1/4 of an inch. In automobile manufacturing, mechanical "tolerance" varies between .01 - .0001 of an inch; in aircraft manufacture tolerance is between .001 - 00001. inch, in astronautics, tolerance between .0001 - .000001 inch, in scientific instrumentation tolerance between .0001-.0000001 inch).

Structure

Systems of dynamically stabilized self-interpositioning energetic events.

Size

Concept of an experience's relationship to other experiences defined in terms of cyclic repetition of any one experimental demonstrable self-terminating or single cycle experience (a triangle, a tetrahedron, or a sphere etc. is a triangle, a tetrahedron, or a sphere *independent* of *size*. An angle is an angle independent of the length of its ledges. All of Plato's solids may have the same length edges because their differences are entirely angular. An angle is inherently a subdivision of a single cycle. Therefore, an angle is *sub*-size). Size begins with one specific cycle's completion. Angles are *conceptual* independently of size. Size is linear. As linear size of an object is doubled surface is fourfolded and volume is eightfolded —ergo areas increase at a velocity of the second power and volumes at a velocity of the third power—ergo size variation relationships are deceptive and not superficially predictable by any one experience. As we double the length of a ship its surface is fourfolded. In as much as the power to drive a ship through the sea and air at a given speed is directly proportional to its surface, when we double its linear size we fourfold

its rate of expenditure of energy but we eightfold its payload capacity. A ship's size is popularly thought of in terms of her length. Therefore, it comes as a surprise to learn that a man with a ship twice that of another's can make eight times as much profit. That is why ship owners and sailors talk to one another in terms of tonnages which is based on volumetric displacement of water by weight.

Synergy

Behavior of whole systems unpredicted by behavior of any of its parts taken separately from the whole. A stone by itself does not predict its mass attraction for another. (Synergy is the only word in any language having that meaning. The German word *gestart* like the English word *constellation* means a complex standing together, but infers no more than the desirable of having all the regular parts i.e., not being deformed). As *synergy* is not a popular word as demonstrated by questioning over a thousand audiences of whom less than five percent had ever heard of the word, it may be concluded that the public does not think that it has need of a word for behaviors of whole systems unpredicted by behavior of any of its parts taken separately, wherefore it is clear that society is unaware of the existence of such a phenomenon. But a sampling of chemistry-honors student audiences and of biochemists shows that 100% of such students are familiar with the synergetic behaviors of nature. This means that society's preoccupations with specialization has precluded its spontaneous comprehension of the significance of its completely compounded experiences.

Universe

The aggregate of all of humanity's consciously apprehended and communicated experiences. The communication can be from self to self or from self to others. Since all experiences are inherently non-simultaneously occurring and only partially overlapping event sequences of different durations and different atomic frequency complexities, Universe is a sequentially evolving scenario and cannot be conceived in one "picture" or "sculpture" sense.

The picture of the caterpillar does not predict the butterfly into which it is progressively transformed nor does one picture of the *butterfly* demonstrate that the butterfly can *fly*. Since each of the experience complexes and each of their parts are terminally finite, the aggregate of their separate finitenesses is sumtotally finite, but being non-simultaneous and complexedly dissimilar is non-unitarily conceptual. It is a synergetic quality of universe that though finite it is inherently non-unitarily conceptual. To ask what is outside of the outside of universe is a single picture question and is inherently unanswerable. It is an intelligent question as would be also which word is the dictionary?

System

The first subdivision of universe into a conceivable entity which separates all the universe into two main parts i.e., all of the universe which is non-simultaneously outside of the system and all of the universe which is non-simultaneously inside the system; and all of the remaining universe which is conceptually in the system's set of component events of conceptually tunable interrelatability — conceptual tuning being physically within the "rainbow" range of the electro-magnetic spectrum, and imaginatively conceivable within the size-independent, angular configurations and topological characteristics of polyhedra or polyhedronal complexes. Systems having *insideness* and *outsidedness* must return upon themselves in a plurality of directions and are therefore interiorially concave and exteriorially convex. Because concaveness reflectively concentrates radiation impinging upon it and convexity diffuses radiation impinging upon it, they are fundamentally different, and therefore every system has an always and only coexisting complementarily. System unity is inherently plural. Unity is plural.

Precession

The affects of one moving system upon another moving system. Precession is describable in vectorial terms i.e., of physically realized Design - expressed differentially as relative angle, velocity and mass (size) modification's in respect to an axis.

The precessional results of all *events* are always threefold, embracing (1) *Action*, (2) *Reaction* and (3) *Resultant*. None of these interprecessional event components occur at 180° to any other components. A system must have a minimum of 4 vertexes in order to have an omni-directional *insideness* and *outsideness* and six is the minimum number of vectorial edges uniquely connecting the four vertexes of the minimum system. The six vectorial edges are comprised of two energy event's inherent three-vector componentation of *action*, *reaction*, and *resultant*.

THE WORLD GAME

R. Buckminster Fuller

Underlying Key Theme. The World Game idea forsakes the political expedient of attempting to reform man and commits man to reforming his environment. This is to be achieved in such a manner as to "up" the performance per each unit of invested world resources until so much more is accomplished with so much less that an even higher standard of living will be effected for 100% of humanity than is now realized by the 40% of humanity who may now be classified as economically and physically successful. The possibility of setting up a large-scale "gaming" format would allow for various types of participating "simulations" on "How to make the total system work more efficiently". The World Game will, then, explore for, and experiment with, grand strategies for making the world work by continually assessing the design science revolution which would provide ever more effective tools and services with ever less, real resource investment per each unit of end performance. For example, a communication satellite weighing only one-quarter of a ton is now out-performing the transoceanic communication capabilities of 175 thousand tons of copper cable. Continual search for such effort reducing, more-for-less uses of our resources would eventually lead to a time when all of humanity could be taken care of at an even higher standard of living than man has as yet conceived of or even yet experienced. "Peace" will then be not just a catch-word, but an experienced reality, which has been assimilated and chosen as the best of all possible alternatives open to human design experience.

The World Game

A Game That Has No Losers

In 1927 I gave the name *ephemeralization* to the design science strategy of "doing ever more with ever less". Because of all the foregoing realizations, I saw in 1927 that it might be possible that we could do so much more with so much less that we could not only discredit the Malthusian dictum but also, and far more importantly, that we might be able to take care of everybody aboard our planet Earth with a very much higher standard of living than anybody has ever known or dreamed of experiencing. If that could be done, the theory of John Von Neumann's war gaming, which holds that utlimately one side or the other must die, either by war or starvation, is invalid. Therefore, I saw that we had an heretofore unconsidered alternative way to play the world game in which, as with mountain climbing, the object would be to find all the moves by which the whole field of climbers would win as each helped the other so that everybody successfully reached the mountain top and all returned safely to its base. This is a mathematically permitted alternative of game playing but it has never been played in any of the war games of the great nations of the Earth. To humanity's general scientific illiteracy, it has been inconceivable that there are invisible chemical and physical principles such as that of the transistor lurking invisibly in the landscape waiting for men to discover them, and thereby also to discover that by doing more with less there could be more than enough to support all humanity at a higher standard of living than any humans have as yet known (whereby realization of lasting peace might occur around our planet for the first time). That is what science has discovered in the last few decades to be possible. But science also finds that such an accomplishment is not possible without eliminating our world-around frustrations of the essential resources integration by the competitive sovereign systems.

S.I.U. Takes the Initiative

We have organized at Southern Illinois University, and we hope it will soon be in operation, a $16 million dollar computer implemented program for playing just such a mutual success seeking game in a dramatically visible way. It will be so photogenic that it will become popularly and repeatedly broadcast on the world's TV circuits. Thus society may come to realize not only what *is* happening but also what could happen in an omni-favorable way.

The Infra World

Humanity has a very limited optical spectrum, wherefore man can see today only one-millionth of the total physical "reality", as the latter is evidenced by the full range of the electromagnetic spectrum. Man used to think of reality as everything that he could sense with his eyes, ears, nose, taste and touch. We have learned, only since about 1930—when the first technical chart of the great electromagnetic spectrum was published—that man has sensorial tunability and is sensibly aware of *only one-millionth of physical reality.* The little rainbow color band of human "seeing" is less than one millionth of the stretched out reality of the invisible colors, of all the ninety-two regenerative chemical elements of associative energy or of the various radiations of energy in its disassociative phase.

Integration of Sensory Input

In addition to the *electromagnetic frequencies spectrum* we have also a *motion spectrum.* The sense of motion is produced by an overlapping continuity of after-images of a plurality of optically tunable separate and sequentially occurring electromagnetic frequency events just as music is produced for the hearing by a metrically momentumed sequence of both separate and resonantly overlapped sound frequency notes. Motion is visual music made possible by the spontaneous retention in the brain of a series of separate still picture frames of our separate sense experiences scanned and reviewed

in the brain at a vastly accelerated sequence rate. Our brain discovers that each successive electromagnetic picture is just a little different from the ones before and our dawning awareness of that increasing difference constitutes our *motion sense.*

Indeterminate Causes and Perceived Effects
The overall range of our human, *motion spectrum* is even more limited in respect to the full range of *cosmic motions* than is our optical frequency spectrum tunability in respect to the total electromagnetic spectrum. We can't see the atoms in motion; we can't see the stars move, though their motions are thousands fold faster than our fastest rockets; we can't see the trees grow; we can't see the hands of the clock move. Most important of all we cannot see the abstract weightless thoughts in the minds of other men. When we survey the total inventory of motions and informations which we can sense we find it to be very limited. The significance of all the foregoing is appreciated when we realize that it is only such phenomena as can be seen to be moving or changing by the public that are politically recognized and heeded. That is why public opinion and vote sampling has come into ever more reliable use.

New Frontiers of Resource Explorations
As the general system of vital trends becomes visible and its components are seen to integrate *synergetically*, we also will begin to discern ways of using the world's resources to ever higher and more universal human advantage. We will soon learn popularly how to play the game to explore for ways in which we may use the world's resources so that we may be able to make our whole planet successfully enjoyable by all humanity without any human profiting at the expense of another and without interfering with one another, and how to do so in the shortest possible time.

Enough Oxygen for All
We had been playing the world game by longhand mathematics long before the computer. As we simulated our plays in the pre-computer era of the late nineteen twenties and early thirties we found out that it is possible to say scientifically that our Planet Earth can successfully support all humanity for all generations to come. Between 1900 and today we have gone from less than one percent of humanity to 40 percent of humanity enjoying a higher standard of living than any king had known before the 20th Century.

Vivid Awareness of Neighbors
During the same period, the amount of chemical materials per each world human have been continually decreasing due to the population increasing much more rapidly than geologists have been discovering physical resources to support humans aboard our planet. It follows that during that same period we didn't amplify forty-fold those enjoying a super-to-royalty standard of living by finding and exploiting more resources. We did it only by doing more with less. That is the only possible explanation. During that same period, we also approximately doubled western man's longevity and his relative health has been correspondingly improved. Even more importantly during that same period humanity eliminated many misinformations from the starting environment of its new life, while implementing the new life to apprehend information from all around our planet in split seconds by giving the new life a vivid awareness of all other humans around our space vehicle Earth never before experienced by humanity. That is why the young of our day are demonstrably skeptical of the only myopically conditioned opinion reflexes of their elders. The ever idealistic young do not know what to do about their intuition that all old customs are treacherous, other than to attack them, having no positive alternative

Military Technology's Diverging Course
So we found that man was inadvertently becoming successful. We also found that all the technology which brought this about has been an inadvertent fall-out from man's exclusively war anticipating acquisition of vastly more with less industrial production capabilities and subsequent conversion to peaceful ends of that technology first produced only for military purposes.

We had blast-furnaces for making battleships for 50 years before a piece of steel went into a skyscraper on the land. We first developed all the great electric generators for sea use. We had refrigeration at sea for 30 years before we brought it ashore. Thomas Malthus of 1800 could not anticipate that one hundred years later refrigeration could preserve foods so satisfactorily that they could reach safely and economically all the world's stomachs.

Wealth

Wealth Is Not Merely a Survival Bank Account
I find man utterly unaware of what his wealth is or what his fundamental capability is. He says time and again, "We can't afford it." For instance, we are saying now that we can't afford to do anything about pollution but after the costs of not doing something about pollution have multiplied many fold beyond what it would cost us to correct it now, we will spend many fold what it would cost us now to correct it. That is a geometrical compounding of inevitable expenditures (originally side-stepped because we believed erroneously that we "couldn't afford" their correction). For this reason I find that in satisfying humanity's vital needs, highest social priority must be assigned to the development of world-around common knowledge of what wealth

is. We have no difficulty discovering troubles but we fail to demonstrate intelligent search for the means of coping with the troubles. This is primarily due to our misconditioned reflex which says that "we can't" afford to do the intelligent things. We discover with scientific integrity that wealth is simply the measurable degree to which we have rearranged the physical constituents of the scenery so that they are able to support more lives, for more days at such-and-such standards of health and nourishment, while specifically decreasing restraints on human thought and action, while also multiplying the per capita means of communication and travel all accomplished without increased privation for any human. Wealth has nothing to do with yesterday, but only with forward days. How many forward days, for how many lives are we now technically organized to cope? The numerical answer is the present state of our true *wealth.*

Physical Wealth

I find that our wealth consists exclusively of two fundamental phenomena: the physical and the metaphysical. The physical in turn consists of two subdivisions. One is the *physical/energy associative* as *matter* and the other is *energy disassociative* as *radiation.* After science discovered the speed of light it went on to discover that when energy was lost from one system it was gained by another local system. It is never lost from the universe. Energy is inherently conserved so the *energy component of wealth cannot be depleted.*

Metaphysical Wealth

The other prime constituent of wealth, the *metaphysical*, is contributed by human intellect. Man's muscle has only a self-starter, button-pushing function. Man's mind comprehends and masters the energy of Niagara Falls. His muscle cannot compete with Niagara. Humanity's unique function is that of his mind's ability to discover generalized principles and to invent effective ways of employing those principles in rearranging the physical constituents of the "scenery" to ever greater metabolic regeneration advantage and metaphysical freedom of humanity. We discover that every time man makes an experiment, he *always learns more. He cannot learn less.* We have learned therefore that the intellectual or *metaphysical half of wealth can only increase.* The physical *cannot decrease* and the *metaphysical can only increase*, wherefore *wealth*, which results from the synergetic interaction of both the physical and metaphysical, *can only increase.* Which is to say, — net — that wealth can only increase with each reemployment, and the more intelligently and frequently it is reinvested the more rapidly it increases. This is not disclosed in any books on economics. It is not recognized by the body politic. So I say to you, man has acquired all the right technology within only sixty years to amplify from less than one percent to forty percent the proportion of all humanity who are now economically successful with the possibility of elevating all of humanity in ever greater degree within another 25 years. All of which enabling technology humanity said it couldn't possibly afford until the military said, "This is the way your enemy is going to fight the war. You either acquire an equal or better technology or die." To which the people responded, "Though we think we can't afford it and though we don't know how we can pay for it, if we have the energy resources plus the know-how and human time to produce that technology we will go ahead and produce it and find out later how to pay for it," not realizing that in investing our time and know-how in producing it we were paying all that would ever be realistically required to pay for it. The constituents "belonged" in truth to no one. That physical phenomena which had originally been commandeered by illiterate sword and gun seizure and had been deeded thenceforth under guarantee of arms as property and that the paper equity had been loaned out at *interest* and compounded arbitrarily as a "debt" imposed by law on someone did not alter the fundamentals of this situation.

Science As Technology's Dogma

Eternity of Meaning Versus Empiricism

I would point out that all of the great scientists have discovered that we have an invisible, abstract, utterly weightless a priori universe. I hear it popularly said the scientist brings order out of chaos. All of the great scientists find the reverse to be true—Scientists experiment, hypothesize and experiment again to test their hypothesis. Suddenly some of them discover a theretofore unknown generalized principle which adds to science's awareness of the eternal resources of a priori order in the universe. They are further amazed to find as time goes by how complete is the inter-relatedness of all the separately discovered principles. None ever contradicts the others. There apparently is a great integrity welding all of the a priori principles. A generalized principle of science cannot be so classified if any special case exceptions to its behavior are found. Because the generalized principles cannot be such unless they are eternally true, the discovery of them by science implies an eternity of meaning order and integrity lying behind our ignorantly and innocently accepted special case and only superficially different experiences.

Eternity of Elements

But the most advanced scientists of today, for instance the leading astrophysicists discover that

regardless of how much we separate out and subdivide our physical experiences with energy, as *matter*, that the proton and neutron, which are not the same but are interchangeable by accommodation of their respective subsidiary team mates — always and only co-exist. You can, by bombardment, separate out momentarily some of the atom's minor "nuts and bolts" particles but you cannot eliminate atoms from the universe nor dispense with their always and only co-existing but never the same protons and neutrons and their intercomplementary intertransformative energy equating, kinetic balancing.

Order Was Always There

These scientists point out therefore that there never could have been chaos. There had perforce always to have been the orderly fundamental complementarity. All the legendary ways of looking at universe as having had a beginning in disorder have for the three last years been completely upset by the astrophysical inventorying of the relative abundance of the fundamental atomic isotopes and their intertransformational accounting on a cosmic scale. We find we are now confronted with an apparently eternal a priori order. The idea of probability gradually converting a disorder to order is invalidated. There is an a priori synergetic integrity of universe which has allowed humanity to be born ignorant. That is manifest. It is not then a derogatory statement to say man is ignorant. He also is born utterly helpless. It is part of the equation of universe that "utter helplessness" be complemented by an a priori competence of universe to "care for" the helpless. Mothers do not have to invent a mammular gland and a bread to feed their babies. The mother doesn't invent the oxygen for the baby to breathe. These essentials were invented by the a priori competence of the universe. Therefore I find man ignorantly pretentious in assuming that he is responsible for either yesterday's or tomorrow's success.

Evolution – The Fulfillment Model For Human Destiny

The Enthusiasm of Evolution

Evolution is inexorably at work, and in order to get man to do what needs to be done when he is ignorant, the built-in drive of fear is provided. I am saying to you, for instance, that if we cannot persuade our government to enact laws which will develop enough of the right technology to do *this* and *that* which evolution is intent upon accomplishing, then that technology will appear in China or elsewhere and thus get into the bloodstream of evolutionary realizations. The faculties of man, his brain, his mind, his inventive capabilities are all part of these a priori principles operating in the universe. And evolution is articulating itself in a very important kind of way. To be able to really understand you have to teach and maintain this comprehensive degree of thinking. I would say that man has a function in the universe, this we discover clearly.

Fundamental Complementarity

We know scientifically that all local physical systems are continually giving off energies. We call this entropy. Due to each of the local systems unique periodicities, etc., the given off energies are diffusely and randomly released in respect to other systems. Thus the physical universe is continually expanding and increasingly disorderly. Fundamental complementarity requires that there must be some phase of universe where the universe is contracting and increasingly orderly.

From Entropy to Antientropy

We look at all the stars and find that we "see" them only because they are giving off energies in increasing disorder. We call this radiation. We find only one place in the universe where we know energies are converging, collecting and being stored and that is our own space ship Earth... our planet. In the International Geophysical Year, world-around measurements indicated that approximately 100,000 tons of star dust are accumulated daily aboard Earth from other stars. Thus energy is being collected here as matter. We also are collecting an enormous amount of radiation from the other stars, primarily from the sun but also as cosmic radiation from myriads of other stars. The energy either as or radiated increments arrives in a very random frequency pattern. We may state it to be experimentally proven that our special space vehicle Earth is at least one mobile energy collecting center in contradiction to the stars which are energy distributors. The sun's energy radiation is not being reflected off Earth as from a mirrored ball. It is refracted, or angularly deflected, by the atmosphere. Thus the sun energy as heat is impounded in the atmosphere to produce weather changes. Thus, also, are the waters refractionally heated by the sun's radiation. Thus, by a series of relay stages is energy impounded aboard our space ship Earth to regenerate life by the photo-synthesis of the vegetation which is a beautiful process whereby the random energy receipts are transformed chemically into beautiful, orderly molecules which are beautiful structures. Here you see the turn-around from disorder to order—from entropy to antientropy.

All the biologicals are converting chaos to beautiful order. All biology is antientropic.

Integrative Potential of the Human Mind

Of all the disorder to order converters, the human mind is by far the most impressive. The human's most powerful metaphysical drive is to understand, to order, to sort-out and rearrange in ever more orderly and constructive ways. You find then that

man's true function is metaphysical. Man's physical function is the same as that of all other biological life; to impound and regenerate physical life which means inherently to produce reconstructive order of every variety. The metaphysical, absolutely weightless function in universe, unique to humans, is that of continually looking for the generalized principles which are operative in all the special case experiences. Thus has humanity discovered that it could move and constructively rearrange multi-ton rocks that man's individual muscle could not move. He succeeded by his weightless mind's discovery of the generalized principle of leverage. Thus also did mind discover the principles of electron conductivity, whatever that may be, for electromagnetics, though discovered and used by man, it is as yet a fundamental enigma. These generalized principles were all found to be operating a priori to man. Man simply finds and employs. He does not put anything into the universe. We must realize that technology was not put into the universe by man. The universe is the comprehensive system of technology. Humanity is discovering and beginning to employ it. The human mind invented the computer as an extension of humanity's integral computer, information storing and retrieving system, the brain. The computer and the automated technologies it commands are about to take over all specialized tasks from humans, thus saving humanity from becoming extinct, for biological science and anthropology have learned incontrovertibly that extinction is always the consequence of overspecialization. Our World Game will be in effect a World Brain. It will free world mind from occupations of brain slavery. Human minds employ the World Brain to solve the problems of all humanity thus escaping the previous recourse only to the individual opinions of too myopically preoccupied ill-informed men. The human mind, as Einstein's metaphysical, weightless intellect, discovered and noted in written symbols the equation of the physical portion of universe, — that physical portion of universe which consists entirely of energy; — energy in two diametrically opposed, intercomplementing and intertransformable behavioral conditions. The one phase is energy associated as matter symbolized as M—and the other phase is energy dis-associative as radiation—symbolized as C—and the rate of the associative phase is in terms of second power of the Michelson, Morely measured speed of light which is scientifically notationed as C^2 which equals the rate of growth of a radiation "bubble's" spherical surface growth. $E = Mc^2$. In Einstein's perceptivity and initiative we have the metaphysical mind taking the measure of the physical. This relationship is irreversible. We have no suggestion that energy will ever conceive of and write the equation of intellect. The Nobel Prize in physics was given in 1956 for discovery of this irreversibility principle of the complementarily but non-mirror-imaged balancing of positive-negative events. Evolution thus became recognized as irreversible. We find here the clue to the coherence and integrity of the universe which can never lose its energy quanta. Universe is the minimum perpetual energy conserving complex of technological intratransformings. Metaphysical intellect and its ability to comprehend and master the intertransformative technology of universe and to reconvene and reconcentrate the physical disorder into conserved order is possibly the highest, separately discernible function in universe. Mortal, physical human bodies have the function of providing a regenerative succession of fresh physical vehicles for the mortal—because entropic-articulation of metaphysical immortality. The long-held popular conception of the existence of two kinds of physical substances—one called *animate* and the other *inanimate*—the first rather mystically maintained and the other subject to stark chemical analysis, was altogether invalidated as science closed in on the assumed threshold between the animate and inanimate at the virus level only to find that there is no threshold and that all the phenomena followed strictly inanimate physical laws. So we find the real separation of the life and the inanimate when humans die and no weight is lost. Life is metaphysical and antientropic. The inanimate is physical and entropic.

Man And His Choice Of Destiny— The Self Fulfilling Prophecy

Life is Metaphysical and Antientropic

Humans have high destiny, possibly the most important in universe. And if the human team aboard space vehicle Earth does not make good at this particular occupation of this particular planet there are probably billions times billions of other planets with human crews aboard who will reboard Earth at some time to operate it properly. We are then a necessary function of universe. If you are going to be wise systems planners, you are going to have to look at things in these big ways.

The Myopic View

I would like you to think of that view of the Earth as seen from the moon in which we saw it enveloped in great atmospherical articulated cloud swirls.

Looking at the sky locally, man is not able to see enough of our sky to see the geometrically spiralling orderly patterning of those ten thousand mile diameter synergetically ordered swirls. Below those clouds man can see only a circular outward from Earth's surface. We must remember that our atmosphere is going around the earth continually and there is no such thing as something you often talk about, as "our air space". The air moves on. The revolving orbiting Earth permits no special view of the stars that could be called "our space". The ecological involvements of

humanity engage the total earth. We cannot solve the world problems locally.

Regenerative Spontaneity

I would like to point to the external costs of the ecological involvements. On such a fundamental world basis, we as a nation are going to have to find ways of organizing ourselves cooperatively, sanely, scientifically, harmonically and in regenerative spontaneity with the rest of humanity around Earth. I think that possibly one of our greatest problems is the educational problem of getting man around the Earth, to realize in time what his problems are and what the most effective priorities may be for saving them all, as discovered by the computer and not as dictated by anyone's opinion or by the passionately evoked opinions of any political bias.

Tolerable Limits for Life

I may have sounded optimistic; I did not mean to be so. I did not mean to be one way or the other. I am interested in whatever the complementarity and irreversibility balance may be. I am interested to learn if evolution requires that we be destroyed. If we were living on the sun, physical we, as incineratable organisms, would be destroyed. But I observe that we are functioning in a region of the universe where everything has been made tolerable for our specific technological model of regenerative life to go on.

I am interested therefore in humanity's unique and essential function in universe. I do say that we have to perform this function of comprehending and employing order to support all the ecological intercomplementation technology of life. We must do so from now on in a total complementation manner.

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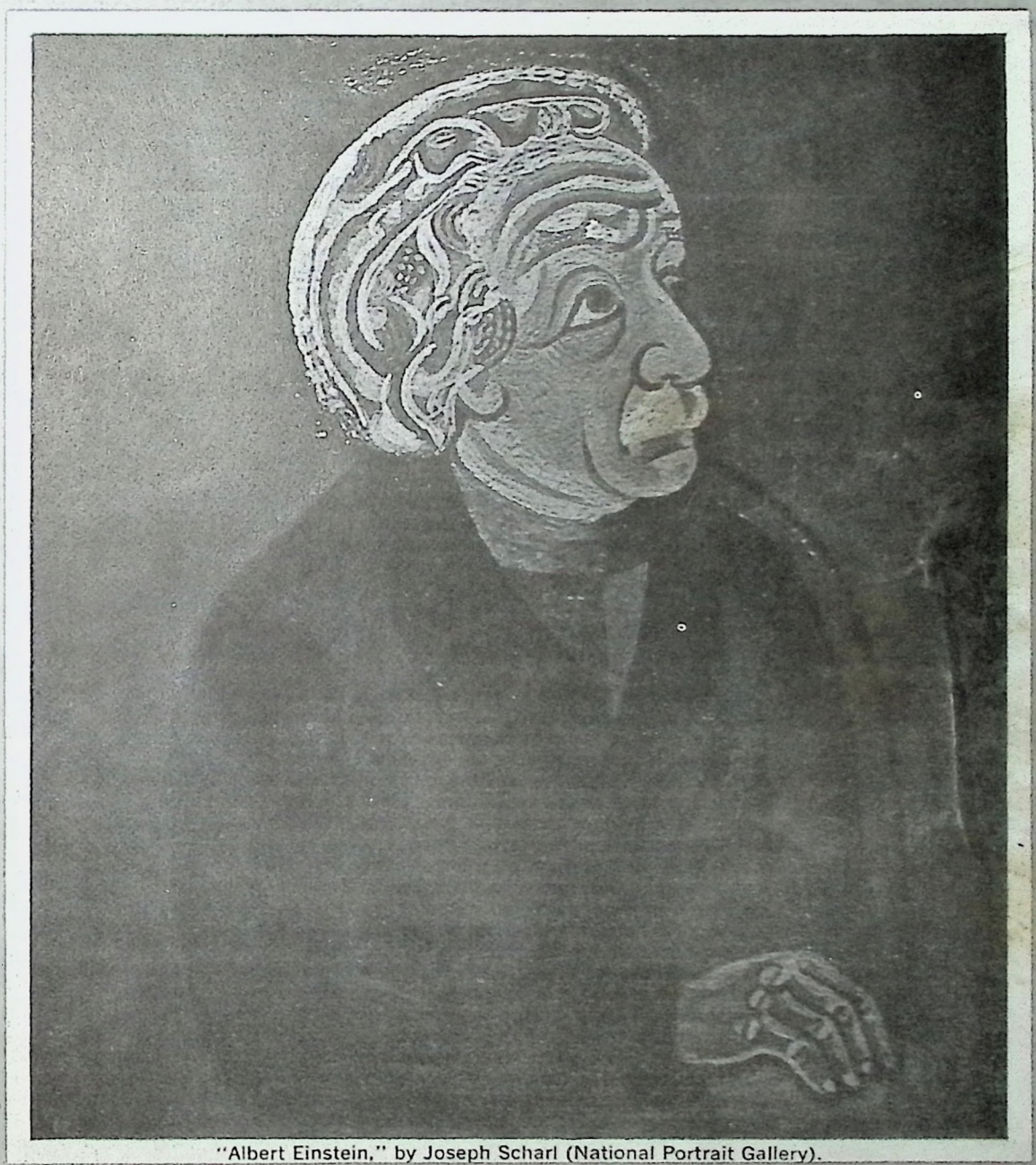
MUST WE REWRITE THE CONSTITUTION TO CONTROL TECHNOLOGY?

By Wilbur H. Ferry



"Albert Einstein," by Joseph Scharl (National Portrait Gallery).

GODDESSES OF THE TWENTY-FIRST CENTURY

By Buckminster Fuller

Saturday Review

Cover photograph by Peter Fink

March 2, 1968

SR: Ideas

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Saturday Review
March 2, 1968

Buckminster Fuller

Goddesses of the Twenty-First Century

Early civilizations worshiped woman, but the male became predominant. Evolution now seems to be restoring the female to a central role beyond any previous one.

THE first census of population in the United States was taken in 1790. In 1810 the U.S. Treasury conducted the first economic census of the young democracy. There were at that time 1,000,000 families. There were also 1,000,000 human slaves. This did not mean that each family had a human slave; far from it. The slaves were owned by relatively few. The Treasury appraised the monetary value of the average American homestead—lands, buildings, furnishings, and tools—to be worth $350. The Treasury appraised the slave as worth $400. It was estimated that the wilderness hinterlands of America were worth $1,500 per family.

Let us assume that the united American citizens of 1810—practicing supreme wisdom—had mustered their most reliably esteemed and farsighted leaders and had asked them to undertake a 150-year grand economic and technical plan for most effectively and swiftly developing America's and the world's life support and advantaging potentials—to be fully realized by 1960. At that time, it must be remembered, the telegraph had not been invented. There were no electromagnetics nor mass-production steel. Railroads were as yet undreamed of—let alone wireless, X-ray, electric light, power by wire, and electric motors. There was no conception of the periodic table of the atoms or of the electron.

Under those circumstances of an assumed capital wealth of the United American States—both public and private—amounting to only $3 billion, it is preposterous to think of humanity's most brilliant and powerful leaders electing to invest their "all" of $3 *billion* in a "thousand times too expensive" $3 *trillion* undertaking. However, such an expenditure for these very purposes was circumstantially conceded during the ensuing century and a half, but only under the war-enforced threat of disintegration of the meager rights won thus far by common man from tyrannical powers of an often ignorant and cruel few.

In 1810, it was also unthinkable by even the most brilliant leaders that 160 years hence, in 1970, the gross national product of the United States would reach $1 *trillion* per year. (This is to be compared with the meager $40 billion of the world's monetary gold supply.) Assuming 10 per cent interest, this 1970 U.S. trillion-dollar product would mean that a capital base of $10 trillion was operative within the United States alone—where the 1810 national leaders had accredited only $3 billion of capital assets. That is, the wisest in 1810 recognized only 1 300 of 1 per cent of the immediate value of the United States's share of humanity's potentials. Of course, those wisest men of the times would have seen little they could "afford" to do.

Our most reliable, visionary and well informed great-grandfathers of 1810 also could not have foreseen that, in that meager century and a half of the billionsfold greater reaches of known universal time, the human life span would be trebled; yearly real income of the individual would be increased tenfold; the majority of diseases would be banished; human freedom of realized travel increased a hundredfold; humans would be able to whisper effortlessly in one another's ear from anywhere around the world at a speed of 700 million miles an hour—their audibility clearly reaching to the planet Venus; and human vision on Earth would be increased enough to see local pebbles and grains of sand on the moon.

NOW, in 1968, 99.9 per cent of the accelerating accelerations of the physical environment changes affecting all humanity's evolution are transpiring in the realm of the electromagnetic spectrum that is undetectable directly by the human senses. Because the prime evolutionary transformations are invisible, it is approximately impossible for world society to comprehend that the changes in the next thirty-three years—ushering in the twenty-first century—will be far greater than in our just-completed century and a half since the first U.S. economic census. We are engulfed in an invisible tidal wave that, as it draws away, will leave all humanity, if it survives, cast up upon the Island of Success, uncomprehending of how it has all happened.

But we can scientifically assume that

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by the twenty-first century either humanity will not be living aboard spaceship Earth, or, if approximately our present numbers as yet remain aboard, that they then will have recognized and organized themselves to realize effectively the fact that humanity always can afford to do anything it needs to do even when it cannot see immediately how that is to be accomplished. A baby lying in the womb could not see how it could afford to be born.

As a consequence, Earth-based humanity will be physically and economically successful and individually free in the most important sense. While all enjoy total Earth, no human will be interfering with the other and none will be profiting at the expense of the other. Humans will be free in the sense that 99.9 per cent of their waking hours will be freely investable at their own discretion. They will be free in the sense that they will not struggle for survival on a "you" or "me" basis and will therefore be able to trust one another and be free to cooperate in spontaneous and logical ways. Clearly, man will have backed into his future as evolution, operating as inexorably as fertilized ovaries gestate in the womb, will have brought about his success in ways as unforeseeable to us today as they would have been to those wisest great-grandfathers of 1810.

ALL of this does not add up to saying that man is stupidly ignorant and does not deserve to prosper. It adds up to the realization that in the design of universal evolution man was given an enormous safety factor as an economic cushion—within which to learn by trial and error to dare to use his most sensitively intuited intellectual conceptioning and his greatest vision in joining forces with all of humanity to advance into the future in full accreditation of the human intellect's most powerfully loving conceptions of the potential functioning of man in universe.

It is one of those strange facts of experience that when we try to think into the future, our thoughts jump backward. It may well be that nature has some fundamental law by which opening up what we call the future also automatically opens up the past in equal degree. Time is not linear, but probably consists of omnidirectional wave propagations.

There is the phenomenon known as the Doppler effect, of which humans took much note in the early days of the steam locomotive. The high tone of the locomotive's whistle as it approached changed to an increasingly low pitch as the locomotive went by. This is because the sound waves of the air coming toward us from the approaching locomotive at about 700 miles per hour are crowded together by the locomotive's approaching speed of 60 miles per hour. Similarly, the waves are thinned by the locomotive's speeding away. The Doppler effect may be operating in our history so that the relative frequency and wavelengths of approaching events are compacted, and receding ones thinned. It could be that by traveling mentally backward in history as far as we have, any information about humans could—like drawing a bowstring—impel our thoughts effectively into the future.

During my lifetime I have witnessed the beginnings of the automobile, the radio, the airplane, and all the myriad of fantastic technologies since then developed; the extent of our knowledge of man's presence on earth has been increased from 50,000 years to a 2,000,000-year range—a fortyfold increase; this range increase of history has been complemented by a future's-opening 40,000-fold increase of new chemical substances compounded and employed by man. I confidently predict that with the further expansion of man's physical-ranging capabilities and forward life and wealth extension, we will open up ever greater knowledge of man in the past.

I am confident, for instance, that twenty-first-century woman will be able to enjoy traveling not only to many places around the world but to many past times, living for hours, days, weeks, months, or years in New York City's Gay Nineties, in Shakespeare's England, or in ancient Babylon. There will be such true reconstructions of original buildings and artifacts in working condition in those places that many humans wearing the clothes and emulating the speech and social behavior disclosed by the very much better history of those times will be found sojourning in those historical spots. They may also be exploring cities at the bottom of the oceans of spaceship Earth as well as cooperating with other intellects of universe in a mutual cosmic colonization.

IT, therefore, is not surprising that my endeavor to think about woman in the twenty-first century brings an echo in my thoughts of a book called *Woman in the 19th Century*, written by my great-aunt, Margaret Fuller, in 1830—twenty years after the first economic census and thirty years before the American Civil War. Woman's political and cultural position was very restricted, and Margaret's life as a writer, teacher, and speaker was fraught with social antipathy to woman's entry into public life. At the time of her writing, Margaret had already founded the *Dial* magazine with Emerson. It was she who persuaded him that his thoughts and writing should be published. She also was the first to publish Thoreau in the *Dial*. She most recently had become Horace Greeley's first literary critic on the New York *Tribune*. One hundred years later her successor to that task, the late Heywood Broun, said that Margaret was the first and last literary critic to appear in a front-page box of a U.S. daily newspaper.

She was a vigorous critic of her times. She felt that literature in America was so powerfully influenced by European writing that it could not as yet claim a fresh viewpoint that warranted its being called American literature. As the semantic concept, "New England"—designating a geographical entity—disregarded its being on a new continent, the writing also was simply "New Europe." Trying to foresee a time when a uniquely American literature might emerge, Margaret wrote in one chapter that not until a century hence, when America would be wired together by the telegraph and not until industrialization had very greatly advanced, would there come a time when an American literature of that new initiative might appear.

In 1830 she foresaw that this might occur around 1930. As she wrote, the telegraph had just been invented. Its wires were not as yet strung about the countryside. There were only two small experimental railroads: one between Albany and Schenectady, one between Washington and Baltimore. The quality of her prophecies was great. She foresaw woman free as she is today. Contrary to C. P. Snow's assumption that all the writers of her time felt an antipathy to the dawning industrialization, she hailed and welcomed it. Paradoxically, Snow cited Emerson and Thoreau—both of whom wrote of their enthusiasm for Margaret's views.

I am confident that the best predictions regarding woman in the twenty-first century will be arrived at through reviewing the largest possible sweep of woman in all history. Fundamental understanding of woman's uniqueness over all time will certainly give great insight into the realization of those characteris-

tics under twenty-first-century conditions — which are not too difficult to foresee, simply because by then, in consequence of technologies' doing more with less, all economic privation of humanity will have been overcome.

Only in the mid-twentieth century did it become scientifically clear that unity is plural—and, at minimum, two; that all experimentally detectable phenomena have their unique opposites, and that the complementary opposite behaviors are never mirror images of one another. Science is remiss and unnecessarily prejudicial in calling one of a pair of complementary behaviors "negative." There are always much better descriptive terms. In structural systems' phenomena we have "compression" and "tension." As we tense a rope it tautens—that is, its girth contracts. This means that the rope is also compressing in a plane at 90 degrees to its tensed axis. But tension and compression always and only coexist, as do all the fundamental complementaries such as concave and convex, or associative and disassociative, proton and neutron, male and female.

As an example of the non-mirror-image behaviors of complementary phenomena, we find that the structural capabilities of columns loaded in compression reach an early limit of what is known as their slenderness ratio, i.e., the relationship between the column's girth diameter and its length (usually vertical). When the columns get taller but no fatter, they bend, buckle, and fail, eventually breaking into two separate shorter columns. In contrast to the generalized compressional behaviors of structures, their tensional ropes, wires, cables, and rods have no fundamental slenderness limit ratio of length in respect to girth diameter. As we get progressively stronger steel alloys, the central spans of wire-cabled suspension bridges are increased. The increased cable strength may be realized as either or both increased length and decreased diameter.

The central span of the Brooklyn Bridge is 1,400 feet; that of the George Washington Bridge is 3,400 feet; the Golden Gate's is 4,200 feet. Today alloys are so improved that a suspension bridge with central clear span of several miles could be realized without increasing the cable's girth over that of the Golden Gate. Due to its having a no-limit tensional-slenderness ratio, this trend approaches very great length with zero girth diameter. This may be thought of as absurd until we realize that the moon and Earth are tensionally cohered by gravity. The moon cannot get away from Earth, yet we can fly an airplane between the centers of gravity of the Earth and moon without severing their coherence. Obviously, the celestial bodies enjoy the zero-diameter-to-great-length tensional relationships.

In further demonstration of the non-mirrored complementary phenomena, we note that compression columns become more and more effective as we make them fatter and fatter going from long, thin cylinders to cigar-shaped systems. By increasing the compression member's relative girth and shortening its height still further, we finally develop a compression structure that is spherical. The sphere is compressionally ideal. As a slender column, it had to be loaded carefully on its neutral vertical axis to avoid eccentric bending. When it is a sphere, however, the compression loads applied from any direction are automatically opposed by one of an infinity of neutral axes. The sphere provides nature's optimum limit in structural opposition to compressive forces in universe—ergo, the stars and planets and atoms are all spherical islands of compression.

We find, then, that nature employs discontinuous compressions and continuous tension. For this reason, compressions are plural and tension is singular. That is, Earth and the moon do not roll around one another like ball bearings. The universe is cohered only by the continuous tensional integrity which is sometimes magnetical, sometimes gravitational, and sometimes produced by forces as yet unexplained by experimental science.

And what has all this cosmology to do with woman in the twenty-first century? Answer: Just what it has had to do with women in all centuries—which is everything—as is manifest, for instance, in woman's tidal flows geared to the moon phases.

Women are tensional and continuous. Each new female as well as male life comes from the womb of the woman. We have, then, the new female life as a series of expanding waves, the new ever emerging from within the older wave. Women are thus continuous, like the single-cell creature, Hydra—the newer part breaking off from the older with its early life overlapping its mother's later life—ergo, never dying. Males are discontinuous. The new male life is noncontiguous to the previous male life. Men are, then, islanded, individual discontinuities.

Woman's nature is attractive. She employs tension, playing her male fish, as does a trout angler, on a long, invisibly thin flexible line whose slackening allows the male to play himself out while being gradually reeled in. The male is compressional—a spear-plunging hunter, impelling his missiles as intermittent punches, arrows, or bullets.

Human packs behaved in earliest times as do packs of wolves and herds of deer even today. The males do the widely ranging hunting and fighting. The females, with the young and the decrepit, wander about in a much smaller circle and central area. In a similar manner, throughout our long human history the male has been the widely ranging hunter, fighter, fisherman, bringing back his catch to the woman, where, surrounded by the young and the old, she hovered near the central hearth. Here woman kept the fire going, cooked the meat, and organized the prolongation of the standby usefulness and viability of that which the hunting male brought home.

Women, aided by the many hands of the children and old people, developed many crafts. They organized the home crew to pound the corn, thresh grain, comb wool, and dry the skins, etc. They invented pottery and weaving, and discovered how to keep foods by cold storage or by cauterizing them with fire. Women, in fact, invented industrialization by differentiating out and coordinating the multifold regenerative functions and antiseptic tasks and anticipatorily developing the containing baskets, pots, and tools with which to work these items of environment-controlling. Woman, then, is the consolidator of gains.

The male hunter was also the fighter who protected and guarded the area. As woman's success in domestication became ever greater, the need for man as the hunter became less, but the need for him as a fighter increased. The successful domestication of land and animals and the production of tools by the woman made the hearth-centered areas of the successful ones tempting to invasion by the less fortunate. Up to yesterday, man has been in high demand as defender of the less than 1 per cent of "haves" against the 99 per cent of humanity's "have-nots."

Men are the natural explorers, hunters, and have been secondarily conditioned to be fighters. Men are disassociative. Women are associative, but both participate in each other's proclivities to some degree, for their "drive" genes

have been mixed. Men made their own hunting spears and fighting weapons that felt best to their own muscles and controls. As they discovered, first, the bronzes and, later, other plentiful metals, the men used these metals in making their hunting and fighting tools.

AS the industry of woman around the earth became ever more powerful and man's hunting grew progressively obsolete, his physical fighting ability was offset by the chemical energy of gunpowder and other mechanization. Thus men were progressively freed from their huntsman's cunning and brute muscle tasks to hang around woman's hearthstone industries and, bemusing themselves, they thought cunningly of a whole new hunting, fighting enterprise with which to compete with other home-commanding men. This enterprise idea came as a natural consequence of the recalled interaction of a complex of man's experiences. He saw that he could add his war-won prisoners to the labor force of his woman's manufacturing industries, and that by substituting his hard metals, the tools would be more incisive and powerful and would not wear out as frequently and thus could produce much more than the home group could consume.

This prospect gave man excess product with which to barter for the resources brought around from time to time by caravaning brigands politely known as traders. As a consequence, man began to take over woman's industry for his male instinct's competitive purposes. So the industrial production which they had invented and developed over the ages went out of the control of women. Production became a competitive weapon for augmenting widely ranging explorations and plunder. With this, the economic downgrading of women followed into the sad state in which Margaret Fuller found them in the nineteenth century. Woman had fallen a long way from her throne of earlier times, when the most virtuous and attractive Olympians were the goddesses. (Indeed, the earliest religions worshipped the fertility goddess.)

The twentieth century, however, has seen woman rising once more and inadvertently taking over the fundamental ownership control of industry because she has unintentionally outlived her husband, who, bereft of fundamental frontiering tasks, vented his exploratory and fighting instincts on gambling, hard riding, boastful drinking, etc. For the last half century, the industrialized world's women have controlled the ownership shares of the great incorporated industries. Women have not, up to now, exercised much of their prime ownership prerogative over American and world industry, but have allowed their lawyers and other trustees to carry on, assuming that coping with the wiles of commerce is as yet exclusively within man's fighting province. Yet woman is now entering the ownership management of commerce and industry to ever more important degree. By the twenty-first century, she will have taken over full management of spaceship Earth.

The number of children that woman has relates to the success of the industry which she invented. The early seventeenth-century colonists of North America—according to the records in the family Bibles of those days—averaged thirteen children per family. As industrialization, waterworks, group sanitation, and, finally, electrical power and mass-production steel arrived, the life expectancy began to rise.

LIFE expectancy has almost trebled within the last century, due physically to science and its improved technology. As technological capabilities have improved and life expectancy has increased, down have gone the numbers of babies per family—demonstrating a constant balancing of evolutionary forces. After the U.S. Civil War and World Wars I and II—when large numbers of young and healthy were killed—the baby-making increased each time for approximately five years, until the score was rectified. All this happened without the conscious cooperation or even the knowledge of the specific humans concerned.

In all the industrial countries of the world today—including Russia and Japan—the birth rate is decreasing and life expectancy lengthening. Japan is the first nation to gain population stability. In the industrialized countries, the number of new babies each year has continually decreased, despite much larger opportunity of the young people to produce babies. Medical science has learned now to exchange vital organs and has also learned how, in many instances, to make mechanical components to keep life going. There is high probability that by the twenty-first century the world birth rate will have attained approximate balance with the number dying, so that the population will be relatively stable but growing older on the average all the time, with the familiar aging of increasing years offset by the progressive elimination of effects which are primarily the consequence of parasites, diseases, and economic worries which will soon disappear. Birth-giving by women will be less frequently employed by evolution than it has been in all the centuries before.

There being enough sustenance and primary accommodation, both mobile and fixed, for all, yesterday's competition will be obsolete, and the competitive fighting urges will be important only in the world of lovemaking and of hunting in the abstract realms of poetry, art, and science. Twenty-first-century man will be preoccupied almost entirely in scientific and poetical research. The men's scientific findings will be converted to industrial production and world service accounts by women. Women will be the undisputed managers of our 60,000-miles-an-hour speeding spaceship Earth in our ever wider exploration of the universe within and beyond the solar system.

Spaceship Earth will be not only the home base of the omniphysical exploration but also of the far more exciting and inspiring exploration of the metaphysical universe. It is probable that the twenty-first-century metaphysical explorations will have vastly modified not only the whole phenomenon of thinking, but the concepts of universe itself. We know that National Man is now potentially obsolete, but still active. By the twenty-first century, National Man will have been forgotten. Even the World Man stage will be as passé at the dawn of the twenty-first century as is ancient Greece's City-State Man in the twentieth century. Even Solar-System Man will have become boringly familiar as humanity will by then be penetrating greater ranges of the cosmos.

Twenty-first century woman will retain her tensional-integrity continuity and will yet cohere the universe. She will be extraordinarily attractive, but her metaphysical attraction will transcend her physical procreative attributes—though these will not have lessened. No longer will the medium be the message. What will count most is what she thinks about metaphysical, weightless you—man—and not what she feels about you physically. In this way she can and will be able to love you forever and you will be able to and will love her forever. Humanity will have verified immortality.

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March 23, 1968

Letters to the Editor

Goddesses of the Millennium

THANK YOU for Buckminster Fuller's article, "Goddesses of the Twenty-First Century" [*SR*, March 2]. His brilliant, heterogeneous insights constitute, in my opinion, a kind of "prolegomena to any future science."

Mr. Fuller unites in one personality the poles of knowledge and feeling—a feat which carping critics proclaim is impossible in our age of specialization. His prose is as challenging as his ideas but always repays the effort of reading. Time and again he has shocked, altered, and extended my view of the world.

PAUL R. BANNES,
Instructor, Southern
Illinois University,
Carbondale, Ill.

BUCKMINSTER FULLER'S observations on the millennium to come are as stimulating as the predictions of many who take a dim view of the future.

None can deny that the achievements of science and discovery will keep pace with the steep rise in population figures. The question is how the new technology will be implemented and whether it will result in peace and plenty for all.

Mr. Fuller's introduction of the Doppler effect as a function of time is ingenious. To be sure, what is past is prologue. But this also implies that human response to given stimuli remains constant—the same yesterday as today and tomorrow. Increased knowledge of our proximate environment and of the universe at large will throw light on the recesses of prehistory and invigorate our conjectures about the future. But to set a precise timetable, as Fuller does, for the flowering of a new golden age on this confused planet is bold, to say the least.

PETER G. NICKLES,
Arlington, Va.

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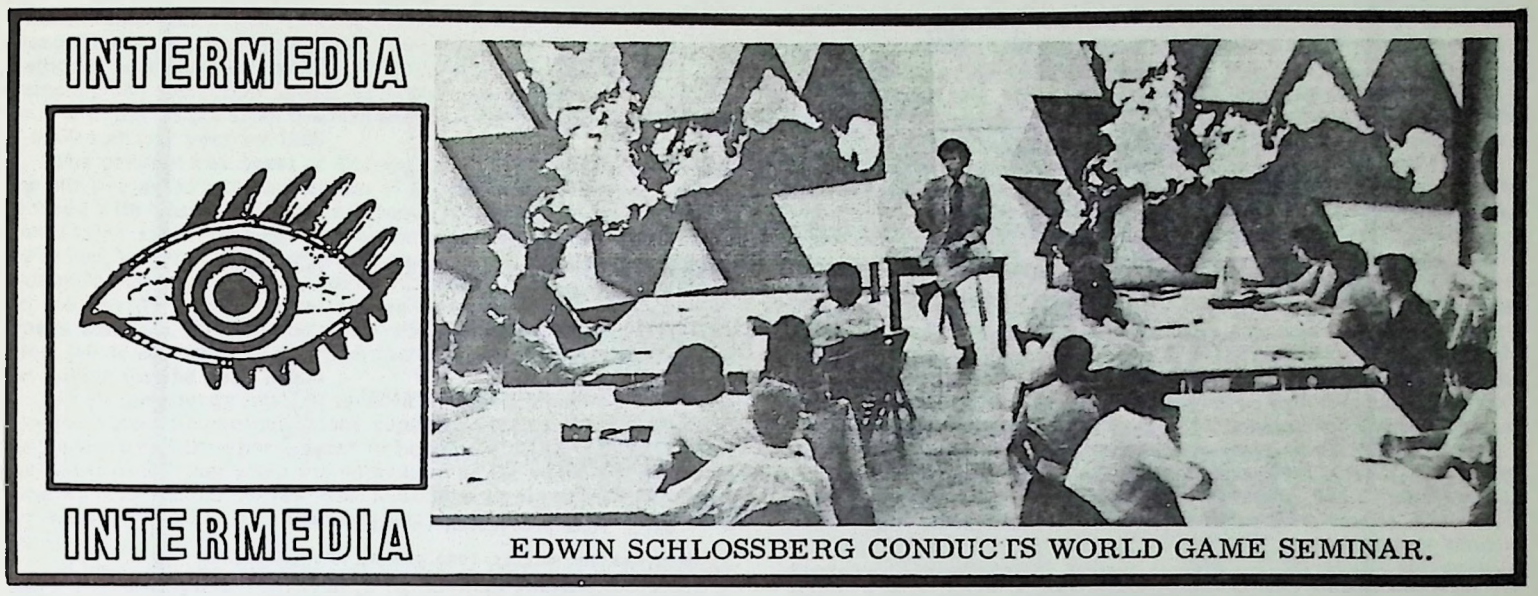


EDWIN SCHLOSSBERG CONDUCTS WORLD GAME SEMINAR.

TECHNOANARCHY

Part Five

World game report

GENE YOUNGBLOOD

Last week I introduced the concept of Buckminster Fuller's World Game, mankind's first practical alternative to politics. I described the physical hardware and the metaphysical software which constitute World Game Headquarters at the World Resources Inventory, Southern Illinois University. I gave a brief description of how the system works, and explained that it is now possible for anyone anywhere to take positive constructive action in shaping the destiny of our society completely outside the realm of politics as we know it.

Following is a report on the first World Game Seminar as conducted by Fuller and Edwin Schlossberg at the New York Studio School from June 12 to July 31 of this year. The seminar was offered as a prototype of the World Game and should not be considered a formal "playing," since the necessary computer systems were not yet available. However, this report should demonstrate the vast scope and authority of the World Game even when practiced by amateurs without the optimum technological facilities.

Schlossberg, 24, is working on a Ph.D. in physics and literature at Columbia University, considering both of them as languages. He teaches a combined course in physics and literature. He is a generalist, a comprehensive thinker, a poet, a revolutionary, a technoanarchist. He publishes GOOD NEWS, a periodical of the whole earth design systems revolution. The remainder of this article is in his words, taken from the World Game Report:

****

We worked with the students in mind. We worked to develop a research and design team to effectively deal with the data and concepts necessary to play World Game. The first four weeks of the seminar were devoted to input. Mr. Fuller thought aloud about his ideas, concepts, inventions, and discoveries. The students did individual research into trends, energy sources, and many other information areas. They were constructing a base on which to develop ideas about the whole earth. We saw films, read extensively, and traveled through the minds of the others in the room. We watched as man successfully stood on another body in space and could see the earth as a spaceship. The students were working to make visible the coordination of that spaceship in order to accelerate the trend toward physical success for all humanity.

Each day the growth of the students and the growth of World Game was extraordinary. Without fear, without competition, the students worked together to realize World Game as fully as they could. The last three weeks were intense with research and organization on how to display the findings that were being made. The energy and information grew visibly before us. We were working at the frontier and each student was working at his frontier. It is dramatic to see human beings so concerned with the operation and well-being of the earth. Mr. Fuller said at the start of the project that it was the most important work to be done.

I. PRE-SCENARIO FACTS.

Our pre-scenario facts consist of the conceptual tools which we found ourselves using most often in our dealings with the whole earth. They are by no means even an attempt at being complete, but are merely a general frame of reference for us, as individual participants, to fit our respective specializations into. To a large extent the specifics of World Game left with its participants; what is here is the general base we started with and evolved through as our individual understanding and refinement grew.

Finding the needs of one man led us to finding the needs for mankind. As we began to deal with man on the collective level we realized the need for establishing a frame of reference, or conceptual tool, to deal with collective mankind's needs. The "bare maximum" was what evolved. Rather than take what was thought to be the bare minimum for mere subsistence levels, we elected to establish levels which would allow man to realize, not his minimum potential, but his maximum potential, anything less than this being, by our definition, sub-human. So, in looking at calorie levels, we found the highest calorie needs to be that of pregnant women who need 3300 cal/day, and that of working men who need 3500 cal/day. Thus if we could insure that caloric level for the world, no one would be deprived. We did the same for protein levels. Between 30 and 45g of total protein per day is the minimum level of protein that must be replaced by the body. We therefore took 90g of protein/day as the bare maximum which should be available to everyone. We then asked: How many acres per capita are necessary to produce the bare maximum food requirements?

In order to supply mankind with his internal needs we found it necessary to evolve a bare maximum parameter for external metabolics which would guarantee the maintenance of man's internal metabolics. This bare maximum is 1242 energy slaves per capita by the year 2000 (Note: one "energy slave" is defined as a machine or system equivalent to 37.5 million foot-pounds of energy). Broken down, that is 15,000 kwh and eight metric tons of coal-equivalents per capita per year. This non-linear yardstick for establishing external relative levels of the development of man's potential to be "human" was arrived at by taking the projected U.S. needs for the year 2000 (present need is 7000 kwh), because it was the maximum. Using these parameters we found that mankind will need a total 100 trillion kwh, 8.5×10^{15} calories, and 21.9×10^{7} tons of protein in the year 2000. (We used the U.N. figures on projected populations for these calculations.)

One man needs per day today:

Internal Metabolics

1.4 lbs. pure air
5.0 lbs. pure water
3500 Calories
90 grams of protein
12 milligrams iron
0.8 grams calcium
0.86 grams phosphorus
vitamins and minerals
5-9 hours sleep
63-77 degrees Fahrenheit
medical attention

Efficiencies of Power Sources:

fossil fuel (coal and oil)	40%
nuclear power plants	40%
magnetohydrodynamics	55%
fuel cells	40 to 60%
thermoelectric	40%
thermionic	10%
heat engine	32%
solar furnace	70%
silicon battery	15%
fusion	10%
hydroelectric	80%

it takes 371 kwh to produce 1 automobile

(What is the net physical wealth of world man? How are we presently using our resources?)

daily newspapers ('62):		
	Asia	1736
	Oceania	114
	Europe	2403
	USSR	457
	Africa	188
	N Amer	2161
	L Amer	765

World ('65)		
book production (titles)		450,000
periodicals		200,000
journals, tech. reports		200,000

radios per 1000 inhabitants ('60):

Africa	28
N Amer	720
Asia	22
Europe	220
Oceania	198
USSR	205
world avg	130

Calories used in different activities (per hour)

lying in bed	77
sleeping	65
sitting at rest	100
walking slowly	200
standing	105
working (painting, carpenting)	240
running	570
swimming	500
walking upstairs	1100

world food production in '67:

570.82 million metric tons animal products
1,457.65 million metric tons vegetable products

trends towards:
use of 92 basic elements
transportation of man around earth
abstraction
specialization
comprehensiveness
doing more with less
self-fulfillment
increased life expectancy
higher education
automation
non-ownership (leasing)
multiple citizenship
increase of energy slaves/cap
increased leisure
increased weather prediction
omni-directional (away from linear)
miniaturization
autonomy

We compared bare maximum requirements with present per capita consumption. We sought to establish a bare maximum communications system for the world. We learned what percentage of world people can presently be guaranteed the bare maximum. We sought to find the bare maximum for world transportation. We asked how much bulk food is produced in calories? How much copper, aluminum and steel is involved in food production? (At present, it takes 42 kwh to produce one metric ton of food.) We sought to find the average per capita protein consumption for the world (68 grams, of which 20 are animal protein).

In order to correlate the vast amounts of data we were accumulating about the world, we devised a chart with which we could clearly display visually our basic working information. This chart was a triangular grid on which one of the three axes were the 22 major geographical areas of the world and their individual countries. The second axis consisted of, in five-year increments from 1965 to 2000, figures on population, population density, calorie and protein intake, total kwh, metric tons of coal-equivalents and energy slaves. The last axis could indicate up to 20 possible world trends for each area and country. We used thirteen: fossil fuel potential, life expectancy, mortality rate, arable land, housing, amounts of copper, aluminum and steel, food literacy, reinvestable time and hydropower.

The chart was four feet high and stretched 60 feet around the game room. We also employed two 10-by-15 foot Dymaxion maps with five clear acetate overlays each to visually present our data on a geographical whole earth. Information about the world's metals sources, world man, the power network, alternate power sources, present population and Year 2000 population projection, food production and transport, was presented on seven of the overlays while three remained free for use during game playing.

II. SCENARIO.

Once we knew what mankind had and what he needed to have, we began to experiment with ways he could go about getting his needs. These ways we called "scenarios." (What are the ways in which man may be enabled to participate more effectively in his relation with the universe?). Throughout our work we found ourselves returning to one common denominator: Can you industrialize an area without electrical power? How can man take care of all of his essential physical needs so as to allow himself to develop his unique metaphysical abilities? Whether we had researched food, communications, travel, housing, or economics, we always returned to electrical energy once we began to formulate any hypothesis about satisfying man's needs. In order to enable people to be fed properly we found that they would first have to have a sufficiently high input of electrical energy to process, transport, and store food and dispose of wastes. We found that, when dealing with collective mankind, it was imperative that we attend to man's external metabolics first, and these would then take care of individual man's internal metabolics. Thus the "Energy Scenario" became our first move in the World Game.

After researching and then plotting the world's electrical network (generating stations and transmission lines) we devised a way of developing and improving its overall efficiency as the first step towards the bare maximum for all mankind. (How long would it take to get a minimum of kwh distributed throughout the world?) By utilizing the world's hydroelectric power (rivers and tides), without any further development of thermal plants, and taking advan-

tage of the increased efficiency of super-high voltage long-distance transmission lines (one million volts, 1500 miles) in a day/night seasonal hookup, we were able to demonstrate that with present methods, technologies, projected population figures, metals resources, and efficiency levels in power generation and consumption, it would be possible to bring everyone on earth to a minimum of 2000 kwh per year by 1980.

The present kwh level of Europe is 2000, and as such not below our projected bare maximum of 15,000 kwh for the year 2000, because with Europe's level of industrial development it would be possible to raise the per capita kwh to 15,000 by the year 2000. We asked: How much copper wire is needed to carry the power necessary for the year 2000 for both industrial and home use throughout the world? How far ahead can we conceive a future life-style? What's the time-lag between installation of electrical energy and an adequate food supply? How much metal is involved to produce the kwh needs for the year 2000?

When the energy input of an area is raised, there is a corresponding rise in communications capacity which in turn increases the necessity of the "have-nots" to become "haves." (In 1938 Fuller determined that when the equivalent of the work that could be done by 200 human slaves was available in electrical and other energy units used by a family of five, that family is included among the "haves.")

In the scenario, the vast hydroelectric potential of both South America and Africa is utilized to raise their respective levels to the per capita figure of 2000 kwh, and the surplus is transmitted via the electric network to areas where there are deficits of electric power. Because we do not have a global network at the present time, the U.S. and other industrialized countries produce and use during the night hours only a small percentage of their electrical power capacity. With a global electric grid, power could be generated at day and night total capacity and transmitted to the daytime peak needs around the earth. (Using our present technology, can we provide electrical needs for everyone without polluting our air beyond endurance? What is pollution?)

The scenario utilized hydroelectric power for other considerations than what is presented above; besides the efficiency and pollution problems of thermal plants, it became overwhelmingly apparent that our "savings account" of fossil and nuclear fuels would soon be depleted at the bare maximum level of consumption. Our constantly-replenished "income" energies were the obvious choice. The amounts of metals, principally copper, aluminum and steel, that would be needed for such an undertaking are within grasp of earth's present economic and industrial development: approximately 9000 tons of steel per 1000-million watt hydroelectric plant, and 60 tons of steel and 25 tons of aluminum for a mile of power line at present efficiencies. (How can we accelerate efficiency throughout the world?) We chose to keep efficiency levels and technological competence at present levels to show we could do this today, with what we have. (How much metal is needed for 100 miles of power lines? When is a game a game?)

After demonstrating man's potential competence for bringing the world average per capita kwh up to 3613 with no one below the present European level of 2000 kwh, stage two of the electric scenario began. Utilizing increased efficiencies, technological progress such as laser-beam power transmission, and some of the earth's varied income energy sources (What is the potential kwh from wind power? Tidal power?), the per capita level of kwh is brought up to the 15,000 bare maximum in the year 2000.

Furnishing an area with enough electric power for its industrialization brings to that area the potential to satisfy its bare maximum food requirements. Knowing from the energy scenario that we could count on using two per cent of the total electric power for agricultural uses, we then looked at ways to increase the per capita calorie and protein levels to the bare maximum. (What percentage of electric energy is essential for food production?) A startling fact which became obvious upon looking at food production was that the world produces more than enough to feed its people adequately, but that in transport, storage and processing, 90 per cent of the tonnage of food is lost (how do we identify waste?). If we could bring methods to increase worldwide efficiency, at the rate we increased food production in the past, the world could feed its population for some time to come.

Shipping food halfway around the globe is inefficient. For example, in 1967, Asia imported and exported the same amount of rice. Ships could be used to transport materials not native to a particular area, or the metal from the ships could be used more profitably elsewhere. Part of the electrical power set aside for agriculture could be used to increase efficiencies in short transport to some areas with low farming efficiency. The increased use of fertilizers and farm equipment, in addition to the increase in knowledge of farming brought about by higher communications capabilities, would help bring the needed increase in efficiency necessary to have the entire population at bare maximum by 1980.

The efficiency would be somewhere between the U.S.'s (feeding about two people per acre) and Japan's (feeding six people per acre). It would be difficult to raise the world's efficiency to that of Japan's, using her methods, because a tremendous amount of manpower would be drawn into agriculture. (Approximately 40 per cent of Japan's people are engaged in agriculture as opposed to nine per cent in America.) There are many new ways to produce food. Examples: using algae (chlorella and others) for food; feeding bacteria plant wastes such as stalks, sawdust, and letting them convert these to food for man; and synthesizing amino acids. However, we didn't employ them in our scenario because we did not want to make a move which would assume changing people's food habits.

At present, most of the important variables in farming are not controlled because the system is as yet open. In a closed system such variables as weather effects, insect pests, loss of water and nutrients would be controlled, or the detrimental effects eliminated. One experimental system could feed 500 people per acre—which would mean a population of six billion people could be fed using only 24 thousand square miles of land. (We're now using around 7 million square miles.) This would be approximately the area Japan uses to feed her people today.

Given enough electrical power, the external metabolics, the earth could feed as many people as she needed—up to 7.8 trillion, for example, on presently-farmed land using the aforementioned experimental system. From this scenario we went on to examine some of the effects these scenarios would have on other areas of man's life.

III. FUTURE DIRECTIONS.

After working out scenarios for satisfying what we considered the two most vital bare maximums—external electric energy and internal food supply—we evolved into some of the possible synergetic scenarios that would result from the first moves. The establishment of bare maximum levels of the above throughout the world would engender the need for bare maximums in housing, medical attention, income, communications and travel.

The housing scenario we were working on clearly showed the inadequacy of our present system. At the present rate, the use of metals in housing would prove to be totally insufficient. Metaphysically-engendered materials such as plastics will have to be developed if we are to solve mankind's housing needs. The housing scenario encompassed more than just the shelter needs of the world. As it evolved we saw that it would encompass communications and mobility. With the trends of increasing mobility throughout the world, we foresaw the possibility that no one would be staying at any one place long enough to warrant the construction of "permanent" shelters. As a total service facility, the housing needs would encompass not only shelter but communications—with its own resultant education, medical information and attention, personal telephone contact with anyone, anywhere, and mobility with anyone going anywhere. These would be accomplished via closed-circuit television and telephone to a world central medical, educational, and travel-routing computer system.

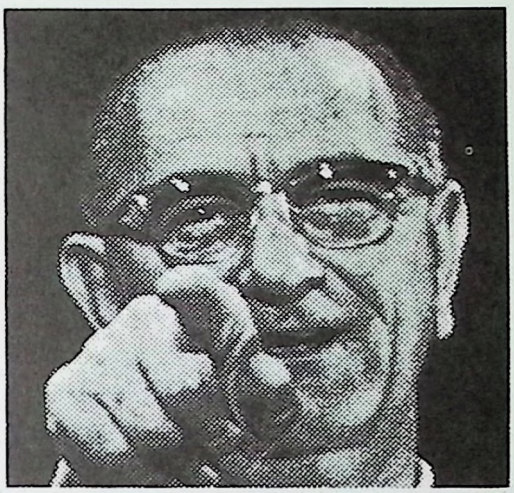
Some future directions and scenarios we touched upon were the possibilities of a world guaranteed annual income; the potential of fluidics as a source of energy; information and automation; the use of heat pollution from thermal electric plants to heat soil to improve crop output; the efficiency-gain by using gasoline or alcohol to run electric power plants and electricity to run cars; the production of alcohol from algae, farm wastes, or garbage and its substitution for gasoline in present-day combustion engines; the laser beam transmission of power and information; the amount of reinvestable time that will be available to mankind as a result of freeing him from the drudgery of having to earn a living (by bringing man to the bare maximum food and energy levels by the year 2000 we will have 16 trillion more hours per year to reinvest into metaphysical regenerative functions); the increase of efficiency rates for power production and consumption, communication, transportation, etc., and the possible surplus and increase of efficiency through the stabilization of the population.

April 1965
price 75¢

Esquire

The magazine for men

"He's easily the best man I've ever seen."



"I think I know what you want. You want to lead the country some day."

"He's a great kid— he hates the same way I do."

"He's a young, dim-witted, curly-headed smart aleck."

"He was a great credit to the Committee and did a tremendous job."

"He's the one I'd put my hand in the fire for."

Who's "he"? And who's right? See page 62.

Esquire
THE MAGAZINE FOR MEN

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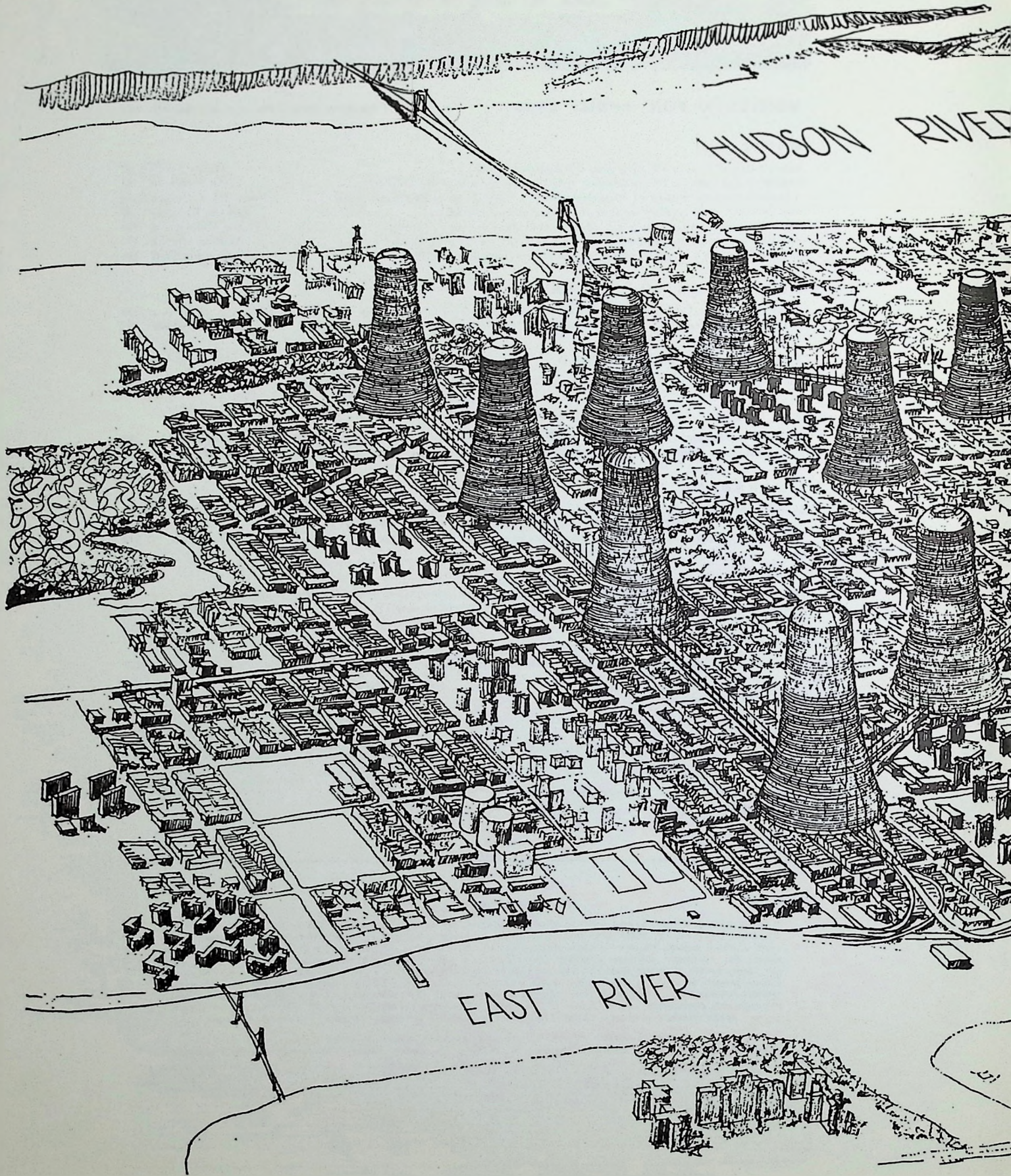

HUDSON RIVER
EAST RIVER

Instant Slum Clearance

by June Meyer

R. Buckminster Fuller designs a total solution
to an American dilemma:
here, for instance, is how it would work for Harlem

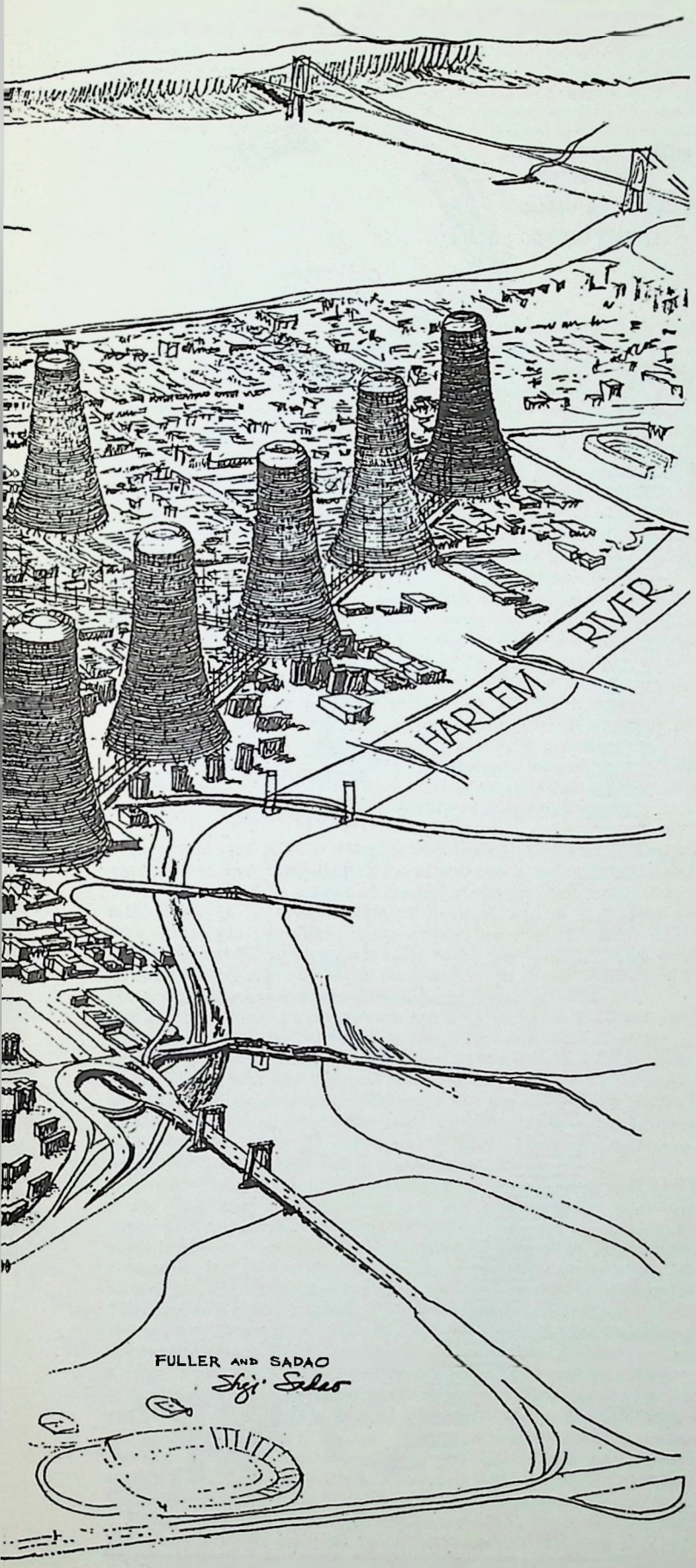
Harlem is life dying inside a closet, an excrescence beginning where a green park ends, a self-perpetuating disintegration of walls, ceilings, doorways, lives. It is also, of course, a political embarrassment for which no political solution is adequate. A housing project planted in the middle of a slum is not an answer. Harlem has been much lamented, but these statistics may be less familiar than others:

1. A typical Harlem child will score *lower* on an I.Q. test in the sixth grade than he scored three years earlier in the third grade.
2. Nine-tenths of its housing units are more than thirty years old.
3. Half the youngsters live with one parent or with none.
4. Harlem has a population of a quarter of a million, but it doesn't contain a high school.
5. Traffic deaths for Harlem youths appreciably exceed the rate plaguing the whole island of Manhattan.

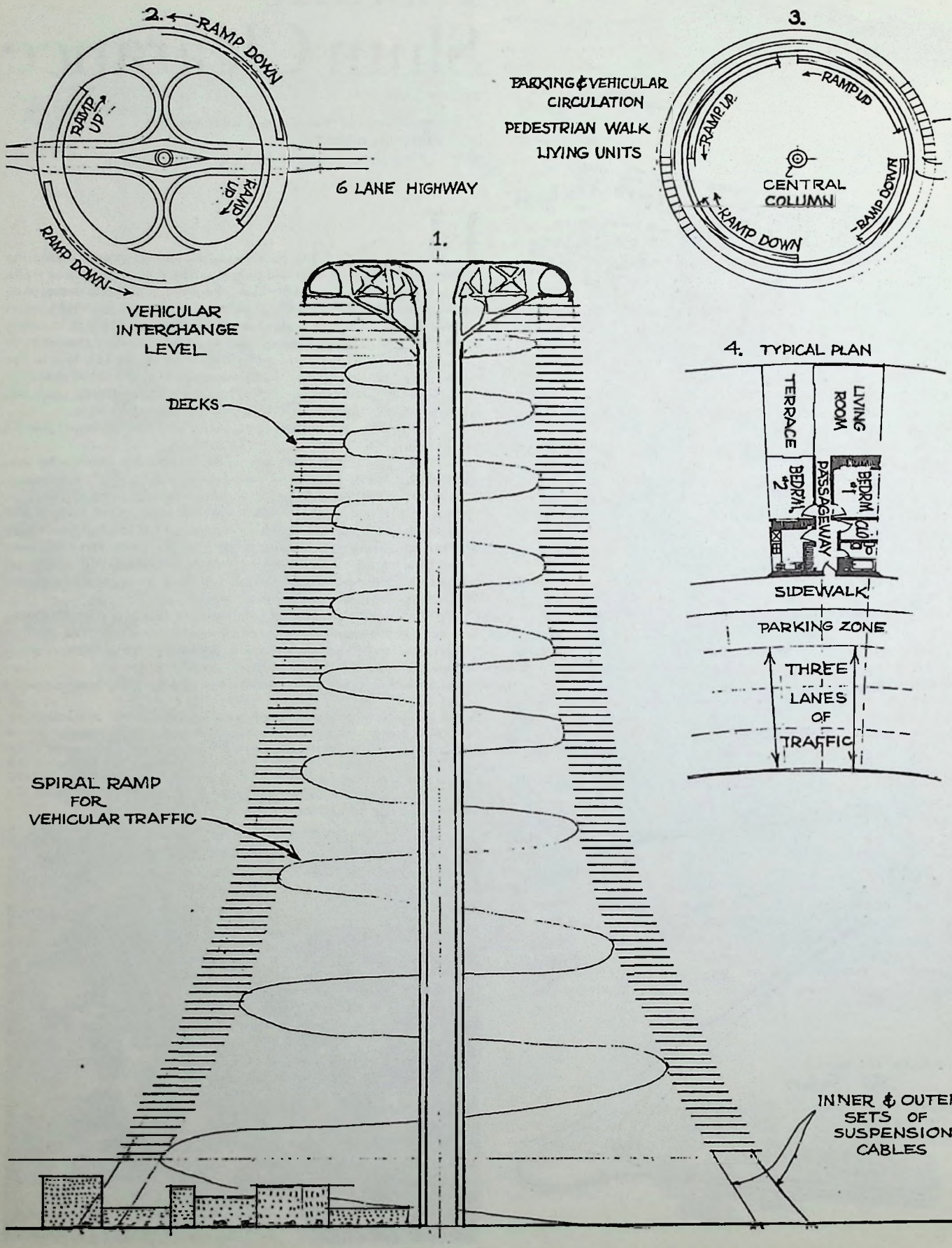
Skyrise for Harlem is a proposal to rescue a quarter million lives by completely transforming their environment. New Harlem will encompass a half million people by removing old limits in exchange for natural boundaries. Harlem will widen from river to river across the island. Its new space will accommodate an additional quarter million residents—everyone willing to participate in the integrated transformation of a ghetto.

Skyrise for Harlem can be completed in thirty-six months. The first year will be spent in what R. Buckminster Fuller describes as "tooling up": organizing the mass production of structural parts and utility units, including all basic furniture.

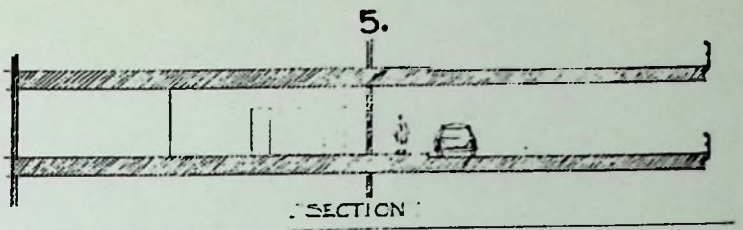
Redevelopment generally means the *removal* of slum residents



Before and After. In the photograph below, Harlem today. In Buckminster Fuller's rendering at left, the same area as it would be re-created. Central Park ends at the extreme left, the George Washington Bridge is at the upper right. Traffic will flow over a new bridge to be built at 125th Street into the system of elevated, interconnected highways connecting all fifteen towers. These highways will handle through traffic in all directions and permit exit into the buildings themselves.


2.
RAMP DOWN
RAMP UP
RAMP UP
RAMP DOWN
6 LANE HIGHWAY
VEHICULAR INTERCHANGE LEVEL
3.
PARKING & VEHICULAR CIRCULATION
PEDESTRIAN WALK
LIVING UNITS
RAMP UP
RAMP UP
CENTRAL COLUMN
RAMP DOWN
RAMP DOWN
1.
DECKS
SPIRAL RAMP FOR VEHICULAR TRAFFIC
INNER & OUTER SETS OF SUSPENSION CABLES
4. TYPICAL PLAN
TERRACE
LIVING ROOM
BEDRM. #2
BEDRM. #1
PASSAGEWAY
CLOSET
SIDEWALK
PARKING ZONE
THREE LANES OF TRAFFIC

Utopian Details. On the opposite page: **1.** A cross section of one tower showing the spiraling, three-lane ramp reaching from ground level to top of tower; the ramp is edged with walks and parking areas. **2.** An overhead view of a tower at the tenth-story level showing the interconnecting elevated highway and the system of interchanges. **3.** A cross section showing the relation of the living units at perimeter of tower to the internal roadways. **4.** Floor plan of a typical apartment.



Above: **5.** Cross section of an apartment with adjacent parking area; exterior wall of tower is at left, center of column at right.

while land is cleared for new buildings and new purposes. In fact, "redevelopment" is frequently a pretext for the permanent expulsion of Negro populations. Fuller's design permits all residents to remain on site while new and vastly improved dwelling facilities rise directly above the old. No one will move anywhere but up. New Harlem will be supported by columns driven into the backyards of the slum, and once the elevated replacement is complete and inhabited, the lower depths will be cleared for roadways and park space. The design will obliterate a valley of shadows: Skyrise for Harlem means literal elevation of Harlem to the level of Morningside Heights. Partial renovation is not enough. Piecemeal healing provides temporary relief at best and may create as many problems as it cures. A half century of despair requires exorcism.

The devastating effects of negligence become easier to understand—if more difficult to forgive—when you consider that New York City itself has been guided by nothing that resembles a master plan since 1811. The city is a model of design by accident, of construction in response to critical demand, high-level payoffs and tax expediencies. Following the Harlem riots of 1964 a profusion of remedies for what was at last accepted as a critical situation appeared everywhere; nowhere, however, was environmental redesign given prime emphasis. Yet it is architecture, conceived of in its fullest meaning as the creation of environment, which may actually determine the pace, pattern and quality of living experience.

An aerial view of New Harlem will disclose a radical landscape: vast, cleared ranges of space with fifteen peaks rising into the sky. These fifteen widely separated conical structures will house a half million people. A cross section of these structures resembles abstract, stylized Christmas trees evenly broadening toward their base with central, supporting trunks. Each tree town is one hundred circular decks high. The lowest level begins ten stories aboveground, above dust level and major cloverleaf-highway systems.

Fuller's circular decked towers are fireproof (concrete and steel cables) and may be delivered in large sections by helicopter. A central supporting mast also functions as the distributing tube for power, light, heat and disposal facilities independent of municipal utilities. The mast is compressional while the decks hang inside a tensional web (i.e., steel supporting cables). Open space between decks avoids a sense of impenetrable mass. From the masthead, lenses capture the light and heat of the sun.

Circling the central mast is a parking system of ramps that never cross. The huge interior space next permits a circling of shops, supermarkets, game rooms and workshops on every deck, plus, on some levels, a cross view of four hundred feet. The penultimate circling of the central mast contains dwelling units which provide an average of 1200 square feet per family as against an average of 720 in today's public housing. This 1200 square feet does not include the parking space given each family nor the balconies which constitute the perimeter of these great wheels of life. Every room has a view. From these hanging gardens, both rivers will be visible.

A comprehensive designer must conserve natural resources and yet control their effects. One of Fuller's solutions for this design problem will be seen in the sky. Protective watersheds will enclose the sky of Harlem like overlapping umbrellas. Rain may cascade visibly from these watersheds to be piped into New York reservoirs. The watersheds float on the strength of transparent truss systems.

Rather than the commonly known sidewalk, there will be wide walkways entirely separate from the cloverleaf ribbonry that will divide the high-speed through traffic from local traffic. Normal grid layout of city blocks will not stifle the reconstructed Harlem. Roughly, eight square city blocks will equal one of the new towering trees of life. Ordinary grid design with its parallel building produces a rigid confrontation of mass-against-mass and rectangular patterns deaden space into a monotonous experience. The circular-decked towers provide tension supports for roads and walkways.

Reconstructed Harlem will increase connections to other communities: 125th Street, as the overloaded thoroughfare of city bus, private car, commercial truck, railroad and subway traffic, now disappears into a coherent organization of goals and rates of approach to these goals. For instance, high-speed traffic from the Triborough Bridge will be separately routed over an arterial system similar to that of the Pulaski Skyway in New Jersey. Various peel-offs into Manhattan give option to the driver. Now it becomes possible to travel from the Triborough nonstop over Manhattan Island and onto a newly created Riverspan Bridge at 125th Street into New Jersey. This bridge multiplies functional reasons for Harlem residents and the other island inhabitants to commingle and cooperate. The inconvenience of having "to go down into the city" in order to leave it will no longer paralyze northern islanders.

Last year, New York City's Planning Commissioner Ballard and Mayor Wagner agreed on a proposal to domesticate the shoreline of New York to permit human beings a share of the river's edge. With Skyrise for Harlem, two marinas will provide recreation and supplement transportation via the river.

Skyrise for Harlem creates cultural centers decked into the sky; cultural centers offering practice studios for musicians, concert halls, theatres, workshops, forums for symposia, dancing pavilions, and athletic fields as well as pathways for strolling under trees. Contemporary sculpture will enrich the open spaces of elevated Harlem. Space will be reserved for the construction of major city institutions such as a Family Court. This accords with the five-year plan promoted by Manhattan Borough President Edward R. Dudley. As Dudley told this writer, the introduction of city institutions into Harlem "would serve to show that their area has not been specifically designed to be set apart."

During the last five years, New York City's Housing Authority has spent $361,407,000 to shelter 30,915 families. Skyrise for Harlem will shelter about 110,000 families at a cost to be determined once the assembly-line manufacturing of all its parts is undertaken by an industry willing to convert, for example, from the furnishings of war to the furnishings of peace. The enormous sum of units entailed by this design assumes the pioneer, belated establishment of housing on a thoroughly industrial basis. One need only consider the economics of mass production and its cost saving per unit (per consumer) in the manufacture of automobiles to realize that the organization of a housing industry is incredibly overdue.

Private financing of Skyrise for Harlem should regard this undertaking as an obvious, regenerative investment. It well might prove possible for private finance to receive government assistance in the form of tax abatement (taxing property at the original value) and deficit subsidy comparable to that enjoyed by public housing.

Where we are physically is enmeshed with our deepest consciousness of self. There is no evading architecture, no meaningful denial of our position. You can build to defend the endurance of man, to protect his existence, to illuminate it. But you cannot build for these purposes merely in spasmodic response to past and present crises, for then crisis, like the poor, will be with us always. If man is to have not only a future but a destiny, it must be consciously and deliberately designed. ##

Vision 65

October, 1965 - S I.U.

R. BUCKMINSTER FULLER - KEYNOTE ADDRESS

Our theme subjects of communications and vision are of immediate interest because today world society is operating almost exclusively in the inaudible and nonvisible area of the physical universe. I think it is safe to say that 99 percent of all the important work now being done by man -- relating to our evolutionary advance -- is work going on in the areas above and below the tunable range of man's direct optical or other sensorial participation in the electro-magnetic spectrum. Society neither hears nor sees the great changes going on.

You who are convening as participants in the Vision 65 meeting are those rare individuals, only one of whom appears in every one hundred thousand humans. You intuit the necessity, and take the initiative in trying to comprehend the significance of the invisible evolution. Thereafter, you develop ways of alerting society to its newly evoluting conditions. It is possible to develop means for society to inter-communicate its new concepts and adjustments thereto at greatly accelerated rates. You are uniquely concerned with finding effective ways for man to visualize, understand, and respond advantageously to what is going on despite approximately total inaudibility and invisibility.

In the very short time which I have to think out loud with you, I want to think about what I know of high potential trends in communication.

Certainly, the accelerating accomplishments in electro-probing of the brain are important. I find that the men who are the physiological probers of the brain are beginning to understand its energy patterns. They have identified many of the storage areas for specific types of information. They have apprehended much of the traffic pattern of the brain's information processing. I find these men are not prone to be prognosticators but do not shudder or feel me to be over daring when I say in their presence that possibily within the next decade we will have discovered that what we have always spoken of in the past as telepathy is in fact ultra, ultra high frequency electro-magnetic wave propagation. We may find that we are doing a great deal more subconscious communicating with one another than we are accomplishing in the "reality" of the visually tunable ranges of the electro-magnetic spectrum. That is one reason why I do not prepare and read or memorize my lectures. I prefer to think my way along in front of my audience, speaking my thoughts as they occur. I am confident that my spoken thoughts are greatly affected by sub-conscious feedback from my audiences.

I'd like also to prospect a little regarding my Skyocean World Map on the stage's backdrop behind me (see opposite page). It is an aid in effectively conceiving the totality of world (and universe) events, as we shall presently realize.

With our enormous specialization we have powerful insights in a variety of unique directions, but we have very little integrated comprehension of the significance of the total information. I find that not only does our vision have a narrow electro-magnetic spectrum range but that we also have a very limited apprehending range within the spectrum of motive velocities. For this reason, we see and comprehend very few motions among the vast inventory of unique motions and transformation developments of the universe.

Universe is a non-simultaneous complex of unique motions and transformations. Of course, we don't "see" and our eyes cannot "stop" the 186,000 miles per second kind of motion. We don't see the atomic motion. We don't even see the stars in motion though they move at speeds over one million miles per day. We don't even see the hands of the clock in motion. We remember where the hands of the clock were when last we looked, and thus we accredit that motion has occurred. In fact, experiment shows that we see and comprehend very little of the totality of motions.

Therefore society tends to think statically and is always being surprised, often uncomfortably, sometimes fatally. Lacking dynamic apprehension it is difficult for humanity to get out of its static fixations and specifically to see great trends evolving.

We do from time to time take progressive stage photographs of subvisibly changing phenomena, such as plant growth, and accelerate the rate of projection of the successive pictures to make possible man's seeing the changes take place at a rate that he identifies as "motion."

To rectify this condition, I have speculated and experimented a great deal on the development of what is called the "Geoscope" or miniature Earth. The particular Geoscope that we think about a great deal is 200 feet in diameter. The reason that we have chosen that 200 foot size -- which is about twice the diameter and eightfold the volume of the world globe at the New York World's Fair -- is that if we use the aerial mosaic contact photographs taken by the Air Force at the lowest standard flight level, and put the whole world inventory of contact size photographs together as a continuous spherical surface mosaic picture, they will make a 200 foot diameter globe. In the 200 foot diameter spherical aerial mosaic we can see men's houses -- but we can't see men. In a sense we can recognize man because we recognize his farm and his house. On a 200 foot globe, pasted up with an aerial photo mosaic, you could see all of humanity's highways, railways, towns and houses. Any human could identify his home on such a sphere.

This 200 foot sphere could be mounted 200 feet above the water, suspended invisibly from masts arising from the Blackwell Ledges in the East River of New York City, just south of Welfare Island. The weight of the structure would be so light that the cables suspending it from the masts would be invisible. You would have a 200 foot diameter miniature Earth apparently floating out in space one half mile away from the United Nations building. The miniature Earth's top would be at about the height of the top of the United Nations Building.

Fourteen years' development work on the 200 foot Geoscope makes it possible to describe it with accuracy. Ten million electric light bulbs, one for each two square inches, evenly covering the sphere's entire surface would be hooked up to a computer. The light intensity in each bulb is controllable. We would in effect, have an omni-directional "spherical" television tube which seen from the United Nations Building would have as good resolution as a fine mesh half tone print. This spherical TV like "tube" would accurately picture the whole earth. We wouldn't need a rigid structural outline of the continents, for the latter would be part of the spherical picture described by the lights. You would be able to look at any part of the earth that you want -- because you could have the computer rotate the spherical earth picture on the 200 foot sphere surface in any preferred way.

How would we use this giant Geoscope? We could, for instance, show all the population data for the world for the last three hundred years. We would identify every thousand human beings by a red light located at the geographical centers occupied by each one thousand human beings. You

would then be able in one minute to develop the picture of the world's population growth and geographical spread for 200 years. You would see the glowing red mass spreading northwestward around the globe like a great fire. You would be able to run that data for another second or two which would carry you through three or four more decades of population growth. While the edge of the data would be unreliable, the gravity and momentum centers of population would be quite reliable.

All the satellites going around Earth make their circuits at about the pace of the minute hand of the clock -- roughly one circuit per hour. So we couldn't see the satellites' motion around the Earth except by accelerated motion it is easy to introduce into Geoscope. All the cloud cover and weather information around Earth can be shown and accelerated to predict the coming weather everywhere.

The Geoscope is only one of many devices that could provide man with a total information integrating medium. We're going to have to have some way for all humanity to see total Earth. Nothing could be more prominent in all the trending of all humanity today than the fact that we are soon to become a world man; yet we are greatly frustrated by all of our local, static organizations of an obsolete yesterday.

I will speak about other technical devices which may develop to facilitate communication. One has been developed in respect to language problems. For instance, there have continued to be great explorations to determine the geographical origins of the Pacific peoples. It has been possible to take all the languages of the Pacific and of all its, as yet, existing tribes and to identify transitional stages in the evolutionary sound pattern developments of the whole range of words. It is possible to identify the earlier and later sound forms in evolutionary sequences. A Southern Illinois University professor was able to identify all these sound patterns and to put them into the computer to find the lines pointing toward origins. The computer showed that the languages of the Pacific clearly came from the region of New Britain just East of New Guinea.

The same kind of evolutionary working with word sounds shows that it is going to be quite possible for the computer to find the most commonly recognizable and speakable sound and meaning relationships common to all world people. Indications are that the computers will probably develop some kind of phonetic acceleration leading toward a common world language. I don't think we need to talk about too many more of such trends, but many will be realized.

Men must have been in critical life sustaining crises to have invented words. When we have something vital to say we can usually develop the means of communication. Today with our great vocabulary inheritance we squander meanings on unworthy causes and communicate little that needs to be said.

I will now talk about what it seems to me needs to be communicated by man today. Up to the time of Thomas Malthus at the opening of the 19th century we had had many great world empires -- but all the pre-sixteenth century great world empires such as those of Ghengis Khan, Alexander the Great, the Ottomans and Rome, were all what I call 'Flat Empires,' that is, they were all part of the same pre-sixteenth century cosmology of man which conceived of the Earth as being flat -- a great island, apparently surrounded horizontally to infinity by the sea. All the great empires were flat postage-stamp empires inside of the great infinity. All our ancient world maps show that flat concept with civilization centered around the Mediterranean Sea, which word means sea in the middle of the land.

And the people, in the times of Alexander the Great or of Caesar or of Saladin, all thought in that flat way. That is why "simple, elementary, plane geometry" is used and taught to beginners and "solid" is considered more difficult and "spherical trig" even more advanced and more difficult.

When you think about the real consequences of that psychologically, philosophically and mathematically, it is devastating. It means that "inside" the empire, we have something we call civilization while "outside" the empire begins the unknown wilderness with pretty rough people and outside of that live dragons and beyond the dragons, flat infinity. What we have in flat land is an only local finiteness, and all outward around us extends the flat infinity. This meant then that the Greeks in attempting to communicate their mathematical conceptioning defined the circle as "an area bound by a closed line of equal radius from one point, "or a triangle as "an area bound by a closed line of three angles, three edges and three vertexes." The Greeks talked only about the area that was "bound" as having validity, finiteness and identity while outside, on the other side of the bounding line there exists only treacherous terrain leading outwardly to infinity and therefore boundless. This has a tremendous feedback effect and explains the ingrained fundamental biases in our present thinking. We tend to think only of one side of a line as definable, organized, and valid. "Our side" is natural, right and God's country" and vice-versa. All humanity has been conditioned to accredit only its own local area of experience as being natural, and the logical prototype of all that is good and acceptable with all else remote, hostile, treacherous and infinite. Infinite systems may contain an infinity of variables. The ancient world was imaginatively controlled by an infinity of Gods.

The British Empire was so called because the great business venturers -- the great outlaws -- the world men -- who ruled the world's ocean found the British Isles to be their most easily defendable ship building bases which coincidentally and conveniently also commanded the whole waterfront of all the European customers for the venturers' Oriental booty. The venturers "Shanghaied" their crews out of the British pubs and because there were so many ships with so many British sailors aboard the world came to identify the most successful world outlaw organization as the British Empire. This was the first empire of man to occur after we knew that the Earth was a sphere. A sphere is a mathematically finite or closed system. It is an omni-symmetrical closed system. A sphere is finite unity.

Thomas Malthus, the professor of political economics of the East India Company was the first economist ever to receive all the vital statistics and economic data from a closed system world. Once. the world is conceived of as a sphere and finite, there are no longer an infinite number of varying possibilities identifiable uniquely as whims of Gods.

Because Earth had been discovered by its high-seas masters to be a closed and finite system, the great pirates who controlled the seas took their scientists around the world to discover and disclose to them its exploitable resources. Only because the Earth constituted a closed system could the scientists inspect, in effect, all the species and only thus was Darwin able to develop the closed system theory of "evolution of species." Such a theory could not have existed before that. It would have had to include dragons and sea-serpents. All the people in all the previous open-edged Empires lived in a system, within whose bordering infinity anything could happen. Paganism (or peasantism) wasn't illogical. Geometrically speaking, the pagans could have any number of gods because any kind might occur in infinity. There were an infinite number of chances of upsetting the local pattern which was a most satisfying idea if it happened that the individual didn't like the prevailing local pattern.

It seems strange that we were not taught about the historical, philosophical and economic significance of the foregoing transition from an open to a closed world system. However, the omission can be explained by realizing that a closed system would exclude any variables supposedly operating external to the system. This automatically would exclude any super-natural phenomena such as the theologies of the organized religions. And because the churches were strong and the great pirates wished to obscure both their monopoly of the riches of the closed infinite system and their grand world ocean strategy for its control, significance of the concept of a closed world system was popularly unrealized.

Once a closed system is recognized as exclusively valid, the list of variables and the degrees of freedom are closed and limited to six positive and six negative alternatives of action for each local transformation event in universe.

In view of Thomas Malthus discovery that the world's people multiplied themselves much more rapidly than they were able to produce goods to support themselves, what could prayers do to alter those hard facts? For approximately a century the world mastering venturers "classified" Malthus' books as secret information, belonging exclusively to the East India Company. Once "classified" that kind of information leaked out only amongst the pirates and the scholars. Marx, as a great scholar, studying in England encountered the Malthusian data. It was equally clear to Marx that there was not enough to go around. Marx said, "Since there is not enough to go around for all and not enough even for 'many' -- certainly those few who are arbitrarily favored by the prevailing system and thereby enabled to survive their allotted span of "four score years and ten" ought to be the ones who are most "worthy" and those who do the work "obviously" -- to Marx -- were the most "worthy".

That is logical thinking.

Those who opposed him said that head work and daring enterprise which alone conceived of the great value to be realized by society could also increase the abundance and support more people and that the enterprisers should be conceded to be the exclusive few who could and should survive. Others said it should be the bright ones -- who by their superior intellectual fittness alone could increase the numbers who could be supported. The choice of "who" should survive has always underlayn all class warfare. Should it be the brightest, the toughest, the bravest -- or who should it be?

Certainly, the corollary to Darwin's theory of evolution which expounded "Survival only of the fittest," seemed to fit neatly with Malthus who observed that only a few were surviving their full span of years. It was assumed to be obvious by those in power that a scientific law supported and vindicated their position. Despite the great pirate's satisfaction, the question persisted amongst the "outs" as to "who were the fittest?" Would it prove in the end to be the workers, or would it be some military class or would it be some intellectual class?

Just before I went to Harvard University in 1913, before the start of World War One, an "uncle" gave me some council. He was a very rich "uncle". My father had died when I was quite young. My "uncle" said, "Young man, I think I must tell you some things that won't make you very happy. I know that you are impressed with your grandmother's Golden Rule: "Do unto others, as you would they should do unto you." But my uncle went on to tell me about the discoveries of Thomas Malthus. He spoke about the pre-Malthusian times when there could reasonably have been any number of Gods. He made it clear that in the early empires, the concept of the golden rule was highly plausible. There seemingly were an infinity of chances that it could work. "But,

my uncle said, "a few of us now know from the closed system experts that the golden rule doesn't work. Those few of us who are rich and who really have the figures know that it is worse than one chance in one hundred that you can survive your alloted days in any comfort. It is not you or the other fellow; it is you or one hundred others. And if you are going to survive -- and have a family of five and wish to prosper -- you're going to have to do it at the expense of five hundred others. So, do it as neatly and cleanly and politely as you know how and as your conscience will allow. At any rate, that's what you're up against." He went on to say, "I'm not going to try to educate your grandmother because she's quite happy in thinking her own golden rule way, and -- of course unknown by her -- I have taken care of her one hundred alternates." My uncle said, "There are few even today who really know this is so. There are those all around the world who have their gods. They keep dying off, short of their potential years, but they keep themselves happy by having their hopes and infinite possibilities. So we don't tell them about it."

That "you or me" pattern began to emerge in the sailor's jargon around the time of World War One. In the time of the 1929 to 1941 depression, Americans began to learn about Malthus. But, I also found Malthus unknown as I interrogated educated audiences, for instance, the University audience in the city of Stockholm in 1961. The people of Sweden think deeply in economics. I asked how many of them had known of Malthus, and found that they had never heard of him. I asked the question around the world and found that Malthus is hardly known outside of the United States and England. So, the Malthus concept -- "knowing what it was all about" -- was not disseminated by the economically successful few to the rest of the world.

At the present moment in history, we find ourselves in a fundamentally different economic position. When, a decade ago, Eisenhower went to meet with Khruschev in Geneva, both had been informed by their military and scientists regarding the magnitude of the destructive capability of the atomic bomb. And Eisenhower said, as he went to that conference, "There is no alternative to peace." I'm sure Khruschev, with the same realization must have felt the powerful responsibility of that moment. Both being political realists and hard fact men, knew that they would not be able to make any important peace agreements as conceived solely by themselves. Their proposals and agreements, if any, would have to be backed by their respective political parties, and their parties were always in mortal contest at home with their chief opposition parties which waited upon altruistic moves of the "ins" as opportunities to impeach them for treachery to their respective sovereign power's ideological premises. Any soft headed step on the part of the leader would throw the party out. While Eisenhower and Khruschev couldn't yield an inch politically, ideologically and militarily both of them brought along their atomic scientists and allowed them to talk to each other in a limited manner regarding any at all possible peaceful uses of the atom.

Only one decade ago, at the meeting in Geneva and its companion meeting of the Food and Agricultural Organization of the United Nations it came so clearly into scientific view that the leading world politicians could acknowledge it to be true that -- as reported unequivocably by Gerard Piel, publisher of the Scientific American -- for the first time in the history of man, it was in evidence that there could be enough of the fundamental metabolic and mechanical energy sustenance for everybody to survive at high standards of living -- and furthermore, there could be enough of everything to take care of the increasing population while also always improving the comprehensive standards of living. Granted the proper integration of the world around potentials by political unblockings, there could be enough to provide for all man to enjoy all Earth at a higher standard of living than all yesterdays' kings, without self interferences and with no one being advantaged at the expense of another.

But clearly both political leaders and their respective states were frustrated by all the political checks and balances each side has set up to protect and advantage only their own and their allies side in view of yesterdays dictum that there was only enough of what it takes to support one in a hundred. So, all the ages-long fears; all the bad habits, all the short-sighted expedients that have developed in custom and law frustrated whatever might be done to realize the new potential. But the fact to remember is that it was only one decade ago that man had this completely surprise news that Malthus was indeed wrong and there now could be enough to go around -- handsomely.

Inasmuch as I have found that the majority of people around the world had never heard of Malthus -- coupled with our observation that not more than 1% of humanity read what Piel said and thereby understood what had occurred at Geneva a decade ago; and at present not more than 1/1000th of one percent of humanity as yet recall and as yet accredit the scientists' realization at Geneva that Utopia was now, for the first time feasible; it is easy to understand that what I am saying to you now must be jolting.

World society's confusions regarding what we are reviewing here are great. The fact is, however, that the foregoing economic facts are mankind's now most important considerations. We are faced with the necessity of developing effective ways to educate all humanity as rapidly as possible regarding this completely new and vital economic situation.

To start with, here is an educational bombshell: Take from all of today's industrial nations all their industrial machinery and all their energy-distributing networks, and leave them all their ideologies, all their political leaders, and all their political organizations and careful study shows that within six months, two billion peoples will die of starvation, having gone through great pain and deprivation along the way.

However, if we leave the industrial countries with their present industrial machinery and their energy distribution networks and leave them also all the people who have routine jobs operating the industrial machinery and distributing its products, and we take away from all the industrial countries all their ideologies and all the politicians and political party workers and send them off by rocket ship to forever orbit the sun -- the result will be that as many world people as now will keep right on eating, possibly getting on a little better than before. This will remove all barriers to completely free world intercourse and thereby permit realization of enough for all.

The fact is that now -- for the first time in the history of man -- and only for the last ten years, all the political theories and all the concepts of political functions are completely obsolete -- in any other than secondary house keeping functions --. The primacy of political ideologies are obsolete because they were all developed on the basis of the exclusive survival only of your party or my party -- simply because there was not enough for both.

The whole realization that mankind now can and may be comprehensively and mutually successful is so startling that we must have it -- as both the <u>whole</u> and as the <u>essense</u> of the theme of our forward undertakings. But, to have enough to go around for all requires a design revolution, for as now designed the world's metals are invested in machinery and structures which are so inefficient that they can only take care of 44 percent of humanity. Engineers and scientists agree that the technical knowledge to correct this now exists. So it is also part of the great message to humanity of those who have the power to communicate that the world's problems cannot be solved by politics and can only be solved by a physical invention and design revolution.

In pursuance of this theme and under auspices to be announced later, we are going to undertake at Southern Illinois University in the next five years, a very extraordinary computerized program to be known as "How to Make the World Work." It is based on general systems theory, combined with Von Neuman's game theory as "played" by the national defense and joint chiefs of staff in the development of computerized world war games and the theory of world economic warfaring.

We find that humanity is developing an increasing confidence in the way in which computers are resolving heretofore vexing and seemingly unsolvable problems. Lest one defective computer may lead mankind seriously astray, he is learning to check results in several computers. We, herewith, review typical ways in which society has gained confidence in the computers' ability to solve, heretofore unsolvable, problems.

After World War II, when enormous new magnitudes of energy mastering tools had been developed, America, despite the astronomical costs of World War II, found itself many fold wealthier than it ever had been before. This was because vast improvements of the means of production, more than of the special end products, won the war. Enormous quantities of energy were now flowing to the ends of levers to produce wealth. American labor began to realize that it could ask for a great deal more participation in the advantages accruing to further regeneration of this vast wealth.

The problem of sustaining post war economic and technical growth in our country was one which involved centrally coordinated scientific, technical, industrial and economic organization, while also developing the profitable growth of the nation's prime contractors. This was accomplished by inducing a regenerative self amplification of the monies which would flow irrigationally through the whole economic system in ten recyclings per year which could convert fifty billion in war orders into a 500 billion gross national product that would yield a fifty-five billion tax extraction for reintroduction of next years fifty billion cold war orders to the prime contractors. To implement this economic irrigation system, Congress extended the President's World War II emergency powers to implement his "anticipation" of the next war -- which realized anticipation we speak of as the cold war. In this way, the economy could and has attained omni-profitable probing for the new economically capitalizable industrial advantage augmentations inherent in the scientific and technical invention evolution of each new military program's development of greater production power of greater hitting power with ever less effort per each function.

The total grand strategy of cold warring introduced an immediate preview of the astronomical complexity of its accounting problems both anticipatory, current and retrospective.

World War I and World War II had demonstrated that human beings were inherently inadequate, as "directors" of the war production complexities. I'll just point out to you quickly that a single family house has about 500 types of parts, a fighter plane has 25,000 types of parts, while a big corporation, e.g., International Harvester, has to keep a live inventory of 135,000 types of service parts -- and these are the figures of just one corporation. When we begin to talk about all the corporations and all the evolution anticipating undertakings and all the stockpiling for ten, fifteen, and twenty years ahead -- of the whole national economy -- in getting ready for the next war -- the myriad millions of types of parts and functions and raw materials and tools to produce and handle them rocketed beyond the thinking capabilities of any individuals. The obvious economic complexity of the cold warring made the swift development of the computers mandatory to the U.S. military leaders. Production of the modern computers had been found to be theoretically feasible in the nineteen thirties in the course of development of the great electrical power distribution systems'

"network analyzers". There were computers in the invention and laboratory development stage and a few minor prototypes of both the analogue and digital computers. It was only a question of allotting enough money to the big universities to pay for the major development research programs. Computers which worked with electronic tubes were developed but were swiftly improved by the invention of transistors.

After the universities had developed the prototype computers, they were given to the big corporation to reproduce. The skilled machinists of the U.S.A.'s labor force had to produce, assemble and tune up the production computers. Though it cannot be confirmed by any published document, I -- as a card carrying "Journeyman machinist" of the International Association of Machinists, one of the U.S.A.'s oldest labor unions, -- am confident that Walter Reuther put into the computers the problem of: "Which would pay General Motors the greatest profit: to grant or not to grant the United Auto Workers not only shorter hours and more pay, but also vacations, retirement and complete life benefits?" The computer said, "General Motors will make much more money by granting." Boards of directors having been elected by the stockholders have always heretofore been mandated to secure all the profits of their corporations for the shareholders and therefore not to yield an inch to labor. However, with the introduction of computers, General Motors' board of directors yielded without a battle to Reuther's unprecendented demands. Therefore, General Motor's Board of Directors also must have put the problem into the computer because they acquiesced so quickly. Within three years after granting, General Motors became the first corporation in history to make a billion dollars net after paying all taxes. This is how well it paid off to allow a percentage of accrued profits to fund labor's wider buying power. They made money because mass production cannot exist without mass consumption and the wider and more persistant the distribution of wealth as buying power the greater and more persistant the sales and profits to all. General Motors' decision to heed the computers insured their profits.

The wealth which we as industrialized society are now dealing in is the tooled and tuned capability to shunt the free flowing inexhaustible energies of universe on to the ends of levers to do the work for us. The tooled capability to satisfy tomorrow's metabolic regeneration of each man is what underlies our wealth today. Though this is not yet officially recognized by either business or by U.S. Government, wealth is our tool-organized capability to deal with the forward metabolic regeneration of humanity in terms of forward man-days of increasing degrees of mutual enjoyment of the whole of the Earth without interferences and without the gains of one to be realized only by the loss of another.

Very recently another extraordinary computer decision occurred. As you know, in America the greatest opposition to centralization of economic power in government authority has been that of the organized private electricity generating industry. The means of electrical power generation and distribution was one of the last great holdings of the old pirates who came off the sea and onto the dry land with their railways to own the mines and control energy as power. They built many electric-power and light generating companies within the U.S.A. and in foreign countries. These "utilities" were adamant against any public control. After the 1929 crash came the New Deal and the government underwriting and control of the banking system, and the public entry into the electrical generating industry -- along with flood control -- as for instance in the Tennessee Valley. Next came the U.S.A. Government's rural electrification and many other governmental developments and ownership of public power services.

As Eisenhower became president, he found himself in the middle of a battle waged between the "private" and the "public" sectors of the electricity producers for control of the fabulously grown energy resources. The private sector progeny of the old pirates hoped not only to win, but in so doing to take over atomic energy despite that its development had cost the government unprecedented billions to develop. This battle was joined in 1952 when the old pirates' progeny, lead by a Wall Street Admiral made a skilled and powerful attempt to reverse their catastrophic loss in 1929 of control of the world's overall economic intercourse and its monetary systems as well as of the prime initiative in guiding the world's capital reinvestment evolution; as well as their loss by default to democratic government of their position as the ultimate creditor, forecloser and underwriting dictator of the comprehensive economic recovery system and its grand domestic and international strategy formulations. Ensconced only in their privately owned security trading houses, divorced entirely from access to bank deposit funds, and possessing only their privately operated public utilities and their privately owned mines whose profitable operation had been bedevilled by the vast and unexpected magnitude of recovery and recirculation of World War I and subsequent, industrial evolution's scrapped metals, the private sector of the 1952 battle had only the momentum of wide public affluence of World War II's vast productivity gains and the McCarthy stilled voices of democratic dissent to support their campaign of "righteous indignation" of a long suffering private enterprise to be restored to supreme power. An intuitively alerted democracy frustrated their coup.

In the last four years metals coming back as scrap into the world's metal markets, with government stockpiling ended, having threatened comprehensive deflation of metals prices and impoverishment of the mines and metals cartels. With the scrap of World War II about to reappear in 1966, we will have a flood of metals. Combining this flood with the weapons industry's continual accomplishment of more power with less resources per each function, it is seen that the metals market will go away down unless a new major use for them develops. This "use" may be in weapons and ammunition. But other forces are at play.

The major interests in metals who are also by heritage close to the major interests in private power began about 1960 to look for new outlets for the major metals, iron, copper, etc., other than for war. One of the ways in which the metals could be employed was very appropriately, in the electrical transmission systems -- and that requires some explaining.

There is no way in which we can get energy from here to there as fast as by wire. Energy by wire is many fold faster than its delivery over the pipelines, or by ships full of oil. When you want to send electricity great distances, you have to get very high voltages and the higher the voltages the wider apart and higher the apparatus must be to avoid short circuiting and overloading by lightning strokes. Distance in electrical distribution has been limited during the last forty years to about 350 miles. That was the capacity of electrical generating and transmission apparatus as then designed. In the 1920's the power and metals controlling pirates had built apparatus with as large a voltage capacity as was feasible in view of the quantity of metals then to be made available without elevating the metals prices beyond negotiability. And the top distances of that 138,000 to 230,000 volt system was 350 miles. It was discovered, however, in 1960 that with the glut of metals coming into availability as scrap from World War II, that there would be sufficient to build a new national network of greatly increased dimensions permitting elevation of long distance transmission from 230,000 volts, up to 500,000 and 1,000,000 volts. With the new high voltage, we could transmit up to 1,500 miles. The metals flood made this new overall voltage magnitude a very practical matter. No part of this story seems to have reached the newspapers or magazines until this year. But, starting about three years

ago, the private sector of the electrical apparatus designing industry began to put the feasibility and quantation problem of a designed reworking and integration of the national electricity networks into the computer. The problem was to discover in which way the private power interests would make the most money -- by or by not upping the voltage and integrating the national distribution networks? With the ultra high voltage it was possible to reach great distances and integrate remote networks systems as we have not been able to do previously even at a top 230,000 volts capacity, between the different time zones of the United States. Every electrical generating company has the problem of maintaining the experience proven minimum surplus margin of standby-power to take care of unexpectedly compounding big electrical power loads -- the unpredictable peak loads. And all standby-power that is not used is completely wasted. If used, it could be pure profit. Network integration smooths out the power loss peaks and increases profits.

It became evident that if the networks of different time zones of the U.S.A. were interconnected by the ultra high voltage, long distance transmitters, that the peaks and valleys of adjacent systems would fit together very efficiently. The computers indicated that with ultra high voltage it would be possible to integrate the whole United States and all four of its time zones. It was discovered by the design researchers, however, that such nationwide integration also involved merging of both the public and private networks which integration heretofore had been theoretically opposed by the private interests as an unwanted reconcilliation with their "enemy".

The computers however showed both the public and private sectors that ultra high voltage integration would result in both sides making a 33% additional profit. Of course both sides signed up and the long battle between private and public power was ended. There was nothing about the merger in the newspapers. If the public had known what had happened, they would have known that Johnson was going to be elected. That was the end of private power's financial underwriting of the Republican party. Because it was the private power interests who most opposed government centralization, this economic point of contention is removed. A new Republican party if it arises will have to find some other kind of economic base. To find an adequate one will mean joining forces with the forces of change and that will mean a liberal Republican party or none at all. The residual old line reactionaries are too few to have significance.

What I am pointing out mostly is that the computer was able to solve this public vs. private power problem which it had been thought could never be solved. So, I assert that we are a society that is going to be developing an increasing confidence in the competently programmed computer to provide clear unbiased answers to questions heretofore held to be unsolvable, particularly those questions which provide answers which can show which way powerful segments of World society will mutually and most copiously profit, in both short and long terms. This will bring about a large series of surprising mergers of heretofore opposed interests.

For instance, it is now visible that after integrating the network across the United States, the new 1,500 miles transmission reach will bring connection to Alaska. This will bring in also the enormous water generated electrical power of the Canadian Rockies. From Alaska we cannot only go right into the Aleutian Islands, but we can go under the Bering Straits and hook up with the great Russian networks in Eastern Siberia. This will provide an intercontinental powerhead immediately adjacent to and ready to flow into China. China's leaders have promised their people physical success through industrialization. The essence of successful industrialization is energy available as unlimited power by wire anywhere. This integrated powerhead will make possible China's achievement of full

industrialization decades earlier than expected. The Americans, the Russians and the Chinese will put the problem into the computer to find which is most profitable to each and all -- to integrate or not integrate. All hands will be informed by their respective computers that network integration will bring large mutual advantages. The Chinese and Russians will have to choose between the political advantages of deliberate, but unnecessary, prolongation of a class struggle between the haves and have-nots and letting the controlled energy flow into their systems to altogether eliminate havenotness everywhere and thereby to eliminate all basis of class struggle. The political leaders forced by their engineers and science educated public will be forced to choose to integrate and the ideological differences will vanish. Thus, all unexpectedly almost all obstacles to man's comprehensive physical success will be removed.

On Southern Illinois University's Carbondale campus, we are going to set up a great computer program. We are going to introduce the many variables now known to be operative in world around industrial economics. We will store all the basic data in the machines memory bank; where and how much of each class of the physical resources; where are the people, what are the trendings and important needs of world man?

Next, we are going to set up a computer feeding game, called "How to Make the World Work." We will start playing relatively soon. We will bring people from all over the world to play it. There will be competitive teams from all around Earth to test their theories on how to make the world work. If a team resorts to political pressures to accelerate their advantages and is not able to wait for the going gestation rates to validate their theory, they are apt to be in trouble. When you get into politics, you are very liable to get into war. War is the ultimate tool of politics. If war develops, the side inducing it loses the game.

Essence of "success in making the world work" will be to make every man able to become a world citizen and able to enjoy the whole Earth, going wherever he wants at any time, able to take care of all the needs of all his forward days without any interference with any other man and never at the cost of another man's equal freedom and advantage.

I think that communication task of reporting on the computerized playing of the game -- "How to Make the World Work" will become extremely popular all around the Earth. Because we're going to be playing that game so soon at Southern Illinois University and because there is such a fabulous acceleration in the rate of world events, I felt that we could no longer wait and am therefore announcing it to you now at this "Vision 65" Congress.

I am deeply interested in the play of our intuitions. I am inclined to think that our integrated organic capability is much more powerful than any of us tend to accredit. I have learned how much we can apprehend in just the flash of an eye. In one ten thousandths of a second, a strobe light can get a beautifully detailed photograph. I am quite certain that humans can enter a room and tell instantly what the real situation is. But, they don't usually trust their own high capabilities so they spend hours trying to find out whether their first flash impression was right or wrong. As I travel around the world today, I see in a flash that the eyes of youth see that the world could be made to work for all of humanity. And I see that they will settle for nothing less. And I see that they are impatient. And I see above all that they can and will soon make it so.

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40TH ANNIVERSARY ISSUE

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PROSPECTS OF AMERICAN CIVILIZATION—
AN INVENTORY OF HUMAN HOPES

Saturday Review

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THE PROSPECT FOR HUMANITY

The following article by Mr. Fuller is the first instalment of an occasional column to appear in SR under the title "Notes on the Future." It is adapted by him from the last chapter of his forthcoming book, "Design Science," which embodies his lectures and conversations as Harvard's 1961-62 Charles Eliot Norton Professor of Poetry. Mr. Fuller, inventor of the geodesic dome and the Dymaxion three-wheeled automobile, was a personal friend of the founding editors of SRL—Henry Seidel Canby, Christopher Morley, Amy Loveman, and William Rose Benét. He was one of the original contributors to the magazine.

By R. BUCKMINSTER FULLER

THE SCRIPTURES were right: the meek have inherited the earth. But they do not know it. Though irrevocable, the will has not as yet been finally probated in the court of public comprehension. The will says, "The prospects for humanity are metabolically excellent, intensely interesting, culturally fabulous, and of ever greater intellectual challenge."

But the will, it must be noted, makes all of humanity its beneficiary. It does not favor or promise unique prosperity to any exclusive blocs of humanity. For the professional secretariat of the Daughters of the Punic Wars; for political spoils systems; for national sovereignties; for annual trade balancing with gold and its concomitant exchange depressions and resultant human wage- and purchasing-power inequities; for any negative social, economic, or psychological differentiations of human origins or color; for might-makes-right; for purchasable accoutrements, architecture, equipment, and gadgets of distinction; and for the plethora of behavioral obnoxica imposed or induced by the supposed inexorability of the Malthus-Darwin theorem of survival only for the slickest fittest, *it is curtains.*

The will of history reads "for everybody or for nobody," and since we balk at "for nobody" it has to be "for everybody." And that's the way it is going, lickety-split and the world around.

I did not say that everybody will be happy and every event a joy. Far from it. If your chief happiness has been that of possessing at the expense of others you will be sunk. This revolution is not being effected by pulling the top down. It is being effected by pulling the bottom up. It is being effected by doing more with ever less in such a manner as to take care of all without taking away the functional capabilities and fundamental advantages of any. The surprise—constantly doing vastly more with ever fewer physical resources per function—is our legacy from the millennia-long armaments struggle to do more with less in a world where a pea-size transistor now does more than an army of yesterday and a fistful of atomic fuel takes a large ship around the earth.

It is an easy matter to foresee the trend of physically dramatic events during the next twenty-one-year generation. We will go to the moon and start communicating with humans in other parts of the universe and open up entirely unexpected new realizations of the significance of man in the universe. We will probably learn that Darwin was wrong and that man came to earth from another planet and monkeys are hybrids degenerated by overlong inbreeding of isolated humans. We will penetrate the ocean depths, enlarging our world threefold. We will float large colonies of humans around the world in tensegrity geodesic cloud-island spheres taxi-serviced by helicopters. And, because every action has its reaction, as we achieve new magnitudes, millionfolding our forward undertakings in time, so will we millionfold our knowledge backward in time. The archeological, anthropological, and ecological history will be as stimulating to mankind as will be the extension of knowledge through realized technology.

Within the next twenty years our theme song may well be "Anything Buck Rogers can do, we will do better," whether it be strapping on our jet-stilts knapsack and jumping Peter Pan-wise to our office window ledge (properly dressed, of course) and winging outward and homeward by automatically steered, collision-avoiding beam controls, or conversing over satellite-relayed, private-beam television with anyone, anywhere around the world or in space.

If you don't credit this forecasting, witness the contracting time spans between man's successive historical advances in circumnavigation of the earth. His first known circumnavigation is in a wooden sailing ship, circa 1500. His second advance is by steel steamship in the mid-nineteenth century. His third breakthrough is by aluminum airplane in the late 1930s. His fourth breakthrough is in a super alloy rocket capsule in 1957. The times required for these circumnavigations—approximately three years by sailing ship, three months by steel steamship, three days by aluminum airplane, and an hour by rocket capsule—clearly show that by 1985 almost anything you can dream of can and will have happened and that man will be living in an entirely new, responsibly conscious relationship to the universe.

I could go on to put meat and muscle on the bones of such forecasting, but since the comics and science fiction have made the coming actualities physically anticlimactic I find it much more rewarding to consider how we may be getting from here to there in the familiar terms of day-to-day economic, political, and cultural reorientations and to speculate on how they may come about. To do this I must take inventory of emerging trends that seem significant.

Trend No. 1. Medical science, through development of interchangeable human parts, both organic and inorganic, may be about to develop the continuous or deathless man. It is now concerned with rendering the integral, mostly internal, corporeal organisms of man ever more adequate to the evolving environment. The architectural scientist has become concerned with rendering the extracorporeal, external organisms of man—the world network of industrialization—ever more successfully adequate to the evolving environment. This is being accomplished by a comprehensively redesigned use of resources in such a manner that the continually decreasing per-capita resources of the earth, which now serve only 44 per cent of humanity with industrial advantage, will be made to serve 100 per cent of humanity at a higher standard of living than has ever been known anywhere by anybody. This is to be done by broad introduction of higher-performance techniques; for example, by substituting wireless for wire in communicating systems, or by scrapping all the two-ton prestige automobiles and producing out of the recovered metals twice as many one-ton cars of higher operating econ-

omy and closer parking capability. Most importantly, in response to the automation-engendered unemployment problem, this design-science revolution may be acceleratingly accomplished by paying everyone to go back to high school, college, university, and research and development laboratories, leaving physical production to ever-increasing automation.

Trend No. 2. The university student, having attained his first freedom of initiative, his optimum level of metabolic efficiency, bodily coordination, and general outlook, finds that his idealism is concurrently exposed to an awareness of powerful intellectual and technical disciplines. At the same time he is the recipient of frequent science-technology breakthrough news, such as under-the-polar-ice passages of atomic submarines and new achievements in rocketry and electronics. He also receives an overabundance of news concerning world want and political stresses that break into ever more frequent crises.

Logically, the student becomes exasperated and says, "Why can't we make the world work? All the negative nonsense is the consequence of outworn, ignorant biases of the old-timers. Let's join forces and set things to rights." Parading in multitudes, students demand that their political leaders take steps to bring about peace and plenty. The fallacy of this lies in their mistaken, age-old assumption that the problem is one of political reform. The fact is that the politicians are faced with a vacuum and you can't reform a vacuum. The vacuum is the apparent world condition of not enough to go around—not enough for even a majority of mankind to survive more than half of its potential life span. It is a "you or me to the death" situation that leads from impasse to ultimate showdown by arms. Thus more and more students around the world are learning of the new and surprising alternative to politics—the design science revolution, which alone can solve the problem.

The students are thrilled to realize that it is themselves they must turn to in order to make the world work, through practical use of their university science and technology resources and their laboratory-supported design science capabilities. The students know that they need no more license to invent the tools that will make the world work than the Wright brothers needed a license to invent one of the most needed more-with-less tools—the airplane. The student's task is clear-cut. It is to increase the over-all efficiency of the world's mechanical devices from their present 4 per cent to an over-all efficiency of 12 per cent. This is easy, since over-all efficiences up to 80 per cent are now feasible. The students know that if they invent the right tools, the tools will be used, given the right emergency. And they know that their design science revolution is bound to work because the emergencies to foster its realization are already here. Their revolution is a bloodless revolution that brings peace in the only way it may ever become effective—by elimination of the physical wants that always underlie war.

Trend No. 3. There are now in the world several thousand powerful high-capacity, information-storage, electronic computers. The number of them approximately doubles yearly. That means a quarter-million of them by 1970, 250 million by 1980, and 8 billion by 1985—more than two per each world human. The computers, both large and small, are machines for mathematical pattern cognition and recognition storage, retrieval, and coordination; the human brain is the prototype. As with the human brain, all pattern processing consists of two main classes: differentiation and integration; *i.e.*, specialization and generalization. Differentiation identifies, evaluates, selects, and separates the uniquely developing patterns. Integration ratiocinates comprehensively the coordination rates and magnitudes of complex interactions, developments, or transformations.

To appreciate our state-of-computer-affairs, we first must be aware that throughout the last fifteen years many philosophers have been disturbed by the claims of some cybernéticians that computers are soon to displace the human intellect. If, instead, they had confined their prediction to the effectiveness of the human brain in respect to the computer, some of their claims might in time prove valid. For a long time philosophers assumed that the computer could not ask original questions. They said that the computer can only re-ask a question man has taught it to ask.

Despite the philosophers' wishful predictions, the computer has now demonstrated its ability to ask an original question—and it did so without being instructed. Otherwise the question could not be assessed as "original." The surprise demonstration came about approximately as follows: You can teach a computer to play games, for instance to play checkers. You can also teach a computer to play backgammon. You also can build a computer with enough parts to permit it to play both backgammon and checkers at the same time.

Now, both backgammon and checkers are played at different rates. Furthermore, the checker moves are simple and direct. Backgammon is complex. Therefore the same computer, playing both games concurrently, completes the checker moves far more rapidly than the backgammon moves. The backgammon rate is not an even wave-length multiple of the checker rate. Therefore, as with disynchronous, high-frequency twin motors, there develops a secondary low-frequency, intermittent recurrence of coincident cycles, or interferences. Suddenly the machine has to make both the checkers and backgammon moves at the same time. Because the computer has a given wave length interval within which to make moves, and because the latter is too short to accommodate both moves, the machine has to decide which it will play first. It has to ask itself and then decide, "Which is more important, checkers or backgammon?" If the machine has stored enough information on variable factors, including previous decisions, it may soliloquize: "Poor people play checkers and rich people play backgammon. I'd better cast my vote for the priority of backgammon because my memory storage also tells me that all the poor people are becoming rich and will emulate their conditioned-reflex image of being rich." From this moment, rightly or wrongly, the machine's storage contains this prospero-proletarian predilection.

"Which is more important, checkers or backgammon?" is an original question that had never been asked by man of himself or of the machine. We find that the asking of original questions is a consequence of interferences, whether in the computer or the human brain.

As far as the computer's differentiating function as judged by experts is concerned, it can be said that the computer is about to make man obsolete as a specialist because the machine can differentiate and seek out much more accurately, swiftly, and persistently than man can. The computer can stay up all night, night after night, selecting the greens from the blues under humanly intolerable conditions of heat, cold, smells, etc., yet never tire. That the machine is to replace man as a specialist, either in craft, muscle, or brain work, is an epochal event. The computer as superspecialist produces, multiplies, and administers "automation." Because the computer is superior to man as specialist, comprehensive world automation has always been developing inexorably and is now inexorably imminent.

The scientist-philosophers of computer integration say that because the asking of original questions is a consequence of interferences, and because interferences are products of time sequences, it follows that original questions are both functions and products of time. There must be a great number of moves and a vast number of computer components before enough time can elapse to develop new types of secondary or tertiary interferences that in turn may from time to time provoke original questions. The human brain as a com-

puter mechanism consists of approximately a quadrillion times a quadrillion atoms in coordinate interpatterning. It will be a very long time before man will be able to develop an extracorporeal computer with that many transistors, storage cells, and other components. The experts also point out that, dealing in integrative complexity as a function of time, the human brain has always been dealing in complexity and has also been integrating comprehensive, historical continuity of human-experience-reflexed, design evolution relayed by human genes. Therefore, the experts say, we would have to have man-made computers running for 1,000,000 years or so in order for them to develop an equivalently integrated complexity. The experts do not see any immediate, or even far distant, competition by the machine computer with the human brain in the functions of complex integration.

We can have an integrator calculating, designing, and automatically manufacturing and putting together a geodesic dome in a giant jig, after which an automated "sky tug" helicopter will carry the dome away to install it and prepare it for human occupancy, thus providing a telephone-system type of inventing, developing, installing, maintaining, relocating, and continually self-improving service industry, able to provide telephone-ordered "instant housing." Such a computer-controlled housing and livingry service industry is even now feasible at 1 per cent of the weight, time, and energy involvement per unit of volume and living equipment found in conventional high-standard suburbia or Park Avenue skyscraper technology.

In relation to the computer-tool hookups of automation, it is to be noted that all tools are externalizations of originally integral functions of human organisms. But externalized functions such as that of the cupped hand to hold water are capable, when translated into ceramic cups, of holding hotter or more acid liquids than the human hand could. This is to say that the limits of capability of the externalized functioning are extended but are not unique in principle. Whereas the craft tools developed by man operated independently, the industrial tools develop interdependently. The machine lathe requires the blast furnace and vice versa. Individual craft tools are the externalized counterpart of the individual's separate functions, while industrial tools are the organic externalization of man's integral metabolic regeneration. The whole process of human life from conception through gestation to birth is entirely automated. After birth, despite parental ignorance of the process, the child grows from seven to seventy pounds and then as a youth often goes to one hundred and seventy pounds. Biological growth is entirely automated. For at least 2,000,000 years, men have been reproducing and multiplying on a little automated space ship called earth, in an automated universe in which the entire process is so successfully predesigned that men did not even know that they were automated, regenerative passengers on a space ship and were so naïve as to think they had invented their own success as they lived egocentrically on a seemingly static earth.

Both the universal and the local ecological automation is so successfully designed as to allow man the luxury of thinking and acting "consciously" in meager and often perverse degree and even of meddling with the evolutionary mechanism without putting the mechanism's many degrees of freedom of action into jeopardy.

With our human-computer brains, we will not now consciously relate the mechanical computers' significances with other important information.

Trend No. 4. At the American Association for the Advancement of Science's annual 1961-62 meeting, among the thousands of papers presented, there were two of special interest to us. One dealt with all the biological species that have become extinct, the other with human tribes that have become extinct. These independent papers searched for common characteristics that might account for the extinction. In both cases it became clear that all the biological species that have become extinct and all the human tribes that have become extinct became extinct for one reason—overspecialization. Evolution involves constant change. When living species become so specialized that they cannot adapt to an unexpectedly large jump in evolutionary events they are "out."

Now, men in our industrial and educational system have become more and more specialized. Everyone, wanting economic security, has seemed to think that as specialist he could command the toll gate of an expressway to unique and essential information. He thought: "A great many people will have to go through my specialization toll gate and I'll have a special, education-guaranteed economic security."

Trend No. 5. When we combine a) the trend toward increasing specialization with b) our knowledge that overspecialization leads to extinction, we realize that our unwitting human trend toward extinction was about to be realized as we developed the ability, through hyperspecialization in mathematical physics, to take the atom apart and thereafter to develop fission and fusion. The scientists, as specialization's victims, knew nothing of how to control the military, commercial, or political evolution of their discoveries. But just as we are about to blow ourselves up, we discover that nature has invented man with a built-in safety factor, an automated self-destruction-arrester. The safety factor is the built-in propensity not only to invent and develop tools of destruction but also inadvertently to invent constructive tools that render the destructive inventions obsolete. In this case the computer was immediately adopted by the military specialist to control the performance of rocket weapons. Here comes the surprise: The computer is now making man to some degree obsolete as a specialist. Therefore, since it was overspecialization that was leading us toward self-extinction, man has inadvertently invented his own anti-self-extinction device. First diverting man from becoming extinct through overspecialization, the computer and its automation will go on to produce enough metabolic capability to provide lavishly for all humanity. It will thus eliminate the you-or-I-must-die corollary, or the Malthus-Darwin theorem of survival only-of-the-fittest.

This means that the computers will soon eliminate war as an evolutionary function by providing enough wealth to supply all mankind. To give man adequate "purchasing power" to keep industrialization in accelerated regeneration, we will pay all of humanity to go back to the schools, to the universities, to the advanced scholar laboratories, where they will generate progressively higher standards of living from fewer resources.

Trend No. 6. Displaced as a specialist, man is now being forced to become preoccupied exclusively with integrative patterning considerations. This means an epochal reorientation. All the educational systems from now on must forsake specialization and cultivate powerful generalization. Everybody will be taught to be comprehensivists. Fortunately, that will come naturally because man is born to be comprehensive. It is his most unique biological characteristic. As he cross-breeds he becomes more comprehensively adaptive. Only inbreeding brings specialized capability. The greater the degree of freedom and acceleration, the higher the probability of cross-fertilization.

Architects constitute the last species of professional comprehensivists, for they try to put things together while the vast majority, the specialists, have been concentrating on taking things apart. The trend of world students will henceforth be toward becoming architects—that is, comprehensive and cooperative design-science artists.

A brand-new type of university will probably be required. The conditioned-reflex disease of "categoryitis" with which world society and its bureaucracy are chronically infected is going to make the university's renaissance difficult. Uni-

versities will be vulnerable to displacement by superior educational enterprises; *e.g.*, the USA and other major world governments will probably adjust their disarming economies by giving multi-billion-dollar contracts to the former armaments prime contractors, such as Boeing, Douglas, Lockheed, and General Dynamics to enable these organizations and their scientific staffs to apply their powerful problem-solving capability to the new educational and communications problems of a one-world and space-age society. The big armaments contractors have become in effect the "super graduate schools." They have sequestered all the classified "advance information" and are therefore in a position to handle education, which is destined to be history's largest and most durable industry. Today's universities must compete or die.

Trend No. 7. In order to understand the hazards of these transitions, we must also understand another major trend. In the trends to disarmament, mankind has already disclosed its joy at the accomplishment of only a token reversal of the weaponry race. Man now hopes his politicians can go further toward disarmament, and the total world compulsion to disarm is felt with increasing force. As a consequence we will probably cut down, slowly, on armaments.

Russia, in her forty years of successive five- and three-year plans, gave priority to all of the heavy industries and then to the lighter industries essential to war. Sixteen million deaths by starvation was the price Russia paid for the priorities to get herself industrialized. She has deferred applying scientific industrialization to the direct raising of her standard of living. She now hopes to do so but is frustrated by the need to focus productivity on the continuing arms race with the U.S. Therefore Russia needs to attain disarmament, or she will not be able to continue to stall off the people's demand for the higher standards enjoyed by the Western world. But disarmament is stalled in the U.S. because the country cannot keep its economy going through the "irrigation system" now fed at the top through annual weaponry undertakings without seemingly subscribing to "socialism." In wartime emergencies, national management of economic activity is exempt from charges of socialism, but by custom and law such centralized authority is forbidden in peacetime. To avoid this embarrassment and to keep our economy healthy, wartime emergency powers are extended to meet the threat of the next war. This extension is called "cold war." The U.S. knows that the world needs and wants disarmament and that its socialism-avoiding subterfuge becomes increasingly evident to the rest of the world and thus less tenable. The government and powerful Washington lobbies of the armaments contractors, supported by the labor unions, are seeking ways in which to keep the economic irrigation system fed from the top while also attaining progressive disarmament.

What is necessary is to keep the multi-billion-dollar annual expenditure in new technology flowing to the prime contractors so that it can flow successively through the wages-and-dividends sluiceways and irrigate all industries and business in succession. For every time the paper dollars run through the system, the inventory of tooled-up capability to handle any production is improved and more of the previously untapped universal energy is piped into the system. Each time the dollars go through we get vastly richer. The old-timers call this "spending"; they need a course in semantics. They should understand what wealth really means in the industrial age. It is to the old pirate's gold as an ocean is to a glass of water. For an instance, the major nations of the earth invested $2.5 trillion in the development of the airplane during the fifty years following the Wright brothers' invention. Since there is only $40 billion in minted gold in all the world, which is only one-sixtieth the airplane's price tag, the wealth that developed the airplane was obviously not the bankers' gold of yesterday. The wealth employed by all the industrial nations of the earth today is the organized metabolic capability wealth. It consists of two basic ingredients: energy and intellection. The energy itself consists of two subingredients—energy as electrochemical matter and energy as electromagnetic radiation. The physicists' law of conservation of energy states that "energy may be neither created nor lost." The physicists are the authority for the irrefutable fact that wealth cannot be lost; therefore it cannot be spent, which means lost. If any old-timers want to argue, send them to the physicists.

Where do the old-timers think all the quadrillions of today's industrial wealth came from? Certainly not from any gold bankers or feudal inheritances. The old static realities are obsolete.

Trend No. 8.

SCIENCE, having been employed almost exclusively in weapons development, will find itself progressively unemployed. The weapons-producing companies and the weapons-support industries, having high capabilities but dwindling contracts, are going to struggle ruthlessly to find other profitable enterprises. They will move overnight into the living as opposed to killing arts. We have already noted their probable move into education. Another probable move is into the arts and services usually and mistakenly spoken of as housing.

All you have to do is have a meeting with advanced industrial technology management to realize their inherent ineptitude in respect to the art and science governing the living service industry. Talk about a "house" and the industrialists immediately think about stamping out an aluminum or plastic replica of a Cotswold cottage, or they think of stamping out curtain walls or partitions: "You have to stamp out *something.*" That is as far as their brains, conditioned by advertisements and traditions, permit them to go in the byways of categoryitis.

The scientists' "house"-catalyzed concepts are even less imaginative and useful. The carriage, railway, and steamship industries of 1904, and their financial backers, directors, and top industrial managements, did not invent the airplane; nor did the university professors or the scientific societies. There is nothing in the present pattern of building that gives a clue to the ramifications of the upcoming world-habitat service industry.

Just as prototype inventions were the keys to the establishment of the aeronautical industry, so will prototype inventions be the key to this vast new industry. Many of the prototype inventions are already on hand. Others are developing in the U.S. and Russian man-in-space programs. What is most needed now is a clear definition of the functions of the world service industry that must be established to accommodate the forthcoming world citizen, requiring, at some times, living facilities in culture centers around the world and, at others, rest in remote places all the way from the tropics to the poles, which permit man to be intimate with nature's every phase without being punished by the intimacy.

If the professional architects of the world are too slow to support their architectural students' initiative in undertaking scientific redesign, then both industry and science will begin to stumble into the living field and it will become a historical fiasco. That could easily happen within the next five years.

The world architectural profession has just about five years to start the architectural students and design-science students developing the capabilities to take, hold, and develop the world's design-science initiative. Architects are going to have to give themselves powerful mathematical abilities. Fortunately, our research discovery of the omni-rational arithmetic of the tetrahedronally coordinate comprehensive mathematical system, employed by nature in all her transformative inter-accommodations, has now become confirmed by many scientific events. It provides a mathematical means adequate to the historical design-science task of redesigning the world's tools and services.

TREND No. 9. We must now consider other powerfully favorable historical factors affecting establishment of the world-around living service. Between Russia and the United States, $6 billion has been appropriated to develop the little scientific house in which man will dwell in space or upon the moon. But we note that though architects profess to be master solvers of space problems, thus far they have not been called into any part of the U.S. space program. The professionals who have been called in are space medicine specialists, physicists, mathematicians, geologists, psychologists, chemists, engineers, biologists; but there are no architects.

I am confident, from my direct experiments, that architects can be trained quickly enough and in such a way as to be much more effective in the space program than are those scientists and businessmen who are now handling the program. The architectural scientists will be especially effective in defining the ecological problem and its solution, thus forestalling the fiasco implicit in the scientists', technologists', and industrialists' esthetically-weighted market-analysis misconceptions.

I have familiarity with the space program in the United States and have found that the big contracts given out so far have gone only to large corporations that have dressed themselves up with large staffs of scientists in order to substantiate their lobbying competitively with the universities. The space scientists, of the successful bidders for space contracts, are given the problem of how to develop the space dwelling. They are not design scientists—they are subjective scientists. Design science must be objective.

Scientists are inherently subjective operators. They are trained to make faithful observations and to theorize about the schemes of nature into which their data may fit, but not to consider the significance of their findings as objectively employable. They are too specialized to comprehend complex integration potentials and industrial realizations. Alone among scientists, the medical man is objective. Chemical engineers but not chemists are objective. I have been amazed when I have been called in by the big corporations as a consultant to discover how little they understand of what seems to me to be proper statement of the scientific, structural, chemical, and mechanical aspects of the scientific sky-dwelling problem and its implications for man on earth. The problem is to reduce the dimensions of the ecological pattern from a vast tree-air-earth-worm-bird-bee-rain-wind relay system to a three-foot-diameter, closed-circuit system by which man is able to sustain high health for twelve months without sewer disposal or further input supply besides sun radiation.

In his 1926 introduction to *Brave New World* Aldous Huxley hinted at a possible exception to his theme of an intellect-void, romance-vitiated, atheistic ahumanity. Mankind might, I gleaned, be inspired by a few leaders with a powerful and power-giving conviction of the existence in the universe of an intellect greater than that of man and of a universally operative integrity guarding and guiding all the inadequacies of man. Mankind, thus led, would work through many crises to attain physical success in the universe without cost to the manifold human freedoms, or any cost of individual joy in creative participation in the universal evolution. In his post-World War II second edition of *Brave New World*, Huxley revised the introduction, saying he tended to have a little more hope that his alternative theme might be realized. And in his succeeding *Brave New World Revisited* he disclosed an even greater hope that the happy alternative could occur.

It is probable that if the world's architect-scientists do gain and maintain the design-science initiative, Huxley's desirable alternative may be realized. If, on the other hand, the architects or students in general fail to gain that initiative within the next five years, then the weapons industry's overwhelming invasion of the livingry field will occur and will swiftly evolve into Huxley's awful dream.

Why is it likely that if the weaponry industry and its scientist-slaves take over the livingry industry, life will move toward Huxley's unhappy dream? And why is it probable that if the world's architectural students take and hold the design-science initiative the world will trend toward Huxley's happy, but to him, improbable dream? To start off with, industrial corporations are too nearsighted while scientists are usually infinitely too farsighted. Industrial corporations tend toward a plastic-flowered heaven with sexy-scented, plastic, call-girl angels. The scientists tend toward test-tube babies and the deflation of the reproductive urge on the psychiatrist's couch. On the other hand, architectural students are realistically idealistic and have well-coordinated vision and a running start on what is needed. Industrial corporations are preoccupied with immediate profits and not with man's total success. They are interested in making money while architectural students are primarily interested in making man a total physical, cultural, and moral success.

Architectural-science students will in due course realize that they are designing an entire family of complementary instruments of livingry—similar in comprehensive functioning to the whole family of musical instruments. They will be willing to allow man the privilege of playing his own instruments and of composing not only one-instrument music but of composing symphonies for the whole family of livingry instruments. The new architect will be wise enough to confine his design science to augmenting the integral organic functioning of man so well that the external organics may be coordinated to operate as unself-consciously as do healthy men's internal organisms. The design-science artist will leave man free to articulate the promptings of his soul in such a manner that each individual may enjoy his newly won and ever-increasing degrees of exploratory and creative freedoms without trespassing on one another and thus frustrating one another.

Optimism is usually thought of as constituting a mildly unwarranted hopefulness in respect to the future. But there is a reverse projection of optimism in the nostalgia-generated myths that recall only the rare and sublime moments of yesterday. Forgetting the negative, reverse optimism overemphasizes, thus deliberately shuts its eyes to reality, and is therefore unable to see the values immediately present.

I am convinced that we are swiftly emerging from the abysmal conformities of yesterday's illiterate, spit-punctuated profanity and monosyllabic verbalism, in which rags, filth, diseased bodies, prevalent stenches, devastating superstition, and local bias reigned supreme.

Beginning with World War I, science, technology, and industry began the epochal and ever-accelerating shift from track to trackless, from wire to wireless, from visible to invisible, and from Newton's norm of changelessness to Einstein's norm of constant, disynchronous, evolutionary transformation. Man entered into the vast ranges of the electromagnetic spectrum. Within the electromagnetic spectrum, visible light is exquisitely minute. At the present moment in history 99.9 per cent of humanity's important physical evolution —scientific, technical, industrial, and biological—is taking place in that major portion of the universe of which man has no direct apprehension, but with which he does have exquisite instrumental hook-up.

THIS brings us to the historical era of invisible architecture. In invisible architecture the harmonics are apprehensible only by our intuitions and subconscious esthetics, and operative only in the twilight zone between conscious and subconscious awareness. This is the area of intuitive and esthetic formulation. Just as we may instruct ourselves to wake up in three hours and thirty-seven minutes and do so with reasonable accuracy, so

also does the subconscious measuring capability of man's eye judge, at considerable distances, tc a sixty-fourth of an inch accuracy, the diameter of the female leg.

One of the last trends of humanity that we take up is this ephemeral esthetic, its intuitive apprehending and conceiving capability, and its now looming major importance in the guidance of human affairs. I will discuss this trend from the viewpoint of my own experience with geodesic domes, which are so relatively ephemeral as to weigh an average of only 3 per cent of the weight of the best alternate clear-span solutions of structural engineering.

There are about 3,000 geodesic structures in fifty countries around the world today. They have all gone to their sites in the last ten years. Many, both near and far, have been delivered economically by air. In Ghana, Nigeria, and other tropical African countries people find that geodesic domes work nicely as large umbrellas. The air circulates in through the top and outward around the wide open bottoms. Geodesics in the Arctic and Antarctic, though light enough for air delivery, are strong enough to handle nature's fiercest winds, snow loads, and temperature extremes.

My kind of work deals with how to find out the ecological problems involved and how to solve them, hoping thereby to bring about the occupant's satisfaction at the earliest possible moment. That is, I deal with the hows of mathematics and economics, the hows of industrial production and distribution, assembly, and service. I don't even consider how any structure is going to look until after it is finished. If, when finished, the structure seems beautiful, I know it is all right. To me, "beautiful" apparently emerges as an ejaculation, spontaneously released by my total set of subconscious control coordinates. "Beautiful" is probably ejaculated when my entire chromosomic neuron bank is momentarily in "happy" correspondence with my entire experience (memory) neurons bank. I speak of my brain as if it were a computer. It is.

THE great evolutionary engagement of man with the non-sensorially apprehensible yet physical universe, achieved only through instrumental hook-up as an extension of man's faculties, is utterly dependent upon the integrity of the instrumental functioning and the integrity of functioning of the adult intellect at a level of purity corresponding to that of the four-year-old child's, whereof Christopher Morley wrote in 1922:

The greatest poem ever known
Is one all poets have outgrown:
The poetry, innate, untold,
Of being only four years old.

Still young enough to be a part
Of Nature's great impulsive heart,
Born comrade of bird, beast and tree
And unselfconscious as the bee—

And yet with lovely reason skilled
Each day new paradise to build,
Elate explorer of each sense,
Without dismay, without pretense!

In your unstained, transparent eyes
There is no conscience, no surprise:
Life's queer conundrums you accept,
Your strange divinity still kept.

Being, that now absorbs you, all
Harmonious, unit, integral,
Will shred into perplexing bits,—
Oh, contradiction of the wits!

And Life, that sets all things in rhyme,
May make you poet, too, in time—
But there were days, O tender elf,
When you were Poetry itself.

By my calculations there is mathematical probability that progressive mastery by man of the physical coordinates of nature, and their progressive subordination to total abstract concepts, may indeed be trending historically to permit the integral being of the child to remain unfractionated throughout the total life span. For instance, we are unaware of our own tongues until we bite them. When in health and good form, the total myriad component functions of our physical being are entirely subordinated to subconsciously coordinated functions of the regenerative pattern of the whole individual life.

Humans dying in hospitals have often been weighed as they crossed the threshold between life and death. No weight is lost. Life is weightless, imponderable. When life has departed, the radiant heat, the brain-propagated energy waves, and the radiance of being are alike gone. The full physical inventory of the corpse remains—useless, reminiscent, but that is all. That is the way I read the data of man's significant exploring.

Margaret Mead said recently that God is rarely mentioned at scientific or social conferences. This is not so much a phenomenon of conferences as it is a characteristic of our times. Many think of science and the age of industrialization as atheistic. Scientists frequently have been asked by less educated men whether anything they observe through their microscopes or telescopes confirms religious dogma and the Scriptures—and, if not, must they not forsake Scripture and religion as having no fundamental significance whatsoever? Surprised by the question and unconvinced that they are atheists, the scientific specialists, also avoiding philosophical speculation as treacherous ground for reasoning, have been notably ineffective in refuting their atheistic status.

Cosmology and philosophy have been differentially dissipated in the era of increasing specialization. Total thinking is now almost completely legendary or speculative. For instance, it is a popular conception that the universe must have been begun in chaos, out of which it has happened from time to time that probability, reversing its law of increase of the random element, has surprisingly accumulated increasing order. It seems that this illogical increase of order accredited by the popular science cosmology has also from time to time been aided by scientists who "wrest order out of chaos." Finally, according to the legend, probability and science together have now provided us with an extraordinarily well-organized chemical, physical, and biological world within a universe of gratifying regularities.

The scientific record refutes this *a priori* chaos scheme. Every great scientist who has documented the events surrounding his major discovery has documented the fact that, in comparison to his crude hypothesizing, his discovery disclosed a sublime regularity of nature. The regularities of nature are governed by pure mathematical principles. Thus, since principles are inherently weightless and infinite—that is endless—the universe could never have been chaotic and thus has no beginning.

In 1930 Einstein wrote of the non-anthropomorphic conception of God and of the cosmic religious sense, asserting that the great scientists such as Kepler who had been called heretics were indeed the most profoundly religious men when appraised in a cosmic, non-anthropomorphic sense. Einstein said, "What an extraordinary faith in the orderliness of universe must have inspired Kepler to spend the nights of his lifetime alone with the stars."

Scientists, having developed double names for their overlapping work (biochemistry, biophysics, etc.), are now finding their total field interconnected and unitary. This is a general trend of science. And so many scientists are now being educated that it may be forecast that within the next half-century not only science but much of educated society will have come naturally through its own explorations and experiences to discover the comprehensive order of the universe. Thus they will inadvertently develop a regeneratively inspiring faith in the order and integrity of the universe.

And because the complexities of this universe are only intellectually comprehensible, recognition of an intellect greater than and anticipatory to our own intellections is inexorably emergent in the integrating totality of scientific exploration. This means the personal, first-hand discovery by increasing numbers of humanity of non-anthropomorphic God, the great intellectual integrity of universal evolution.

LETTERS TO THE EDITOR

SR/ September 26, 1964

CONGRATULATIONS ON your fortieth-anniversary issue [*SR*, Aug. 29].

It is characteristic of you—and *Saturday Review* to observe this anniversary looking ahead, rather than looking back. Sharing, as I do, the conviction that we are coming to a more hopeful time for man, I especially welcome the challenge of this confident view of the opportunities opening to us all.

I hope that America's leadership—and the leadership of America—will prove worthy, not only to protect the peace of man, but to lead toward fulfillment of the promise of man in our land and around the world.

LYNDON B. JOHNSON,
President of the United States.

Washington, D.C.

THE FORTIETH-ANNIVERSARY ISSUE of *Saturday Review* has just reached my desk.

I wish to add my congratulations to all the others *Saturday Review* is receiving for forty years of excellent intellectual endeavor. I have noted with gratification this magazine's growth in scope, circulation, and influence under your editorship.

The world of ideas owes much to *Saturday Review* and to you.

DEAN RUSK,
Secretary of State.

Washington, D.C.

IT IS A PLEASURE to congratulate you upon celebrating the fortieth anniversary of *Saturday Review*. Your anniversary issue is truly an excellent illustration of the high place the magazine has won. . . .

Saturday Review today rates as one of the foremost organs of criticism and information in the free world not only in the arts but also on affairs in general.

You and your brilliant staff may well be proud of your accomplishments.

My best wishes for continued progress throughout the years to come.

NELSON A. ROCKEFELLER.
Governor,
New York State.

Albany, N.Y.

I HAVE JUST HAD the opportunity to look over a copy of the fortieth-anniversary issue of *Saturday Review*. It is a most impressive edition.

Through the years I have watched *Saturday Review* and noted the contribution it has made to a better America. I am especially indebted to the help you have given us in your coverage of Peace Corps activities around the world.

SARGENT SHRIVER,
Director, Peace Corps.

Washington, D.C.

BRAVO! Forty years has brought *Saturday Review* the maturity and strength—but not the flabbiness—of middle age. Yours is a journal of the highest quality and I am proud to add my kudos to those you are undoubtedly receiving. . . .

May *Saturday Review* continue to flourish . . ., bringing insight and wisdom to its readers, and proving that life does indeed begin at forty.

ABRAHAM RIBICOFF,
U.S. Senate.

Washington, D.C.

IT IS INDEED A PLEASURE to extend congratulations on the fortieth anniversary of *SR*.

At the end of four decades, the *Review* can look back upon a sometimes precarious but always interesting and productive existence. I join with your ever-widening readership in wishing you not only many more prosperous years ahead, but an ever-greater contribution to the intellectual and cultural life of the nation.

CLIFFORD P. CASE,
U.S. Senate.

Washington, D.C.

THE FORTIETH ANNIVERSARY of *Saturday Review* is occasion for congratulations to your magazine on its extraordinary achievement in proving that a publication which holds fast to such high principles can be successful, and to N.C. for the editing which has done so much to make it so. . . .

ABNER W. SIBAL,
U.S. House of Representatives.

Washington, D.C.

SR/ October 3, 1964

I HAVE JUST SEEN a copy of *SR*'s anniversary edition [Aug. 29] and, though I have not had a chance to read all of it, I must say that its contents truly reflect the breadth and scope of your magazine's contribution to our society.

I note that your cover page carries the subtitle "Prospects of American Civilization: An Inventory of Human Hopes." This, I think, is more than a description of the edition; it is an assessment of forty years of constructive endeavor to reflect both the hopes and the needs of the American democracy.

Please accept my warmest congratulations on completing a generation of remarkable service both to your readers and to the nation.

THOMAS J. DODD,
United States Senate.

Washington, D.C.

THE FORTIETH-ANNIVERSARY ISSUE was excellent and thoroughly enjoyable, containing the appropriate balance of happy reminiscence and thought-provoking polemic.

But more importantly, this issue was an accurate reflection of *SR* through the years—a journal that brings pleasure but not smugness, information but not a shallow recitation of facts, and criticism not only of books but of ideas and institutions.

On such a diet, *SR* aficionados can be sure that their favorite magazine will flourish for at least forty more years.

JACOB K. JAVITS,
United States Senate.

Washington, D.C.

CONGRATULATIONS ON *SR's* FORTIETH-ANNIVERSARY issue. It should be placed in a time capsule to give future historians a fascinating picture of the past four decades.

John Lear's "The Future of God" is stimulating reading. The future of the Creator seems somewhat more certain than that of his creatures in the world ahead.

I wonder if it ever occurs to Sir Julian Huxley that the statement that the "god hypothesis" must be abandoned is self-refuting when he finds it necessary also to say that there "must be something to take its place." Voltaire, whom Huxley is echoing, seems to have seen the truth better.

I have always liked the statement of T. H. Huxley (Sir Julian's grandfather): "It is the first duty of a hypothesis to be intelligible." God is not a hypothesis but an intelligible reality, as the experience of the great mass of mankind illustrates.

(The Rt. Rev.) WALTER H. GRAY,
Episcopal Bishop of Connecticut.

Hartford, Conn.

I HESITATE TO CONTRIBUTE to the burden of what I am sure must be an avalanche of mail felicitating *SR* on the fortieth-anniversary issue. It is a stunning achievement, not because it contains many high spots, but because it is a superbly conceived mosaic of pieces by the *one* perfect fellow for each assignment, and there is not a single weakness.

The one compelling complaint is that, given the volume of must reading with which we are all confronted, it is a real outrage to come up with so thick a book, every single item of which must be read and will then, of course, be treasured.

THEODORE WALLER.

New York, N.Y.

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WORD MEANINGS

R. Buckminster Fuller

Because of the experimentally demonstrable fact that the minimum complex of acts involved in measuring always alter that which is being measured we accept Heisenberg's principle of inherent "*indeterminism*" which concedes that *absolute exactitude* is unattainable; it is also experimentally demonstrable that the relative degree of inexactitude of measurement to be tolerated at any one moment is progressively reducible.*

In view of the foregoing (A) *indeterminism* and (B) *reducible tolerance* and subject to further modifying inclusions, exclusions, rearrangements and refinements, we may tentatively assume the following word meanings.

Design (Considered both subjectively and objectively, metaphysically or physically).

Contiguous angle and frequency modulation of event interactions in respect to the axis of any two specific event foci.

* *Foot Note:* The smallest increment of spacing between naked human eye perceiving physical event-center points is between 1/50 and 1/100 of an inch. In the buildings business the "tolerated error" varies between 1/2 and 1/4 of an inch. In automobile manufacturing, mechanical "tolerance" varies between .01 - .0001 of an inch; in aircraft manufacture tolerance is between .001 - 00001. inch, in astronautics, tolerance between .0001 - .000001 inch, in scientific instrumentation tolerance between .0001-.0000001 inch).

Structure

Systems of dynamically stabilized self-interpositioning energetic events.

Size

Concept of an experience's relationship to other experiences defined in terms of cyclic repetition of any one experimental demonstrable self-terminating or single cycle experience (a triangle, a tetrahedron, or a sphere etc. is a triangle, a tetrahedron, or a sphere *independent* of *size*. An angle is an angle independent of the length of its ledges. All of Plato's solids may have the same length edges because their differences are entirely angular. An angle is inherently a subdivision of a single cycle. Therefore, an angle is *sub*-size). Size begins with one specific cycle's completion. Angles are *conceptual* independently of size. Size is linear. As linear size of an object is doubled surface is fourfolded and volume is eightfolded —ergo areas increase at a velocity of the second power and volumes at a velocity of the third power—ergo size variation relationships are deceptive and not superficially predictable by any one experience. As we double the length of a ship its surface is fourfolded. In as much as the power to drive a ship through the sea and air at a given speed is directly proportional to its surface, when we double its linear size we fourfold

its rate of expenditure of energy but we eightfold its payload capacity. A ship's size is popularly thought of in terms of her length. Therefore, it comes as a surprise to learn that a man with a ship twice that of another's can make eight times as much profit. That is why ship owners and sailors talk to one another in terms of tonnages which is based on volumetric displacement of water by weight.

Synergy

Behavior of whole systems unpredicted by behavior of any of its parts taken separately from the whole. A stone by itself does not predict its mass attraction for another. (Synergy is the only word in any language having that meaning. The German word *gestart* like the English word *constellation* means a complex standing together, but infers no more than the desirable of having all the regular parts i.e., not being deformed). As *synergy* is not a popular word as demonstrated by questioning over a thousand audiences of whom less than five percent had ever heard of the word, it may be concluded that the public does not think that it has need of a word for behaviors of whole systems unpredicted by behavior of any of its parts taken separately, wherefore it is clear that society is unaware of the existence of such a phenomenon. But a sampling of chemistry-honors student audiences and of biochemists shows that 100% of such students are familiar with the synergetic behaviors of nature. This means that society's preoccupations with specialization has precluded its spontaneous comprehension of the significance of its completely compounded experiences.

Universe

The aggregate of all of humanity's consciously apprehended and communicated experiences. The communication can be from self to self or from self to others. Since all experiences are inherently non-simultaneously occurring and only partially overlapping event sequences of different durations and different atomic frequency complexities, Universe is a sequentially evolving scenario and cannot be conceived in one "picture" or "sculpture" sense.

The picture of the caterpillar does not predict the butterfly into which it is progressively transformed nor does one picture of the *butterfly* demonstrate that the butterfly can *fly*. Since each of the experience complexes and each of their parts are terminally finite, the aggregate of their separate finitenesses is sumtotally finite, but being non-simultaneous and complexedly dissimilar is non-unitarily conceptual. It is a synergetic quality of universe that though finite it is inherently non-unitarily conceptual. To ask what is outside of the outside of universe is a single picture question and is inherently unanswerable. It is an intelligent question as would be also which word is the dictionary?

System

The first subdivision of universe into a conceivable entity which separates all the universe into two main parts i.e., all of the universe which is non-simultaneously outside of the system and all of the universe which is non-simultaneously inside the system; and all of the remaining universe which is conceptually in the system's set of component events of conceptually tunable interrelatability — conceptual tuning being physically within the "rainbow" range of the electro-magnetic spectrum, and imaginatively conceivable within the size-independent, angular configurations and topological characteristics of polyhedra or polyhedronal complexes. Systems having *insideness* and *outsidedness* must return upon themselves in a plurality of directions and are therefore interiorially concave and exteriorially convex. Because concaveness reflectively concentrates radiation impinging upon it and convexity diffuses radiation impinging upon it, they are fundamentally different, and therefore every system has an always and only coexisting complementarily. System unity is inherently plural. Unity is plural.

Precession

The affects of one moving system upon another moving system. Precession is describable in vectorial terms i.e., of physically realized Design - expressed differentially as relative angle, velocity and mass (size) modification's in respect to an axis.

The precessional results of all *events* are always threefold, embracing (1) *Action*, (2) *Reaction* and (3) *Resultant*. None of these interprecessional event components occur at 180° to any other components. A system must have a minimum of 4 vertexes in order to have an omni-directional *insideness* and *outsideness* and six is the minimum number of vectorial edges uniquely connecting the four vertexes of the minimum system. The six vectorial edges are comprised of two energy event's inherent three - vector componentation of *action*, *reaction*, and *resultant*.

THE WORLD GAME

R. Buckminster Fuller

Underlying Key Theme. The World Game idea forsakes the political expedient of attempting to reform man and commits man to reforming his environment. This is to be achieved in such a manner as to "up" the performance per each unit of invested world resources until so much more is accomplished with so much less that an even higher standard of living will be effected for 100% of humanity than is now realized by the 40% of humanity who may now be classified as economically and physically successful. The possibility of setting up a large-scale "gaming" format would allow for various types of participating "simulations" on "How to make the total system work more efficiently". The World Game will, then, explore for, and experiment with, grand strategies for making the world work by continually assessing the design science revolution which would provide ever more effective tools and services with ever less, real resource investment per each unit of end performance. For example, a communication satellite weighing only one-quarter of a ton is now out-performing the transoceanic communication capabilities of 175 thousand tons of copper cable. Continual search for such effort reducing, more-for-less uses of our resources would eventually lead to a time when all of humanity could be taken care of at an even higher standard of living than man has as yet conceived of or even yet experienced. "Peace" will then be not just a catch-word, but an experienced reality, which has been assimilated and chosen as the best of all possible alternatives open to human design experience.

The World Game

A Game That Has No Losers

In 1927 I gave the name *ephemeralization* to the design science strategy of "doing ever more with ever less". Because of all the foregoing realizations, I saw in 1927 that it might be possible that we could do so much more with so much less that we could not only discredit the Malthusian dictum but also, and far more importantly, that we might be able to take care of everybody aboard our planet Earth with a very much higher standard of living than anybody has ever known or dreamed of experiencing. If that could be done, the theory of John Von Neumann's war gaming, which holds that utlimately one side or the other must die, either by war or starvation, is invalid. Therefore, I saw that we had an heretofore unconsidered alternative way to play the world game in which, as with mountain climbing, the object would be to find all the moves by which the whole field of climbers would win as each helped the other so that everybody successfully reached the mountain top and all returned safely to its base. This is a mathematically permitted alternative of game playing but it has never been played in any of the war games of the great nations of the Earth. To humanity's general scientific illiteracy, it has been inconceivable that there are invisible chemical and physical principles such as that of the transistor lurking invisibly in the landscape waiting for men to discover them, and thereby also to discover that by doing more with less there could be more than enough to support all humanity at a higher standard of living than any humans have as yet known (whereby realization of lasting peace might occur around our planet for the first time). That is what science has discovered in the last few decades to be possible. But science also finds that such an accomplishment is not possible without eliminating our world-around frustrations of the essential resources integration by the competitive sovereign systems.

S.I.U. Takes the Initiative

We have organized at Southern Illinois University, and we hope it will soon be in operation, a $ 16 million dollar computer implemented program for playing just such a mutual success seeking game in a dramatically visible way. It will be so photogenic that it will become popularly and repeatedly broadcast on the world's TV circuits. Thus society may come to realize not only what *is* happening but also what could happen in an omni-favorable way.

The Infra World

Humanity has a very limited optical spectrum, wherefore man can see today only one-millionth of the total physical "reality", as the latter is evidenced by the full range of the electromagnetic spectrum. Man used to think of reality as everything that he could sense with his eyes, ears, nose, taste and touch. We have learned, only since about 1930—when the first technical chart of the great electromagnetic spectrum was published—that man has sensorial tunability and is sensibly aware of *only one-millionth of physical reality.* The little rainbow color band of human "seeing" is less than one millionth of the stretched out reality of the invisible colors, of all the ninety-two regenerative chemical elements of associative energy or of the various radiations of energy in its disassociative phase.

Integration of Sensory Input

In addition to the *electromagnetic frequencies spectrum* we have also a *motion spectrum.* The sense of motion is produced by an overlapping continuity of after-images of a plurality of optically tunable separate and sequentially occurring electromagnetic frequency events just as music is produced for the hearing by a metrically momentumed sequence of both separate and resonantly overlapped sound frequency notes. Motion is visual music made possible by the spontaneous retention in the brain of a series of separate still picture frames of our separate sense experiences scanned and reviewed

in the brain at a vastly accelerated sequence rate. Our brain discovers that each successive electromagnetic picture is just a little different from the ones before and our dawning awareness of that increasing difference constitutes our *motion sense.*

Indeterminate Causes and Perceived Effects
The overall range of our human, *motion spectrum* is even more limited in respect to the full range of *cosmic motions* than is our optical frequency spectrum tunability in respect to the total electromagnetic spectrum. We can't see the atoms in motion; we can't see the stars move, though their motions are thousands fold faster than our fastest rockets; we can't see the trees grow; we can't see the hands of the clock move. Most important of all we cannot see the abstract weightless thoughts in the minds of other men. When we survey the total inventory of motions and informations which we can sense we find it to be very limited. The significance of all the foregoing is appreciated when we realize that it is only such phenomena as can be seen to be moving or changing by the public that are politically recognized and heeded. That is why public opinion and vote sampling has come into ever more reliable use.

New Frontiers of Resource Explorations
As the general system of vital trends becomes visible and its components are seen to integrate *synergetically*, we also will begin to discern ways of using the world's resources to ever higher and more universal human advantage. We will soon learn popularly how to play the game to explore for ways in which we may use the world's resources so that we may be able to make our whole planet successfully enjoyable by all humanity without any human profiting at the expense of another and without interfering with one another, and how to do so in the shortest possible time.

Enough Oxygen for All
We had been playing the world game by longhand mathematics long before the computer. As we simulated our plays in the pre-computer era of the late nineteen twenties and early thirties we found out that it is possible to say scientifically that our Planet Earth can successfully support all humanity for all generations to come. Between 1900 and today we have gone from less than one percent of humanity to 40 percent of humanity enjoying a higher standard of living than any king had known before the 20th Century.

Vivid Awareness of Neighbors
During the same period, the amount of chemical materials per each world human have been continually decreasing due to the population increasing much more rapidly than geologists have been discovering physical resources to support humans aboard our planet. It follows that during that same period we didn't amplify forty-fold those enjoying a super-to-royalty standard of living by finding and exploiting more resources. We did it only by doing more with less. That is the only possible explanation. During that same period, we also approximately doubled western man's longevity and his relative health has been correspondingly improved. Even more importantly during that same period humanity eliminated many misinformations from the starting environment of its new life, while implementing the new life to apprehend information from all around our planet in split seconds by giving the new life a vivid awareness of all other humans around our space vehicle Earth never before experienced by humanity. That is why the young of our day are demonstrably skeptical of the only myopically conditioned opinion reflexes of their elders. The ever idealistic young do not know what to do about their intuition that all old customs are treacherous, other than to attack them, having no positive alternative

Military Technology's Diverging Course
So we found that man was inadvertently becoming successful. We also found that all the technology which brought this about has been an inadvertent fall-out from man's exclusively war anticipating acquisition of vastly more with less industrial production capabilities and subsequent conversion to peaceful ends of that technology first produced only for military purposes.

We had blast-furnaces for making battleships for 50 years before a piece of steel went into a skyscraper on the land. We first developed all the great electric generators for sea use. We had refrigeration at sea for 30 years before we brought it ashore. Thomas Malthus of 1800 could not anticipate that one hundred years later refrigeration could preserve foods so satisfactorily that they could reach safely and economically all the world's stomachs.

Wealth

Wealth Is Not Merely a Survival Bank Account
I find man utterly unaware of what his wealth is or what his fundamental capability is. He says time and again, "We can't afford it." For instance, we are saying now that we can't afford to do anything about pollution but after the costs of not doing something about pollution have multiplied many fold beyond what it would cost us to correct it now, we will spend many fold what it would cost us now to correct it. That is a geometrical compounding of inevitable expenditures (originally side-stepped because we believed erroneously that we "couldn't afford" their correction). For this reason I find that in satisfying humanity's vital needs, highest social priority must be assigned to the development of world-around common knowledge of what wealth

is. We have no difficulty discovering troubles but we fail to demonstrate intelligent search for the means of coping with the troubles. This is primarily due to our misconditioned reflex which says that "we can't" afford to do the intelligent things. We discover with scientific integrity that wealth is simply the measurable degree to which we have rearranged the physical constituents of the scenery so that they are able to support more lives, for more days at such-and-such standards of health and nourishment, while specifically decreasing restraints on human thought and action, while also multiplying the per capita means of communication and travel all accomplished without increased privation for any human. Wealth has nothing to do with yesterday, but only with forward days. How many forward days, for how many lives are we now technically organized to cope? The numerical answer is the present state of our true *wealth.*

Physical Wealth

I find that our wealth consists exclusively of two fundamental phenomena: the physical and the metaphysical. The physical in turn consists of two subdivisions. One is the *physical/energy associative* as *matter* and the other is *energy disassociative* as *radiation.* After science discovered the speed of light it went on to discover that when energy was lost from one system it was gained by another local system. It is never lost from the universe. Energy is inherently conserved so the *energy component of wealth cannot be depleted.*

Metaphysical Wealth

The other prime constituent of wealth, the *metaphysical*, is contributed by human intellect. Man's muscle has only a self-starter, button-pushing function. Man's mind comprehends and masters the energy of Niagara Falls. His muscle cannot compete with Niagara. Humanity's unique function is that of his mind's ability to discover generalized principles and to invent effective ways of employing those principles in rearranging the physical constituents of the "scenery" to ever greater metabolic regeneration advantage and metaphysical freedom of humanity. We discover that every time man makes an experiment, he *always learns more. He cannot learn less.* We have learned therefore that the intellectual or *metaphysical half of wealth can only increase.* The physical *cannot decrease* and the *metaphysical can only increase*, wherefore *wealth*, which results from the synergetic interaction of both the physical and metaphysical, *can only increase.* Which is to say, — net — that wealth can only increase with each reemployment, and the more intelligently and frequently it is reinvested the more rapidly it increases. This is not disclosed in any books on economics. It is not recognized by the body politic. So I say to you, man has acquired all the right technology within only sixty years to amplify from less than one percent to forty percent the proportion of all humanity who are now economically successful with the possibility of elevating all of humanity in ever greater degree within another 25 years. All of which enabling technology humanity said it couldn't possibly afford until the military said, "This is the way your enemy is going to fight the war. You either acquire an equal or better technology or die." To which the people responded, "Though we think we can't afford it and though we don't know how we can pay for it, if we have the energy resources plus the know-how and human time to produce that technology we will go ahead and produce it and find out later how to pay for it," not realizing that in investing our time and know-how in producing it we were paying all that would ever be realistically required to pay for it. The constituents "belonged" in truth to no one. That physical phenomena which had originally been commandeered by illiterate sword and gun seizure and had been deeded thenceforth under guarantee of arms as property and that the paper equity had been loaned out at *interest* and compounded arbitrarily as a "debt" imposed by law on someone did not alter the fundamentals of this situation.

Science As Technology's Dogma

Eternity of Meaning Versus Empiricism

I would point out that all of the great scientists have discovered that we have an invisible, abstract, utterly weightless a priori universe. I hear it popularly said the scientist brings order out of chaos. All of the great scientists find the reverse to be true—Scientists experiment, hypothesize and experiment again to test their hypothesis. Suddenly some of them discover a theretofore unknown generalized principle which adds to science's awareness of the eternal resources of a priori order in the universe. They are further amazed to find as time goes by how complete is the inter-relatedness of all the separately discovered principles. None ever contradicts the others. There apparently is a great integrity welding all of the a priori principles. A generalized principle of science cannot be so classified if any special case exceptions to its behavior are found. Because the generalized principles cannot be such unless they are eternally true, the discovery of them by science implies an eternity of meaning order and integrity lying behind our ignorantly and innocently accepted special case and only superficially different experiences.

Eternity of Elements

But the most advanced scientists of today, for instance the leading astrophysicists discover that

regardless of how much we separate out and subdivide our physical experiences with energy, as *matter*, that the proton and neutron, which are not the same but are interchangeable by accommodation of their respective subsidiary team mates — always and only co-exist. You can, by bombardment, separate out momentarily some of the atom's minor "nuts and bolts" particles but you cannot eliminate atoms from the universe nor dispense with their always and only co-existing but never the same protons and neutrons and their intercomplementary intertransformative energy equating, kinetic balancing.

Order Was Always There

These scientists point out therefore that there never could have been chaos. There had perforce always to have been the orderly fundamental complementarity. All the legendary ways of looking at universe as having had a beginning in disorder have for the three last years been completely upset by the astrophysical inventorying of the relative abundance of the fundamental atomic isotopes and their intertransformational accounting on a cosmic scale. We find we are now confronted with an apparently eternal a priori order. The idea of probability gradually converting a disorder to order is invalidated. There is an a priori synergetic integrity of universe which has allowed humanity to be born ignorant. That is manifest. It is not then a derogatory statement to say man is ignorant. He also is born utterly helpless. It is part of the equation of universe that "utter helplessness" be complemented by an a priori competence of universe to "care for" the helpless. Mothers do not have to invent a mammular gland and a bread to feed their babies. The mother doesn't invent the oxygen for the baby to breathe. These essentials were invented by the a priori competence of the universe. Therefore I find man ignorantly pretentious in assuming that he is responsible for either yesterday's or tomorrow's success.

Evolution – The Fulfillment Model For Human Destiny

The Enthusiasm of Evolution

Evolution is inexorably at work, and in order to get man to do what needs to be done when he is ignorant, the built-in drive of fear is provided. I am saying to you, for instance, that if we cannot persuade our government to enact laws which will develop enough of the right technology to do *this* and *that* which evolution is intent upon accomplishing, then that technology will appear in China or elsewhere and thus get into the bloodstream of evolutionary realizations. The faculties of man, his brain, his mind, his inventive capabilities are all part of these a priori principles operating in the universe. And evolution is articulating itself in a very important kind of way. To be able to really understand you have to teach and maintain this comprehensive degree of thinking. I would say that man has a function in the universe, this we discover clearly.

Fundamental Complementarity

We know scientifically that all local physical systems are continually giving off energies. We call this entropy. Due to each of the local systems unique periodicities, etc., the given off energies are diffusely and randomly released in respect to other systems. Thus the physical universe is continually expanding and increasingly disorderly. Fundamental complementarity requires that there must be some phase of universe where the universe is contracting and increasingly orderly.

From Entropy to Antientropy

We look at all the stars and find that we "see" them only because they are giving off energies in increasing disorder. We call this radiation. We find only one place in the universe where we know energies are converging, collecting and being stored and that is our own space ship Earth... our planet. In the International Geophysical Year, world-around measurements indicated that approximately 100,000 tons of star dust are accumulated daily aboard Earth from other stars. Thus energy is being collected here as matter. We also are collecting an enormous amount of radiation from the other stars, primarily from the sun but also as cosmic radiation from myriads of other stars. The energy either as or radiated increments arrives in a very random frequency pattern. We may state it to be experimentally proven that our special space vehicle Earth is at least one mobile energy collecting center in contradiction to the stars which are energy distributors. The sun's energy radiation is not being reflected off Earth as from a mirrored ball. It is refracted, or angularly deflected, by the atmosphere. Thus the sun energy as heat is impounded in the atmosphere to produce weather changes. Thus, also, are the waters refractionally heated by the sun's radiation. Thus, by a series of relay stages is energy impounded aboard our space ship Earth to regenerate life by the photo-synthesis of the vegetation which is a beautiful process whereby the random energy receipts are transformed chemically into beautiful, orderly molecules which are beautiful structures. Here you see the turn-around from disorder to order—from entropy to antientropy.

All the biologicals are converting chaos to beautiful order. All biology is antientropic.

Integrative Potential of the Human Mind

Of all the disorder to order converters, the human mind is by far the most impressive. The human's most powerful metaphysical drive is to understand, to order, to sort-out and rearrange in ever more orderly and constructive ways. You find then that

man's true function is metaphysical. Man's physical function is the same as that of all other biological life; to impound and regenerate physical life which means inherently to produce reconstructive order of every variety. The metaphysical, absolutely weightless function in universe, unique to humans, is that of continually looking for the generalized principles which are operative in all the special case experiences. Thus has humanity discovered that it could move and constructively rearrange multi-ton rocks that man's individual muscle could not move. He succeeded by his weightless mind's discovery of the generalized principle of leverage. Thus also did mind discover the principles of electron conductivity, whatever that may be, for electromagnetics, though discovered and used by man, it is as yet a fundamental enigma. These generalized principles were all found to be operating a priori to man. Man simply finds and employs. He does not put anything into the universe. We must realize that technology was not put into the universe by man. The universe is the comprehensive system of technology. Humanity is discovering and beginning to employ it. The human mind invented the computer as an extension of humanity's integral computer, information storing and retrieving system, the brain. The computer and the automated technologies it commands are about to take over all specialized tasks from humans, thus saving humanity from becoming extinct, for biological science and anthropology have learned incontrovertibly that extinction is always the consequence of overspecialization. Our World Game will be in effect a World Brain. It will free world mind from occupations of brain slavery. Human minds employ the World Brain to solve the problems of all humanity thus escaping the previous recourse only to the individual opinions of too myopically preoccupied ill-informed men. The human mind, as Einstein's metaphysical, weightless intellect, discovered and noted in written symbols the equation of the physical portion of universe, — that physical portion of universe which consists entirely of energy; — energy in two diametrically opposed, intercomplementing and intertransformable behavioral conditions. The one phase is energy associated as matter symbolized as M—and the other phase is energy dis-associative as radiation—symbolized as C—and the rate of the associative phase is in terms of second power of the Michelson, Morely measured speed of light which is scientifically notationed as C^2 which equals the rate of growth of a radiation "bubble's" spherical surface growth. $E = Mc^2$. In Einstein's perceptivity and initiative we have the metaphysical mind taking the measure of the physical. This relationship is irreversible. We have no suggestion that energy will ever conceive of and write the equation of intellect. The Nobel Prize in physics was given in 1956 for discovery of this irreversibility principle of the complementarily but non-mirror-imaged balancing of positive-negative events. Evolution thus became recognized as irreversible. We find here the clue to the coherence and integrity of the universe which can never lose its energy quanta. Universe is the minimum perpetual energy conserving complex of technological intratransformings. Metaphysical intellect and its ability to comprehend and master the intertransformative technology of universe and to reconvene and reconcentrate the physical disorder into conserved order is possibly the highest, separately discernible function in universe. Mortal, physical human bodies have the function of providing a regenerative succession of fresh physical vehicles for the mortal—because entropic-articulation of metaphysical immortality. The long-held popular conception of the existence of two kinds of physical substances—one called *animate* and the other *inanimate*—the first rather mystically maintained and the other subject to stark chemical analysis, was altogether invalidated as science closed in on the assumed threshold between the animate and inanimate at the virus level only to find that there is no threshold and that all the phenomena followed strictly inanimate physical laws. So we find the real separation of the life and the inanimate when humans die and no weight is lost. Life is metaphysical and antientropic. The inanimate is physical and entropic.

Man And His Choice Of Destiny— The Self Fulfilling Prophecy

Life is Metaphysical and Antientropic

Humans have high destiny, possibly the most important in universe. And if the human team aboard space vehicle Earth does not make good at this particular occupation of this particular planet there are probably billions times billions of other planets with human crews aboard who will reboard Earth at some time to operate it properly. We are then a necessary function of universe. If you are going to be wise systems planners, you are going to have to look at things in these big ways.

The Myopic View

I would like you to think of that view of the Earth as seen from the moon in which we saw it enveloped in great atmospherical articulated cloud swirls.

Looking at the sky locally, man is not able to see enough of our sky to see the geometrically spiralling orderly patterning of those ten thousand mile diameter synergetically ordered swirls. Below those clouds man can see only a circular outward from Earth's surface. We must remember that our atmosphere is going around the earth continually and there is no such thing as something you often talk about, as "our air space". The air moves on. The revolving orbiting Earth permits no special view of the stars that could be called "our space". The ecological involvements of

humanity engage the total earth. We cannot solve the world problems locally.

Regenerative Spontaneity

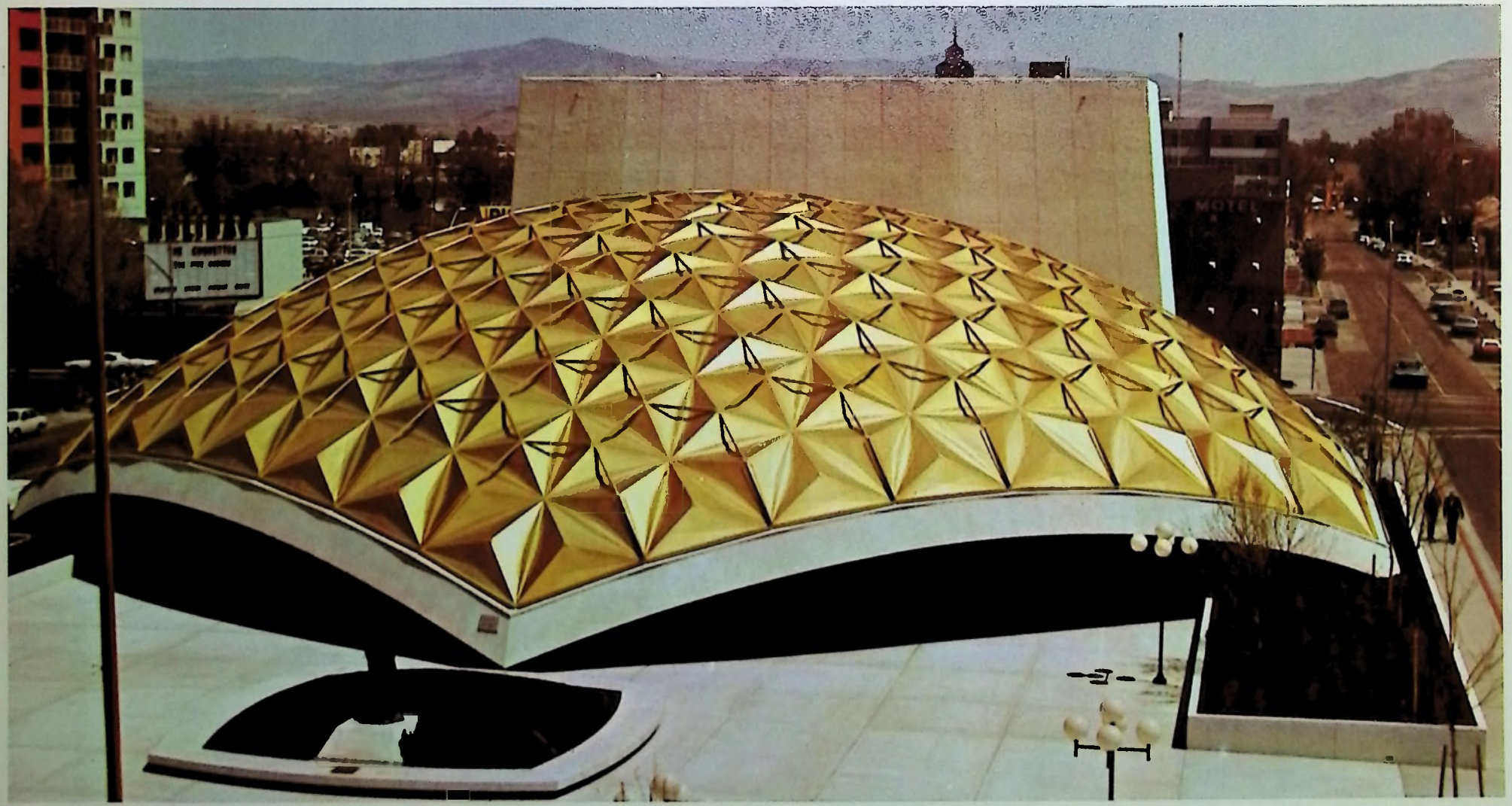
I would like to point to the external costs of the ecological involvements. On such a fundamental world basis, we as a nation are going to have to find ways of organizing ourselves cooperatively, sanely, scientifically, harmonically and in regenerative spontaneity with the rest of humanity around Earth. I think that possibly one of our greatest problems is the educational problem of getting man around the Earth, to realize in time what his problems are and what the most effective priorities may be for saving them all, as discovered by the computer and not as dictated by anyone's opinion or by the passionately evoked opinions of any political bias.

Tolerable Limits for Life

I may have sounded optimistic; I did not mean to be so. I did not mean to be one way or the other. I am interested in whatever the complementarity and irreversibility balance may be. I am interested to learn if evolution requires that we be destroyed. If we were living on the sun, physical we, as incineratable organisms, would be destroyed. But I observe that we are functioning in a region of the universe where everything has been made tolerable for our specific technological model of regenerative life to go on.

I am interested therefore in humanity's unique and essential function in universe. I do say that we have to perform this function of comprehending and employing order to support all the ecological intercomplementation technology of life. We must do so from now on in a total complementation manner.

TEMCOR GEODESIC DOMES



PIONEER THEATER AUDITORIUM, RENO, NEVADA BOZALIS, DICKINSON–ROLOFF A.I.A.

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TEMCOR DOME SYSTEMS

Maximum systems performance of Temcor Domes has been achieved by the integration of three distinct structural concepts, Geodesic Geometry, the Space Truss and the Structural Panel. TEMCOR of Torrance has been granted an exclusive license by Kaiser Aluminum and Chemical Corp. as the manufacturer-erector of the aluminum Geodesic Dome system.

Geodesic Geometry, unlike some more conventional dome geometries, has omni-directional strength. Its three-dimensionally triangulated Great Circle framing makes it equally strong under eccentric and symmetrical loading. Dr. R. Buckminster Fuller (the inventor of geodesic geometry). Temcor personnel and Kaiser Aluminum have worked together to develop this form of construction to the fine art displayed in the Temcor Dome.

Space Truss efficiency has been accomplished by bracing the solid aluminum diamond-shaped panels with an aluminum tubular strut spanning the short diagonal, thus each panel with its strut forms a tetrahedron. These tetrahedrons are joined together at the four corners with forged aluminum gusset and hub fittings to structurally define a space truss that follows the Geodesic Geometry.

The **Structural Panel** is an integral part of the Dome structure, as well as the finished exterior surface. These diamond-shaped panels of heavy gage aluminum are pre-sized with machined tolerances for exact fit-up. The Temcor diamond panel sizes, fabrication tolerance and complete structural stability have been developed and proven through hundreds of full size panel tests. The Temcor Geodesic Dome solves the total problem through complete systems integration, by eliminating the relative expansion and fit-up problems of a separate skin applied to an independent frame.

AN ECONOMICAL, PRACTICAL METHOD OF CONSTRUCTION

Temcor Dome structures represent one of the best values in today's construction market, as almost all of the construction dollars go into the finest quality materials rather than labor. The Geodesic Dome components are precision manufactured of stainless steel and aluminum structural materials, and are carefully crated for shipment to all areas of the world.

To assure maximum function and quality, the Temcor Domes are erected by trained Temcor crews using specially developed equipment. The men work at ground level to erect the Temcor Dome by successively lock bolting rings of diamond-shaped panels and struts together around the base of a lifting tower. The Dome is hoisted up the tower as the assembly of each ring is completed. This efficient construction procedure makes it possible for a 160-foot clear-span Temcor Dome to be erected by a crew of six men in less than four weeks.

After the Temcor Dome is totally assembled, hoisted and secured to prepared supports, the lifting tower is removed and the top opening is closed with more panels, a cupola ventilator or a skylight. The Dome is then sealed and made ready for closure walls and interior treatment.

SPECIFICATIONS

DIVINE MERCY CATHOLIC CHURCH, MERRITT ISLAND, FLA. GREENING & SAYERS A.I.A.

ALUMINUM DOME SPECIFICATION

The Dome contractor shall furnish and fabricate all Dome materials and components, provide the necessary labor and equipment to erect the Dome. All work shall be executed by mechanics skilled and experienced in the fabrication and erection of aluminum.

The Dome shall be of Geodesic design with five circular perimeter arcs. It shall constitute a portion of sphere with an 80- (or 112-) foot inside spherical radius and a ___ foot span.

The Dome panels shall be an integral part of the structure, and be fabricated of aluminum alloy 6061-T6 of 12 gage minimum thickness.

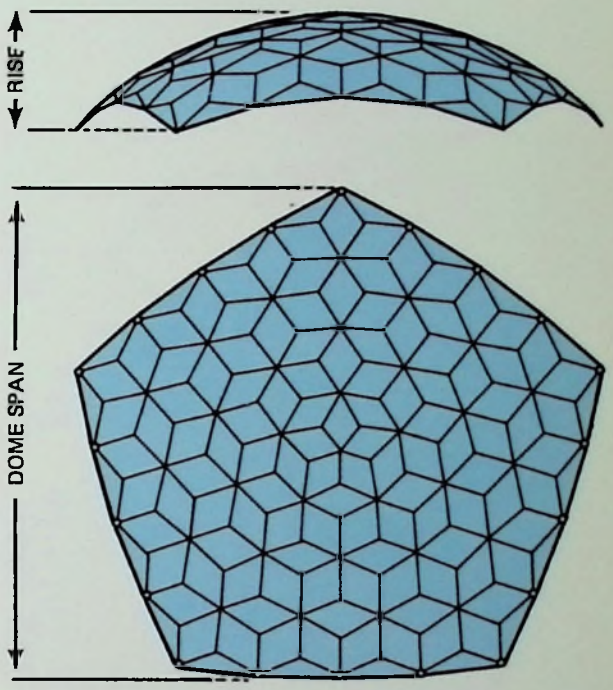
The panel strut shall be extruded 6061-T6 aluminum 3-3/8" O.D. hexagonal tube with a wall thickness no less than 5/32".

The structural flange columns shall be aluminum 5086-H34 alloy, size as required for Dome span. All panel and strut connection gussets shall be forged aluminum 6151-T6. All fasteners shall be 2024-T4 aluminum, stainless steel lock bolts or plated high strength steel bolts.

The Dome base shall be pin-attached with 1-1/8" diameter stainless steel pins at a maximum of 12 feet on center around the Dome base perimeter. All aluminum welding shall be with heliarc, using 5356 aluminum wire. All joints shall be sealed with approved thiokol or silicon sealant. The Geodesic Dome shall be erected by and under the direct supervision of the Dome fabricator.

All exposed exterior aluminum shall be mill finish or Temcolor clear, gray, gold or black, anodized finish.

Reference data. Specific information and engineering data on Dome and space structures is available on request.



TYPICAL DOME SIZES

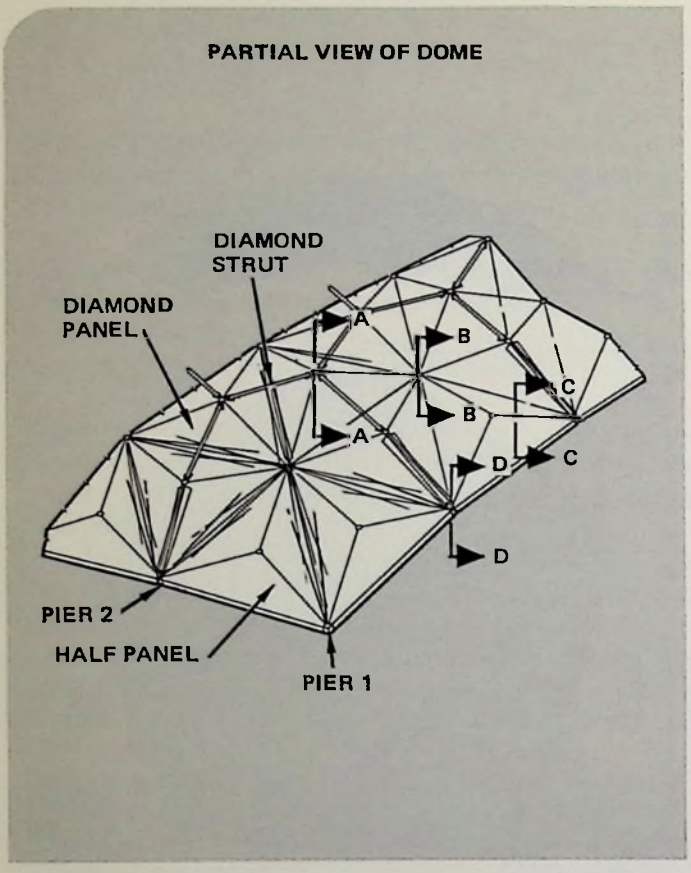
Dome Span	Dome Rise	Floor Area	Surface Area
* 75	11.5	4,400	5,000
91	16.4	6,400	7,200
108	24.1	9,100	10,500
122	32.7	11,600	14,500
134	41.7	14,000	19,000
144	30.5	16,600	19,500
160	38.8	20,300	24,400
173	47.5	23,500	29,500
186	56.5	26,300	34,600
195	65.4	28,700	41,000

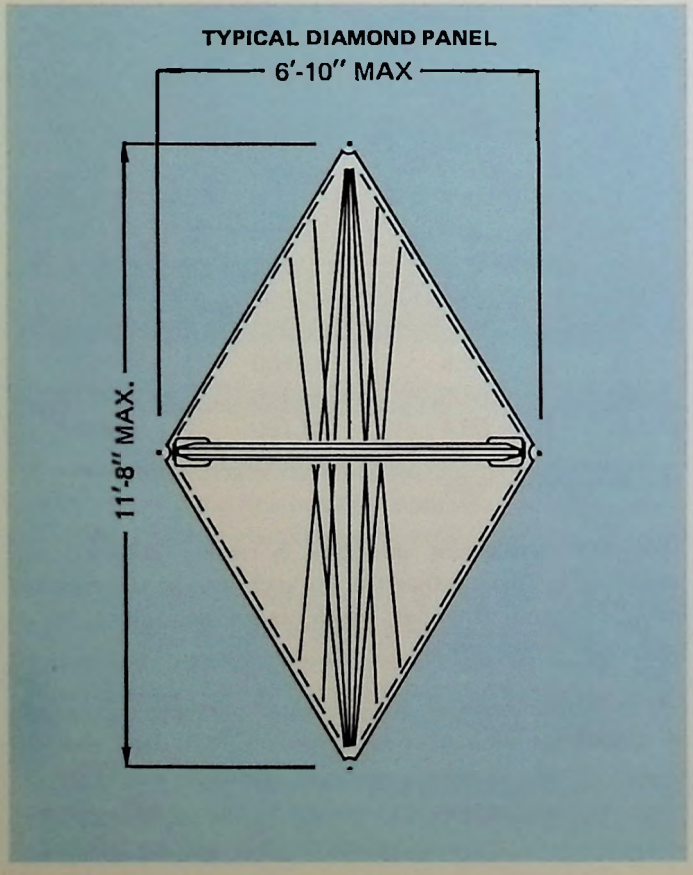
*This Dome has six sides

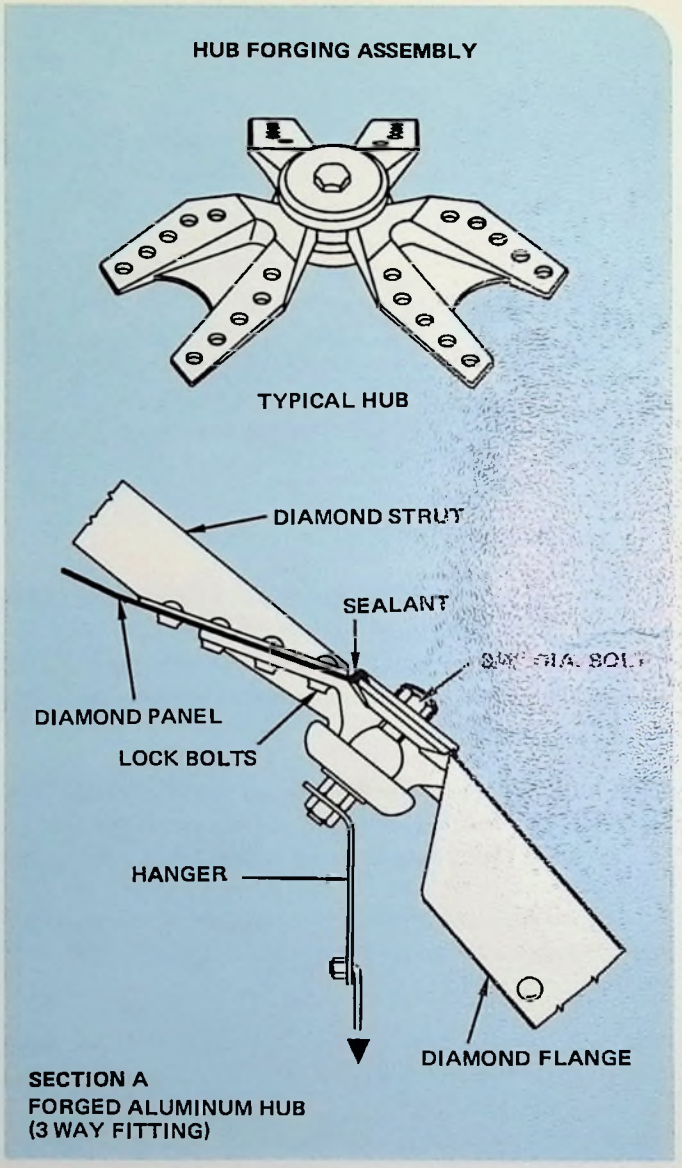
This new outstanding structure is readily accepted by municipal building authorities for such uses as community centers, schools, churches, opera houses, convention halls, banks and sports arenas.

Let a Temcor representative be your planning and detail consultant for your next space closure. With early consideration of this geometric, efficient and light-weight structure, you can contemplate savings in the overall project, whether it is for a private, public or governmental facility.

STRUCTURAL DETAILS







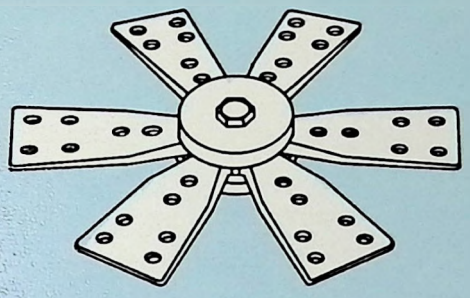
SUSPENDED LOADS

Static loads such as lights, fixtures, sprinkler systems, ceilings and insulation may be suspended from the Dome hubs, gussets and flanges as shown in Sections A, B and C. The hub and gusset fittings are located approximately 6 feet on center in a triangular pattern.

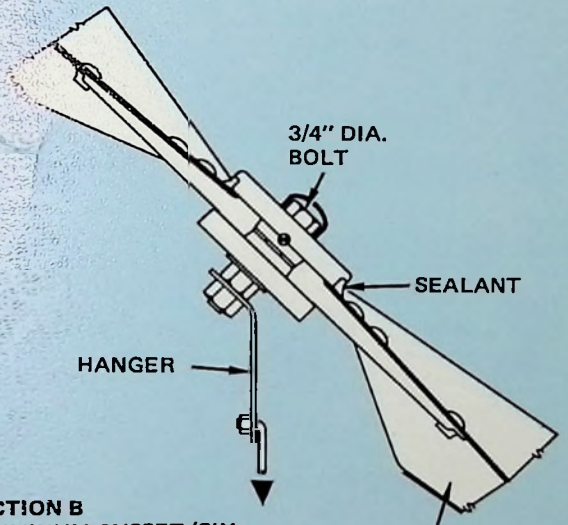
STRUCTURAL PANEL

The diamond-shaped structural panels are made in 28 different sizes and are assembled in various combinations to construct the unique Temcor Geodesic Domes. Each panel has 14 precisely formed creases for internal stability and 4 formed perimeter flanges for edge strength. The panels are fabricated of 11 or 12 gage 6061-T6 aluminum alloy, as required by Dome span. The largest panel weighs about 70 pounds.

GUSSET FORGING ASSEMBLY

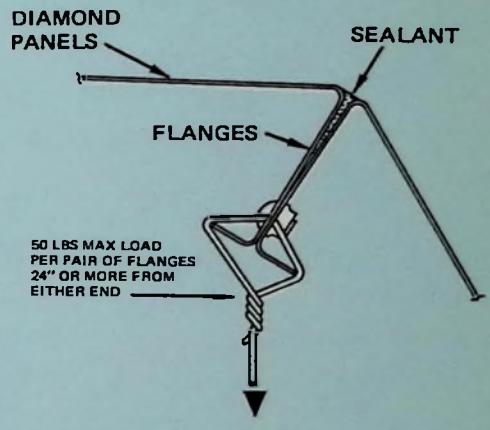


TYPICAL GUSSET

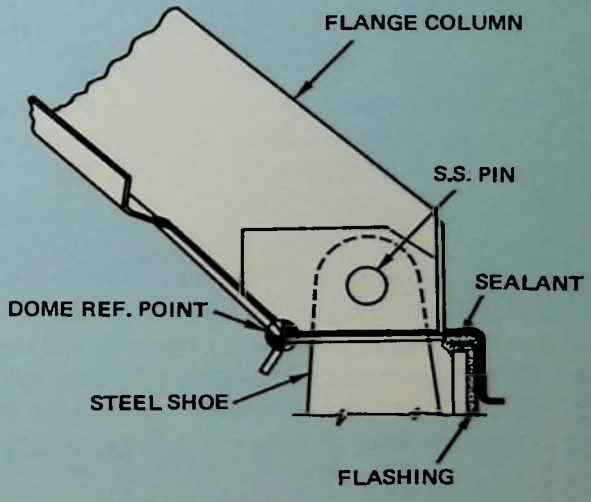


SECTION B
ALUMINUM GUSSET (SIX WAY FITTING)

DIAMOND FLANGES



SECTION C



SECTION D

VENTILATION AND OPENINGS

An optional cupola gravity ventilator, having a 35-square-foot opening can be provided at the top of the Dome. The cupola is designed to receive a 5-foot diameter and up to 3 H. P. exhaust fan, when required. Additional openings through the Dome's surface for vent stacks, etc., also can be provided by Temcor.

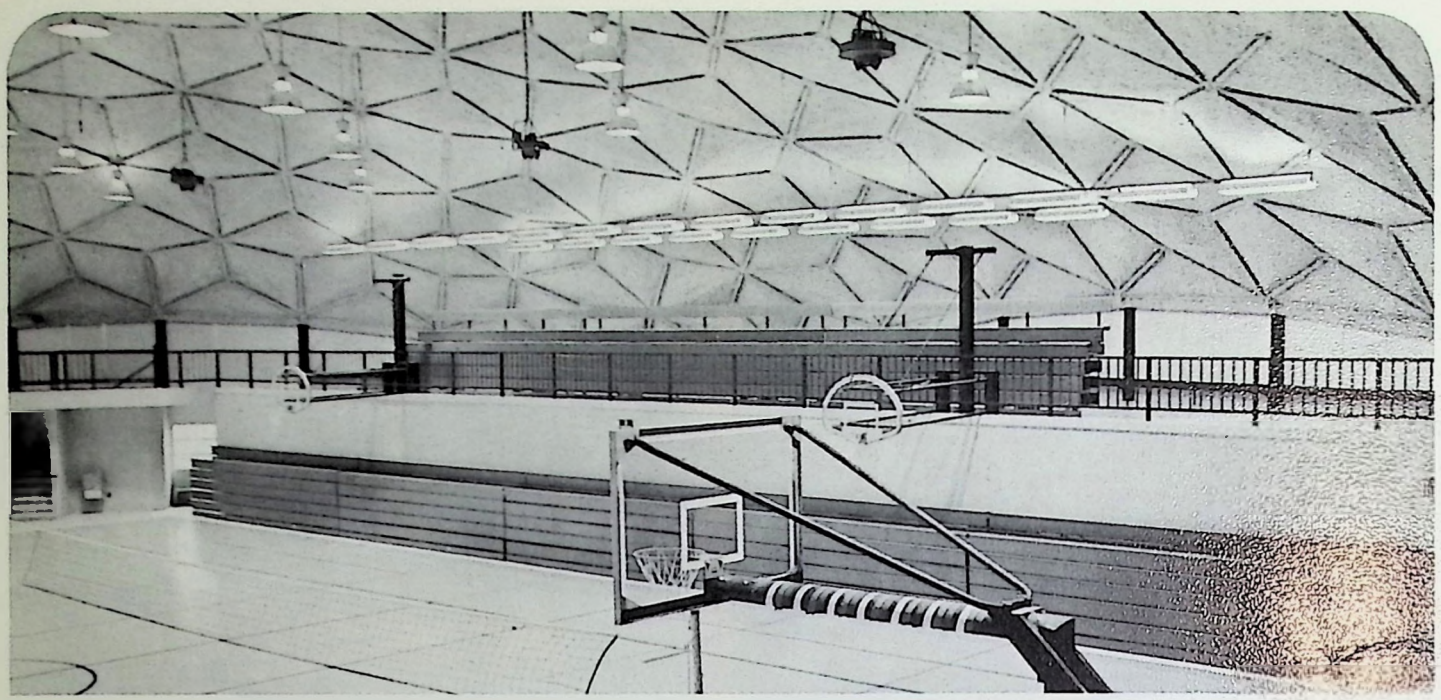
DOME SUPPORT

The Temcor Geodesic Dome is usually supported several feet above the floor on vertical wall framing or arches of either steel or concrete. The Dome supports can be clear-span arches, column-supported tension rings or a number of independent piers around the Dome perimeter.

The aluminum Dome is pin-connected to its supports, allowing for relative thermal motion, as shown in Section D. Pier design loads are available on request.

DOME DESIGN LOADS

The Temcor Domes weigh less than 2.5 pounds per square foot, yet have been designed for a 40 pound per square foot snow loading and 125 m.p.h. winds. Since Temcor Domes are made entirely of aluminum alloys, their tensile continuity and resiliency, as well as light weight, make them ideally suited for use in severe earthquake areas.



BLUEFIELD COLLEGE BLUEFIELD, VIRGINIA E. T. BOGGESS A.I.A.

Fireproofing. Temcor's Geodesic Domes are made of structural aluminum which is classified as a non-combustible material. Fire protection, if required, may be achieved with either suspended sprinklers or a sprayed-on fireproofing such as asbestos fiber.

Thermal insulation. Aluminum domes have an inherent advantage of high heat reflectivity and conversely low emissivity. Bare aluminum has a "U" value coefficient of .95.

Spray-on insulation. After the Dome has been erected and sealed, thermal insulation such as asbestos or cellulose fiber may be sprayed directly on the prepared interior surface of the aluminum Dome, as shown in Figure 1, and the Bluefield College gymnasium photograph. Typical insulation "U" values for one inch of insulation are .23 for asbestos and .17 for cellulose.

Blanket insulation. Another method, shown in Figure 2, utilizes an extra wide glass fiber blanket type insulation, faced with a flame-resistant vapor barrier. This blanket can be secured at the flanges with a rigid fiberboard or formed aluminum strips. "U" value of .10 can readily be achieved.

Panel insulation. The third and most efficient method of insulating is shown in Figure 3, where the Dome is first sprayed with fiber insulation, then 20 gage aluminum ceiling panels are screw attached to the Dome flanges, allowing an inter-connected 3-inch air space. The ceiling panel joints are then taped to provide a vapor seal, and a final layer of insulation is sprayed on the underside of the ceiling panels. The total result is an optimum control of heat and sound, still maintaining the crisp geodesic interior design. A "U" value of .05 can readily be obtained with this solution.

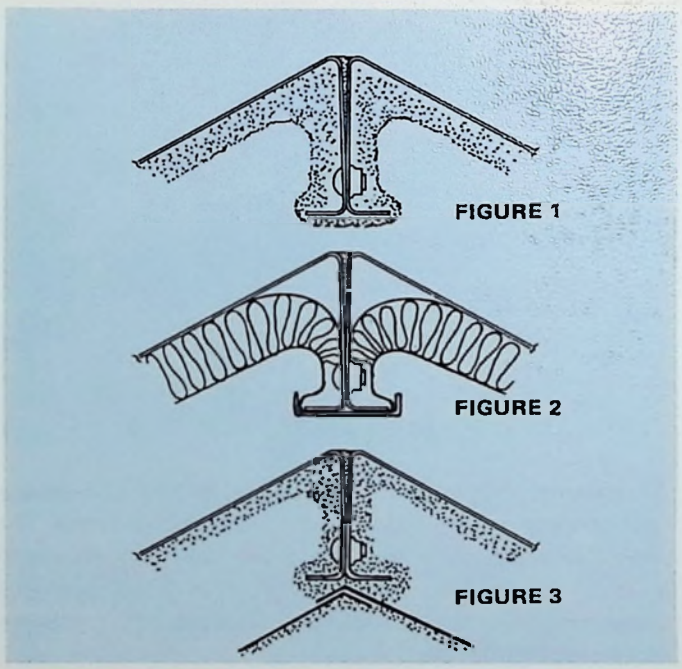


FIGURE 1

FIGURE 2

FIGURE 3

Acoustics Acoustic treatment, which depends on the use and the total building design, presents no unusual consideration in a Temcor aluminum Dome. Moreover, it has a certain inherent advantage over smooth-shell domes in that the faceted shape of the individual panels helps to reduce interior sound focusing.

Sound can be effectively controlled, as proven in a number of acoustically excellent Temcor Dome theaters and convention centers.

ALUMINUM GEODESIC DOMES

BEAUTIFUL AND PRACTICAL THROUGHOUT THE WORLD

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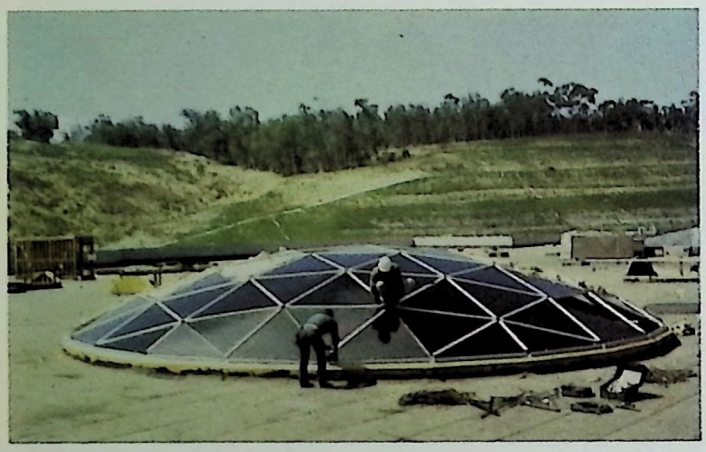

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EXPLORATIONS

EXPLORATIONS

CONTENTS

Editor: MARSHALL MCLUHAN

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December 1967

UNIVERSITY OF TORONTO

graduate

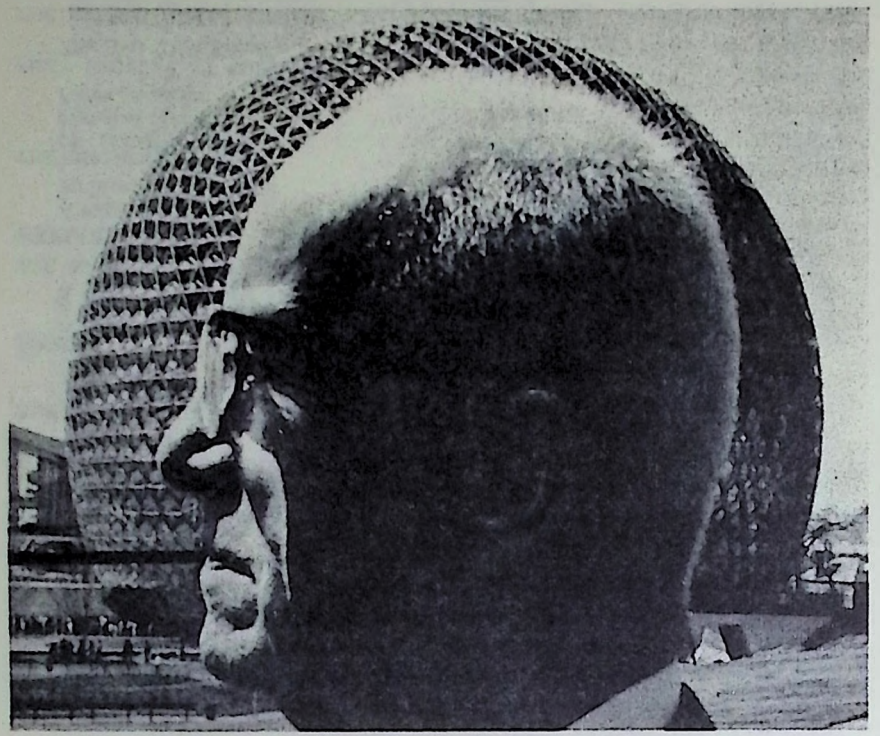
Incorporating *University of Toronto Monthly* est. 1900 and *Varsity Graduate* est. 1948 VOLUME I NUMBER I

THE COVER: On the Fordham University campus, his base for the current academic year, Professor Marshall McLuhan chats with an English major, Miss Mary Jane Scott, and a history major, Larry Kilian. In background is Keating Hall where Professor McLuhan gives his lectures and has his office. The photograph is by Roy Kemp. *See pages 65, 97, 101.*

"BUCKY"

Driven spontaneously by the brain's
Experience assessing and sorting mechanisms
Billions of children start collections —
Coins, seashells —.
My brother collected stones.
I collected papers with my name on them
As written or printed by someone else
Letters, post cards, pictures
Bills, programs, school reports.
My collection, though weighty,
Was less bulky than my brother's
And easier to transport
Between our summer and winter homes.

As a consequence of surprises
Emanating from my collection's
Progressive patterning
In 1917, at the age of 22
I made a grand strategy decision.



Beginning in 1917, I determined to make myself the guinea pig in a lifelong research project; i.e.:—documenting *the life of an individual born in the "Gay Nineties" (1895), the year automobiles were introduced, the wireless telegraph and the automatic screw machine were invented and x-rays were discovered; having his boyhood in the "Turn of the century"; and maturing during humanity's epochal graduation from the inert, materialistic nineteenth into the dynamic, abstract twentieth century.*

Had I perceptivity at that time equal in magnitude to the scale of my intuitive prospecting of forward events this case history's era might have been more accurately identified as that which terminated Sir Isaac Newton's normally "At Rest" and myriadly isolated hybrid world cultures, to which change was anathema, on the one hand; and, on the other opened Einstein's, normally "dynamic", omni-integrating world culture to which change has come to seem essential and popularly acceptable.

Though I lived within seven miles of Boston's center, so new and rare an

object was the automobile that I was seven years old when I first saw one. I first drove one when I was twelve. When I was nine years old, the airplane was invented but I did not see one flying until I was fourteen and I did not fly one until I was twenty-three.

Along with millions of other boys, I had been trying to invent that airplane, first, with paper dart models and then with box-kite-like multi-planed gliders. Despite our elders' doubts and engineering's down-to-earth negatives, imminent invention of the "airplane" was everywhere present in the mind-wind of my pre-Wright Brothers knee-breeches years. It is interesting that our latest supersonic and 2000 mile-per-hour planes are beginning to take on the overall shape perfection of those early, paper darts. Children's intuitions are keen.

My extraordinary experiences with the U.S. Navy's World War One galaxy of new tools — oil-burning turboelectric ships, aircraft, diesel-engined submarines, radios, automatic rangekeepers, etc., convinced me that the experience pattern of my generation was not to be just one more duplicate generation, in a succession of millions of generations of humanity, with an approximately imperceptible degree of environmental change, as compared to the immediately previous generation.

I was convinced that, unannounced by any authority, a much greater environmental and ecological change was just beginning to take place in my generation's unfolding experience than had occurred between my father's and my grandfather's or between that of my great-grandfather's and my great-great-grandfather's successive generations. I had (and as yet have) their diaries, expense accounts or letters containing descriptions of their lives in their successive undergraduate days at Harvard. They all told of day-long trips walking or driving from Cambridge to Boston via Watertown Bridge. I realized intuitively that the subway, which opened to connect Cambridge and Boston in seven minutes in 1913 during my freshman year at Harvard, was a harbinger of an entirely new space-time relationship of the individual and his environment.

It was clearly the environment that was changing and though the environment changes might not alter man's genes changes in his external conditions might permit man to realize many more of his innate capabilities. Dwellings are environment-modifying machines. So are automobiles. Automobiles are little part-time dwellings on wheels. Both autos and dwellings are complex tools. Both autos and dwellings are component tools within the far vaster tool complex of world-embracing industrialization. Life continually alters the environment and the altered environment in turn alters the potentials and realities of life. Environment embraces a complex of non-simultaneously occurring but omni-integrating, or inter-stimulating and therefore inter-regenerating mutations of man's integral, internal, metabolic regeneration organisms

on the one hand, and on the other of his external, invention realized metabolic regeneration organism which we think and speak of as industrialization.

Even though our Harvard freshman class of seven hundred members boasted only three automobile owners, one of whom was Ray Stanley, whose father had invented and produced the Stanley Steamer, it was even then at least wishfully clear that mankind in general might sometime acquire automobiles. Since that time I have owned successively fifty-six automobiles, three of which I invented and built and have personally driven the fifty-six cars a total of one million and a quarter miles. I have lived long enough in various places to have had my cars registered in ten states. I have flown one million and a half miles, part of that distance in three of my own planes. I have owned many boats, traveled in many others, and have commanded several ships in the United States Navy.

My total travel, by land, sea and air, aggregates more than three million miles to date and I now find my work taking me annually around the world. This is in no wise a unique record. It is fairly average for millions of men who have responsibilities in the general frontiers of technology, business, and statecraft of evoluting world man.

Three million is paltry mileage for any senior Pan American Airways pilot or for Pan American's founder-president, Juan Tripp, or for Howard Hughes, or the late John Foster Dulles.

Pre-1900 average world man covered only 30,000 miles in his entire lifetime which is only 1 per cent of my mileage to date. There is no longer valid dissent to the concept of an accelerating change in the affairs of man on earth. The average U.S.A. family now moves out of town every four years. My present official address for passport and taxation accommodation is in Carbondale in Southern Illinois. Illinois is the sixth state within which I have had successive voting privileges. Whether I am "in residence" or not, my land, my house and I whirl constantly around the Earth's axis together at about 800 miles per hour as all the while our little space ship Earth zooms around the sun at thirty thousand miles per hour while at the same time our solar system rotates in its nebular merry-go-round at hundreds of thousands of miles per hour.

In all reality I haven't "left home" as it is usually said of me. My backyard has just grown progressively bigger until now the world is my backyard. "Where do you live?" and "What are you?" are progressively less sensible questions. "At present I am a passenger on the space ship, Earth", and "I don't know what I am. I know that I am not a category, a hybrid specialization, I am not a thing —a noun. You and I seem to be verbs—an evolutionary process. Are we not integral functions of the Universe?"

In 1917, in the U.S. Navy, I had intuited that an inter-multiplicative acceleration of technical events was beginning which would bring about a fundamental reorientation of human life in universe. This concept of accelerating-acceleration which had been discovered by Galileo circa 1600 in respect to the first "Laws of Motion" had not been conceived of, however, as accelerating our ecological evolution — up to the date of my intuiting and acting upon its arrival. Discussion of economic and ecologic evolution acceleration does not begin in the intellectual publications until more than a decade later. Nor did my 1922–1927 discovery that — ever higher tool performance per units of pounds, time and energy as fallout from the weaponry industries into the domestic consumer economy — when erstwhile weaponry support contractors, sought to exploit their advanced technological position, after their war goods contracts were terminated by progressive obsolescence — was resulting sum totally in doing ever more with ever less in the domestic economy. The domestic economy had theretofore thought only in terms of more security — only to be accomplished with more weight — the more the better. This reversal of affairs seemed to me to suggest that Malthus' dictum that only a few could survive successfully might be wrong. Conversely, it seemed that it could come to pass that all of humanity might become both physically and economically successful even within the foreseeable future. I identified this progressive doing-more-with-less as *ephemeralization*. Though FORTUNE Magazine published my 1922 concept of *ephemeralization* in 1940 in a prominent manner, and despite ephemeralization having subsequently wrought epochal advancements in the standard of living for two billion previously deprived humans, ephemeralization is a fact which is as yet — in 1966 — largely unknown to, or overlooked by the world's professional economists. Nonetheless the combination of accelerating-acceleration and ephemeralization have now brought 40 per cent of humanity into the paradoxical state of bewildered, ergo apprehensive, physical and economic success.

I decided in 1917 to contribute to the scientific documentation of the emergent realization of the *era of accelerating-acceleration of progressive ephemeralization*. I determined to do so by methodical and chronological inventorying of all the communications in which I was personally involved — i.e., all in-bound and out-bound correspondence as well as correspondence and documentation concerning me transacted by others. I have kept this life-long file which I call the *Dymaxion Chronofile* and in 1960 presented it to Southern Illinois University's Morris Library, where it is now installed in a special room in their rare documents' archives.

The Chronofile consists, so far, of two hundred and fifty volumes (half of them now bound in leather), containing (circa) eighty-thousand letters, i.e., 300–400 pages per volume.

The first important regenerative effect upon me of keeping this active chronological record was that I learned to "see myself" as others might see me. Secondly it persuaded me ten years after its inception to start my life as nearly "anew" as it is humanly possible to do. Thirdly it persuaded me to dedicate my life to others instead of to myself not on an altruistic basis but because the chronofiled first thirty-two years of my life clearly demonstrated that I was positively effective in producing wealth only when I was dedicated to others. Further chronofile observation then showed that the larger the number for whom I worked the more positively effective I became. Thus it became obvious through the chronofile that if I worked for all humanity I would be optimally effective.

In setting about to start life all over again I did not try to make myself a new or *different* man — another man. I sought only to allow myself to articulate my own innate motivational integrity instead of trying to accommodate everyone else's prefabricated credos, educational theories, romances and mores as had occurred in my "first life".

One basic tenet of my new volition was that whatever was to be accomplished for anyone must never be at the cost of another. Robin Hood whose story my father read aloud to me when I was very young, and not long before my father died, became my most influential early years' mythical hero. This meant that in my "first life" I had improvised methods in general to effect swift moral and romantic justice for those whom I found in trouble or danger. Foolishly self-confident in my "first life" I had often rushed thoughtlessly to assume responsibilities beyond my physical or legal means. This rashness led me into complex dilemmas, for in attempting to keep my assumption of responsibilities legal I inadvertently involved my unwitting family dragging them into preposterous financial sacrifices. In inaugurating my new life I took away Robin Hood's longbow and staff and gave him only scientific text books, microscopes, calculating machines, transits and industrialization's network of tooling in general. I made him substitute new inanimate forms for animate reforms. I did not allow Robin any further public relations professionals or managers or agents to "promote" or "sell" him. It seemed obvious that if the new tools which the "new" Robin Hood developed could provide valid man-advantage increases they could inevitably be adopted by society in general as the inexorable emergencies which dictate the proper rate of regenerative gestations of evolution took place.

Along with the Dymaxion Chronofile, I have kept all the tear sheets of newspapers, magazines, and programs, etc., in which my work was reported. I have never subscribed personally to a clipping service. Others have done so for brief periods. What clippings I have came into my hands by my own discovery or

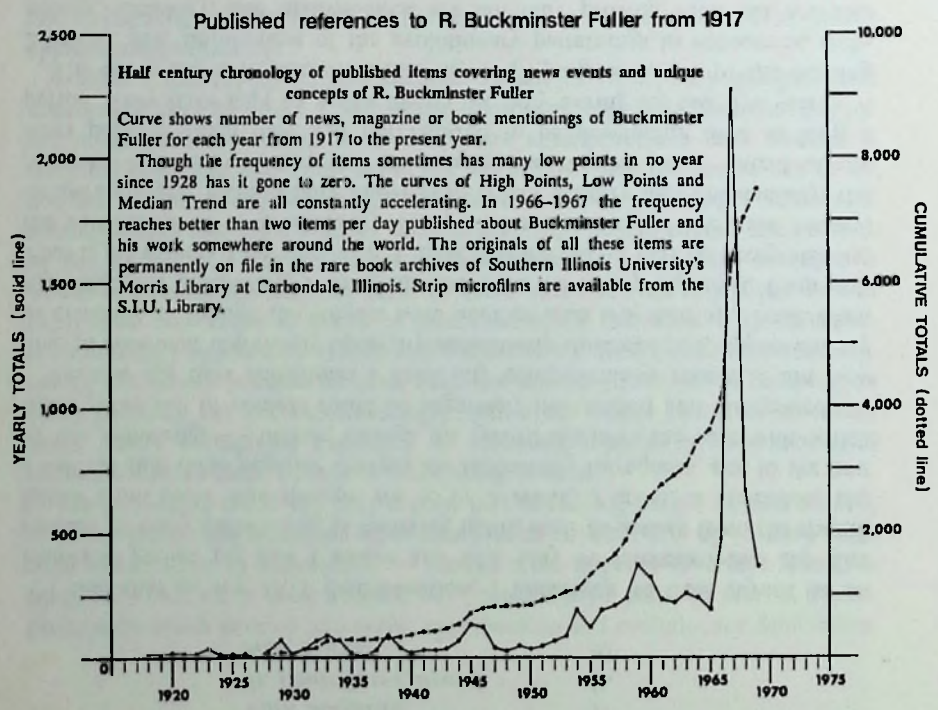
as a consequence of friends and acquaintances spontaneously sending clippings to me. This record now contains over 3,500 unique items. It begins in 1917. Half of the 3,500 unique items have occurred in the last eight and one-half years.

I am enclosing a curve (page 74) showing the precise number of separate and individually written news items per annum from 1917 to-date. As you will see, it is a curve of many peaks and valleys. Altogether it constitutes a wave pattern of ever-increasing magnitudes, with the valleys never going quite as low as previously and the peaks going ever higher. "Smoothed-up", the record patterns into a ski-shape curve — an initially long, almost horizontal pattern with its nose finally rising ever more swiftly. It *is* an accelerating-acceleration curve. The successive peaks relate to my Navy days; my 1918 publication of "Transport" magazine; my 240 Stockade buildings of 1922–27; the 4-D monograph of 1927–28; the Dymaxion House; my publication of "Shelter" magazine; the Dymaxion Car; the Dymaxion Bathroom; my book "Nine Chains to the Moon"; Industrial Man's Ecological Transformation Charts; Energetic/Synergetic Geometry; Dymaxion Airocean World Map; Fuller House in Wichita; University visiting; Geodesic Domes; my U.S.A. Pavilion for the 1967 Montreal World's Fair; the World Students Design Science Decade; Inventory of World Resources, Human Trends and Needs; my computerized game for Southern Illinois University's Centennial "How to Make the World Work" — known as the "World Game"; The "World Man Territory Trusteeship" inaugurated on Cyprus under joint auspices of Archbishop Makarios and World Academy of Science and Art, Caresse Crosby and myself; scientific publications by others identifying my work with discoveries at various levels of the microcosmic structures of nature; and most latterly to a general admixture of editorial realizations that the separately experienced fundamental disclosures all relate to a total and unified philosophy which emerges as pertinent to the unfolding historical reality.

The preponderance of latest items published relates clearly to my general philosophy and to my world redesigning strategems. There is a dawning awareness that I am saying something realistic when I say "Reform the environment, don't try to reform man". There is a dawning awareness that I may be right in saying we have been asking the politicians to do what only we can do ourselves by cooperative use of our intellects and our innate and politically transcendental integrity. Let automation take over the metabolics and let's go to work with our brains and wisdom.

All these published items are now in the Southern Illinois University Morris Library and the Library has just finished microfilming them in their chronological entirety. Prints of the micro-film have gone to the New York Public

(text continues on page 75)



1917 Marriage to Anne Hewlett
1918 U.S. Navy
1922 U.S. Naval Reserve Activities
1923 Early Flying Activities
1926 Stockade Building System
1927 Private Publication of B.F.'s book *4D* disclosing his philosophy — En/Syn Geometry — Chicago
1929 Dymaxion House — Art Exhibits, Lectures
1931 Greenwich Village, New York City — B.F. testing reaction to his philosophy of new form vs. social reform
1932 *Shelter* Magazine (B.F. publisher-editor)
1933 Dymaxion Car, Bridgeport, Connecticut

1934 New York — Connecticut
1935 Washington — Chicago
1936 Phelps Dodge Research — B.F. history of world industrialization and economic charts, New York
1937 Dymaxion Bathroom
1938 *Nine Chains to the Moon*
1939 *Fortune* Magazine — Economic Charts
1940 Dymaxion Deployment Unit — Butler Mfg., Kansas City — New York
1941 Board of Economic Warfare — Washington, D.C.
1942 Dymaxion Map — *Life* Magazine — New York — Washington
1944 Energetic Geometry — Industrial Brazil — Washington, D.C. — U.S.A.
1945 Fuller House — Beech Aircraft — Wichita, Kansas
1947 Fuller Research Foundation — Wichita, Kansas
1948 En/Syn Geometry Models — Geodesic Domes — Forest Hills
1949 Black Mountain College
1950 University Projects around the world
1951 University Projects around the world
1952 University Projects around the world
1953 Ford Motor Company — Geodesic Domes —
1954 U.S.M.C. and Radomes
1956 U.S. World Around Trade Fairs — Geodesic dome
1958 Visit to South Africa — around world travelling begins — En/Syn Geometry — Nuclear Identity
1959 Moscow Fair — Mark's Book — Professor, Southern Illinois University
1960 University visits, Domes, Japan Scientist Lectures
1961 International Union of Arch. Students' World Redesign inaugurated by B.F.
1962 En/Syn Geom. & Virus Identity, Harvard, Chas. Eliot Norton, Prof. of Poetry
1963 Five of B.F.'s books published; Economics, Philosophy, Math, Science-Gen. Business & Govt. Consultation
1964 *Time* Cover Story — *Saturday Review* Series
1965 Arch. U.S. Pavilion 1967 Montreal World's Fair — *New Yorker*, Profile, *American Scholar* piece — 5 Delos Symposions
1966 Keynoter to annual congresses of metallurgists, geographers, planners, medics & businessmen, mathematicians — N.A.S.A. Research — Cape Kennedy lecture
1967 50th Anniversary Harvard 1917 — 50th Wedding Anniversary — *Saturday Review*, cover story, completion and realization of U.S. Pavilion Expo '67 — *New York Times*

Library, 42nd Street and Fifth Avenue branch. Prints may be had by other libraries and institutions at cost from the S.I.U. Morris Library. All of the items have been indexed by dates, authors, titles, and brief summaries. As typical examples, I am enclosing summaries of the one-third-century record of items that have appeared in the *New York Times*, *New York Herald Tribune*, *New Yorker*, *Time* Magazine, *Architectural Forum*, and the *St. Louis Post-Dispatch* (to introduce a mid-American continent note into the record). I myself, have been surprised by the shape of the results. For instance, I would have expected that the *Architectural Forum* would have had many more items than the *New York Times*, which surmise turned out to be wrong. The score is as follows:

New York Times	285 items
Architectural Forum	93
New York Herald Tribune	62
Time Magazine	69
St. Louis Post-Dispatch	45
New Yorker	20

I said that by my 1917 determination, I undertook to treat myself as an historical guinea pig and I assure any who may be interested that my files include as many unflattering as flattering items, such as notices from the sheriff, letters from those who thought me to be a crank, a crook, a charlatan, etc. I will say that these negative charges are fortunately infrequent, and to the best of my knowledge — untrue, though the record discloses the ease with which items taken out of context could be negatively interrelated and interpreted.

Because the data constitutes a faithfully comprehensive record, I am now able to comment objectively upon my subjectively disclosed self, approximately as critically as though the subject were another man. As with any book when my subject is prospering, I am glad, and when he is unprosperous, I am sad. That is the extent of my prejudice. I think that the curves may be acceptable as: the realization of a scientifically disciplined marshaling of the case history, deliberately and methodically undertaken a half century ago. Incidentally, the *New York Times* was surprised to discover the "earlier years" extent of my news pattern which they had not realized to be developing over so long a period. They have kept an active file on me only during the last five years.

The curve seems to document that my 1927 prognostication of the ensuing 25 to 42 year unfoldment of the evolutionary patternings in economics, technology, sociology, and mathematics, are not only proving valid but are also trending further to accredit my present prognosticating. My 1961 prognostication covering world developments to 1982 as contained in *Education*

Automation, as publised by the Southern Illinois University Press (now in paperback) is trending to be far more spontaneously assimilated than was for instance my *4-D* monograph of 1928.

Possibly a more interesting trend is the acceleration in the curve of the rate at which books by others refer to my work. Books represent a certain amount of research filtering and retrospective processing. The curve of *books with references to me, or my work*, is accelerating more swiftly than is the general publications curve.

I also keep a record of hearsay items published about my work and reported to me as having occurred over and above the items which I have actually received and entered into the record. There is a fairly constant percentage in the average of uncollected but reported items as ratioed to collected items. Reliable reports of the existence of uncollected items average 25 per cent of the number of items collected. The largest number of uncollected items occur outside of the United States. There is less and less tendency of the uncollected items to get into my hands as my friends no longer look upon such published treatment of my work as *news* and therefore do not realize that it might be "good news" for me to receive and therefore worth their taking the trouble to send to me. As it is, the curve of *collected* items about my work is now averaging better than one individually written news item or story each and every day of the year being published somewhere around the world.

All the while my long, sparse items curve had been developing there also occurred spectacular news eras of famous individuals and events that rocketed into saturation prominence. *Time* Magazine has made many studies of the *top* frequency items. Curves such as the Hitler curve represent tremendous rocket bursts which when super-imposed on my chart, render the peak magnitudes of my "notices" invisible. What is interesting, however, is that my curve has been steadily growthful throughout all those spectacularly prominent yet relatively short-duration news explosions. It is at least interesting that my kind of curve could go on and on without my ever approaching "popularity" magnitude either as a positive or negative subject. I am well-known in certain limited circles but my wife Anne agrees with my surmise that we will never register in a motel in which the man at the desk will recognize either our "name" or our "face" when we sign the register nor connect my name with any of my work, even if he does vaguely remember that there was a U.S.A. golden "Dome" in Moscow.

I have discovered that one of the important characteristics of most economic trends is that they are too slow in their motion to be visible to man. We cannot see the motion of the stars, or the atoms, or a whirling airplane propeller, or even of the hands of a clock. As with the electro-magnetic spectrum, most of

the frequencies and motions of the universe are ultra or infra to man's apprehending tunability.

I think I am saying all this because I want to fortify any glimpses and impressions derived from it with some knowledge regarding the reliability of my prognostications, which may have more appropriateness than whether a sampling of people who know about my work shows that the people like or do not like it. I am firmly convinced that I can see clearly regarding a number of coming events and am therefore vitally eager that people should not be hurt by the coming of these events, particularly when I can see ways in which it would be possible not only for them to avoid hurt but even to prosper by and enjoy what now seems to me to be inevitable. Much that I see to be inevitable is unthinkingly opposed by various factions of society. Reflex-conditioned society, facing exclusively towards its past, backs-up into its future, often bumping its rump painfully but uncomprehendingly against the wealth coffers of its future years' vastly multiplying capability to favorably control its own ecological evolution and the latter's *freedom multiplying* devices.

The publishing world can play a great part in helping people to turn around, to comprehend and assimilate favorable aspects in what has up to now often been looked upon as unfavorable — though often to prove favorable later, but frequently too late to have avoided the (unnecessary) pains of fearful incomprehension which develop into active apprehension and evolutionary debilitation.

CHRONOLOGICAL INVENTORY OF PROMINENT SCIENTIFIC, TECHNOLOGICAL, ECONOMIC AND POLITICAL EVENTS— 1895 TO DATE

upon which has been superimposed the utterly personal chronology of Buckminster Fuller, his family, his discoveries and his inventions, both philosophic and technological.

The integration of the prime world history events with those of one individual and his family at first exaggerates the infinitesimal stature of the individual in respect to humanity's integrated, news processed and arbitrarily classified experience.

But this exaggerated relationship of the minute individual in respect to the whole is none the less the only possible common direct experience of each and every human being. All else is hearsay.

The inventions of the single individual at first seem irrelevant and preposterous as associated with the great legends of the publicly accredited historical accounting. Gradually, however, the relevancy of the philosophy of the individual to the comprehensive evolution may become visible and his inventions may gradually appear feasible, even logical if he persists and learns how to perfect them both by inclusions and refinements.

If the individual were not moved by the seeming significance of his undertakings as exaggeratingly disclosed in this *chronological juxtaposition of men and man* he would not have an adequately sustaining drive to reduce his inventions to commonly inhibitable practice and possible common advantage.

Taken out of the context of scientific search for data apparently governing and motivating the individual inventor in the era of the massive corporation and the massive state and the latter's apparently staggering economic and political starting advantage over the prime design initiative of the individual the following record could only be classified as egotistical. However, it was compiled and is submitted in scientific earnest, by its only possible *direct* observer.

Because the lag between the dates of invention and common public use average 22 years, the dates of the inventions listed must be considered only as harbingers with their effective industrial realizations and public advantaging variously postponed.

1895 Automobile (first U.S.A. gasoline engined) designed under Charles Duryea's U.S. patent; wireless telegraph; automatic screw machine invented; X-rays discovered. First diesel engine. R. Buckminster Fuller born, July 12, Milton, Massachusetts, U.S.A.; Cleveland, President. At this time Flat Iron Building, 22nd St. & Broadway & 5th Ave., N.Y. City, was tallest occupied building in world and Eiffel Tower, built in 1889 and 1,056 feet high was tallest man-made structure in world and remained tallest until Empire State Building of 1,250 feet erected in 1930.

1896 Steam turbine, disc plow; Anne Hewlett (B.F.'s future wife) born, January 9, Columbia Heights, Brooklyn, New York, U.S.A.

1897 Electric trip hammer drill; William McKinley becomes President.

1898 Electron discovered; Spanish-American War begins.

1899 Flotation of ore (oil); B.F. enters kindergarten, makes octet-truss.

1900 Escalator; Caterpillar tractor; dirigible balloon (Zeppelin); electric steelmaking; mercury lamp; Quantum theory, by Max Planck; President Cleveland elected (second inauguration).

1901 Wright Brothers' glider; gas welding; Marconi's trans-Atlantic radio telegram; yellow fever vanquished. B.F. enters elementary school. President McKinley assassinated.

1902 Radio telephone; photos by wire, (both in lab. only). Mt. Pelee erupted Martinique destroying 30,000 people, powerful impression B.F.

1903 Around-the-world telegram 12 minutes; Wright Brothers' gas engine propelled airplane flight, Kitty Hawk, N.C.; airplane 'supercharging', turbo-generator; ultra microscope (arc light); oil-burning steamship. Ford Motor Company founded, beginning of mass-production automobiles.

1904 Theodore Roosevelt elected President; reinforced concrete; Russian-Japanese War; N.Y.C. Electric Rapid Transit "Subway" opened 42nd to 14th Streets. (B.F.'s Uncle Waldo Fuller a chief engineer of project. Uncle Waldo Fuller, a Harvard football great of 1883, who had gone to Klondike in the gold rush was Bucky Fuller's boyhood's greatest living hero.) B.F. enters Milton Academy, lower school. His parents travel to Europe and South America. B.F. and family go to Penobscot Bay, Maine, buy Bear, Compass and Little Spruce Head Islands.

1905 Einstein's relativity. B.F.'s family occupy Bear Island, Maine as summer home.

1906 Sperry Gyrocompass; radio vacuum tube; crystal radio detector. BF enters Milton Academy, upper school. San Francisco earthquake and fire.

1907 Ford's model "T" automobile inaugurates major world mass production industry; demountable tires; Bakelite (phenolic resin plastic); B.F.'s father has stroke, brain clot.

1908 East River (LIRR) and Hudson railroad tunnels; President Theodore Roosevelt re-elected. Fire destroys Chelsea, Mass., witnessed by B.F.

1909 Bleriot flies English Channel; North Pole discovered by Admiral Peary, April 6; Typhus vaccine discovered.

1910 Salversan discovered; Albany to New York Curtis flying-boat flight; B.F.'s father dies.

1911 South Pole discovered by Amundsen, December 14; atomic nucleus proton discovered; hydro-plane; pulmotor; gyrocompass servos (Sperry).

1912 President Taft elected; vitamins. (President Taft rode in a "White" Steamer Automobile made in Cleveland, Ohio). S.S. *Titanic* sunk in

collision with iceberg; first S.O.S.; New Orleans music — "Alexander's Ragtime Band", Turkey Trot, begins. U.S.A. new type music and dance, displacement of classical and European dances.

1913 Tungsten incandescent lamp; gasoline "cracking" process; B.F. graduates from Milton Academy and enters Harvard University in class of 1917. U.S.A. internal monetary system goes off gold standard and establishes Federal Reserve System (as private bankers' gold becomes inadequate to implement new industrial mass production magnitudes of trade). But Federal Reserve as yet in private banker management, as the Alexander Hamilton U.S. constitutional interpretation or the dogma persisted that U.S. government had no fundamental wealth initiative and must borrow all wealth from private bankers and repay them through collection of taxes, tariffs and excises. B.F.'s Milton home sold.

1914 Military tank; regenerative radio circuit; chrome-nickel-steel; Panama Canal; World War I begins. B.F. expelled then reinstated at Harvard College after intensive experience as a millwright in cotton mill at Sherbrooke, Quebec.

1915 Transcontinental telephone; gas warfare; radio telephone. B.F. expelled from Harvard second time. Employed in New York City by Armour and Co. worked in 28 branch houses throughout greater N.Y. City, working 3 a.m. to 5 p.m. daily. Woolworth Building, New York City, 792 feet high, 60 stories, succeeded Singer as world's tallest occupied building and remained tallest until exceeded by Empire State Building fifteen years later (1930).

1916 Stainless steel (secret World War One accomplishment) does not get into commercial use until 1928. Depth bomb; President Wilson elected. S.S. *Lusitania* sunk by German submarine. B.F. and A.H.F. engaged, B.F. corporal at U.S. military training camp, Plattsburg, New York.

1917 U.S. into World War I; Russian Revolution; U.S.S.R. born; Anne Hewlett and Buckminster Fuller married at Rock Hall — which was Hewlett family homestead at Lawrence, Long Island, New York, for one hundred and thirty years. Rock Hall built by Josiah Martin, British Governor of Antigua and his son Josiah Martin, British Colonial Governor of North Carolina as their joint summer mansion about 1750. Rock Hall used by English as Tory Headquarters in Battle of New York during American Revolution. Rock Hall now a public museum of Nassau County, New York, given by Hewletts to the public in 1946. B. Fuller enrolled March,

1917, Ensign U.S.N.R., Ensign U.S.N., Lt. (JG) U.S.N. B.F. to U.S. Naval Academy, Annapolis, Maryland special course. Then to active war zone Atlantic troop transport duty as personal aide Admiral Gleaves, who commanded cruiser and transport forces U.S. Atlantic Fleet. Service in U.S.S. *Great Northern*, U.S.S. *Seattle*.

1918 World War I Armistice Nov. 11; Buckminster and Anne Fuller's first child, Alexandra Willets Fuller, born December 12. Electron employed and development of mass spectroscopy.

1919 U.S. Navy flying boat NC-4 flies Atlantic in three jumps, Newfoundland, Azores, Lisbon, Spain, May 16–27; trans-Atlantic two-way radio telephone conversation; U.S.S. *Geo. Washington* in Brest Harbor, France, to Arlington Tower, Washington, D.C., U.S.S. *Geo. Washington* was transport which carried President Wilson to France for his Versailles Treaty and inauguration of League of Nations. B. Fuller assigned temporarily to U.S.S. *Geo. Washington* at this time; Alcock and Brown fly Atlantic in airplane non-stop, Newfoundland to Ireland, June 14–16; British dirigible R-34 crosses Atlantic, England–U.S.A., July 2. Nov. 1 — B.F. resigns from U.S. Navy, as his admiral assigned as commander-in-chief Asiatic fleet and B.F.'s daughter Alexandra successively contracted infantile paralysis and spinal meningitis in N.Y.C. B.F. became assistant export manager of Armour & Co. in their N.Y.C. headquarters in new Equitable building at 120 Broadway. B.F., Anne and Alexandra live in house on Pearsal Place, Lawrence, Long Island, N.Y.

1920 Neutron discovered; commercial radio broadcast of voice; President Harding elected; League of Nations began, Geneva, Switzerland, (minus U.S.A.)

1921 Alcoholic beverage prohibition begins in U.S.A. B.F. resigns from Armour & Co. to become National Acct. Sales Manager of Kelley-Springfield Truck Co. with office in Equitable Bldg., N.Y.C.

1922 Practical automobile self-starter (Bendix); air conditioning; insulin; radar; B.F. resigns Kelley-Springfield Truck Co. and starts career as independent enterpriser. Stockade Blocks invented by B. Fuller's father-in-law, J. M. Hewlett and manufactured by Buckminster Fuller; Bucky and Anne's only child, Alexandra Willets Fuller dies, November 14, just before her fourth birthday. A.H.F.'s mother dies, and her brother, Willets, killed in auto accident.

1923 House oil burners. B.F. and Anne live in apartment. East 95th St., N.Y.C.

1924 President Coolidge elected. First dynamic loudspeakers on radio sets, using Major Armstrong's regenerative circuits; First inter-city auto bus line's established — Chicago to Detroit. Fageol twin coach — Greyhound buses. B.F. and Anne have apartment East 94th St., N.Y.C.

1925 First commercial airline Detroit to Chicago; phototelegraphy.

1926 Transcontinental airmail carried by cloth-covered wing, biplanes. Electric refrigerator; talking, moving pictures; Amundsen, Nobile fly to North Pole in Italian Dirigible; Richard Byrd flies Norway to North Pole and return, May 9, in airplane. B.F.'s five Stockade Building System companies have their blocks and building system employed in total of 240 homes and commercial buildings between 1922–1927. B.F. resigns as President of the Stockade Company.

1927 Television (laboratory only, not in popular use in U.S.A. until 1947); Photo-electric cell; Lindbergh flies airplane, "Spirit of St. Louis", across Atlantic, N.Y. to Paris, non-stop, May 20–21. Heisenberg's indeterminism; Holland Tunnel under Hudson River, New York to New Jersey; B.F.'s and A.H.F.'s second child, Allegra Fuller, born August 28, Chicago, Ill.; B.F. and family live on Belmont Ave., Chicago. B.F. writes book, 4D, privately published; B.F. founds "4D" company for research, development and patent protection of his Dymaxion house and car. Energetic/Synergetic geometry discovered by B.F.; Dymaxion House invented as part of his concept of air-deliverable, mass-producible world-around, new human life protecting and nurturing scientific dwelling service industry as means of transferring high scientific capability from a weaponry to livingry focus, thereby to render successful all world's people instead of only a few, on the premise that a comprehensive anticipatory design science could, through increased technical efficiency and upping of overall performance per pounds of world resources, bring about physical success for humanity — never to be obtained in political reform — thereby eliminating fundamental causes of war. I.e., "you or me to the death — on behalf of yours or mine for there is not enough to sustain both" a seemingly scientific fact established by Malthus in 1835 and classified as secret until the twentieth century.

1928 Teletype; President Hoover elected; dirigible "Graf Zeppelin" flown across Atlantic by Dr. Eckner; Amelia Earhart flies Atlantic, June 17; Sir Charles Kingsford-Smith flies Pacific, Oakland, California, to Brisbane,

Australia in airplane "Southern Cross", May 31. Both Amelia Earhart and Sir Charles Kingsford-Smith became warm friends of B.F. Ford Introduces Model A, with stainless steel headlight trim.

1929 Aston's closest packing-effect; B.F. & family move from Chicago to N.Y. World Stock Market crash, "Great Depression" begins. Night airmail inaugurated out of Chicago in cloth-covered biplanes. B.F. and family take house Woodmere, Long Island, New York; Coaxial cables; rocket engine (Goddard).

1930 Cyclotron (atom smashers) and jet engine invented and neoprene rubber developed. *Fortune* Magazine, conceived in pre-1929 boom days to service the boom's millionaires and frustrated by the crash comes inadvertently into being as protagonist of the (hopefully) emergent enterprise concept of a self-perpetuating industrial management capitalism, surprisingly escaped from Finance Capitalism's 1929 shipwreck and death, by "drowning", of International Banking as the world's economic master. B.F. and family have house Johnson Place, Woodmere. B.F. also has apartment on the roof, Leehigh-Starret Building, N.Y.C. B.F. sells Navy life insurance policy to finance taking over "T-Square" Mag. in Phila. and renames it *Shelter* Magazine.

1931 Piccard's stratosphere balloon flight; Post and Gatty fly around world by airplane in succession of refuelling short hops; George Washington Bridge opens, 3,500-foot span; Ford Trimotor Stout aluminum airplane flown.

1932 Economic depression depth in U.S.A.; President F. D. Roosevelt elected; Boeing and Douglas DC-3 all-metal passenger airplane; inauguration of trans-continental U.S.A. airline service; 92nd isolation of a chemical element; X-ray diffraction. B.F. closes *Shelter* Magazine after Nov. election of F.D.R. and inauguration of New Deal hoping that economic ills which *Shelter* cited might be corrected. *Fortune* Magazine publishes "The Industry that Industry Missed" citing B.F. Dymaxion House as prototype of new mass production house industry.

1933 Dymaxion car (invented in 1927), built and successfully demonstrated by B.F. in 1933 in old plant of Locomobile Co. at Bridgeport, Conn., as first stage experimental vehicle leading to eventual omni-medium wingless transport-propelled and maneuverably controlled by twin, orientable, rocket and jet-stilts. Alcoholic beverage prohibition ends in U.S.A.; Adolph Hitler becomes chancellor of Germany, Jan. 30; U.S. banks failing at rate 5,000 per day; Bank moratorium declared by President of

U.S.A., Mar. 6; Mar. 9 Congress gave President power to control money; law upheld by U.S. Supreme Court, February 18, 1935. Approximately all of world's monetary gold paid over to U.S. Government and put back into Kentucky Mountain vaults. World completely off gold standard of exchange. B.F., Anne and Allegra live in house, Darien, Conn.

1934 N.R.A. (U.S. National Relief Administration); W.P.A. (U.S. Work Progress Administration); R.F.C. (U.S. Reconstruction Finance Corp., world's largest capital); R.E.A. (U.S. Rural Electric Adm.); T.V.A. (U.S. Tennessee Valley Authority); S.E.C. (U.S. Security and Exchange Commission); and H.O.L.C. (U.S. Home Owners Loan Corp.) B.F.'s mother dies. Sulfanilamide discovered.

1935 B.F. completes Dymaxion Transport #3 — Displayed at Chicago World's Fair.

1936 Cortisone; First trans-Pacific airplane passenger service. Pan Am. flying boats. B.F. joins Phelps Dodge Corporation, Research Department. B.F., Anne and Allegra have apartment East 87th St., N.Y.C. B. Fuller as guest performer of Gilbert Seldes — Director of frequent experimental broadcasts of C.B.S. television from Grand Central Station office building studio to 100 experimental sets of C.B.S. executives. Television broadcasts in England.

1937 Atomic fission theoretically envisaged Hahn and Stressman in Germany. *Nylon* produced. B.F., Anne and Allegra move to apartment 105 East 88th St., N.Y.C.

1938 R. Buckminster Fuller's book, *Nine Chains to the Moon* published. B.F. joins *Fortune* Magazine as technology consultant. Munich. Hitler.

1939 World War II begins. Sikorsky helicopter invented.

1940 Plutonium fission. Meningitis vanquished. B.F. leaves *Fortune* Magazine. Inaugurates Dymaxion Deployment Unit of Butler Mfg., Kansas City. Used as first radar shacks and as air-conditioned dormitories of U.S. flyers and mechanics making fly-away delivery of war planes to Russians at head of Persian Gulf.

1941 Penicillin; Pneumonia vanquished; Japanese attack Pearl Harbor, U.S.A. enters World War II. Commercial T.V. inaugurated in U.S.A. but held up until war's end.

1942 B.F. joins U.S.A. Bd. of Economic Warfare, Washington, D.C. Uranium

fission. B.F., Anne and Allegra move to 2222 Decatur Place, N.W., Washington, D.C.

1943 Sikorski helicopter successfully flown; R. Buckminster Fuller's Dymaxion projection Airocean World Map published *Life* Mag., March 1.

1944 First jet airplane (fighter), English; real prototype Dymaxion House manufactured by aircraft industry, Wichita, Kans., under joint auspices AFL-CIO Labor, War Production Board, War Manpower Commission, Aircraft Industry Production Board, Beech Aircraft's Executive Administration; B.F. as Chief Des. Eng. B.F., Anne and Allegra move to 6 Burns St., Forest Hills, N.Y.C. apartment, but B.F. goes to live Wichita, Kans., '44, '45, '46.

1945 Franklin Delano Roosevelt dies, President Truman succeeds; Mussolini executed April 28; Hitler committed suicide April 29; United Nations meets April 25, chartered June 26; first atomic bomb, Alamogordo, (secret) New Mexico, July 16 — Hiroshima, Aug. 6 — Nagasaki, Aug. 9. Streptomycin developed.

1946 Regular trans-Atlantic airplane passenger service begins with prop-driven Douglas DC-4 trans-oceanic "Work Horse" of World War Two; League of Nations dissolved.

1947 Geodesic domes invented by R. Buckminster Fuller. Commercial television broadcasting gets underway in U.S.A. B.F. Black Mt. College.

1948 President Truman re-elected. Aureomycin developed. B.F. to Mass. Inst. Tech.

1949 Giant electronic computers introduced to implement complex stockpiling and anticipatory arming and preparation for 3rd world war under title "Cold War"; general industrial automation emerging.

1950 DC-6 airplane passenger service inaugurated. Brink's robbery of million dollars — Boston, Mass. B.F. in heavy university visiting.

1951 Korean War begins. DC-7 propeller driven airplane introduced. B.F. & A.H.F.'s daughter Allegra Fuller marries Robert Snyder.

1952 President Eisenhower elected. Ford Motor Co. River Rouge Geodesic Dome project started — Dec. 26.

1953 Ford Motor Company's 50th Anniversary, Dearborn, Michigan, 93′ diameter geodesic Rotunda dome installed as first successful industrial

acceptance of R. B. Fuller's concepts quarter century after his 1927 prediction that first realization would be in 1952. Alexandra Fuller Snyder born Nov. 1 (Bucky and Anne Fuller's first grandchild). Polio vaccine (Salk).

1954 Peak Mt. Everest climbed; first atomic powered submarine (U.S.A.) launched; U.S. Marine Corps' family-house-size geodesic dome helicopter air-lifted and delivery at 60 knots, geodesic domes adopted by U.S. Marines for all advanced base enclosures.

1955 DEW Line geodesic radomes installed in Arctic; Salk polio vaccine effective; Jaime Lawrence Snyder, born April 28 (Buckminster and Anne Fuller's first grandson).

1956 Transistor discovered and developed. First trans-continental helicopter flight, 37 hours; first trans-Atlantic telephone cable; U.S.A. International Trade Fairs adopt geodesic domes as main pavilions. First geodesic 100′ diameter trade fair dome flown to Kabul, Afghanistan in one DC-4. Dome erected by Kabulians led by one U.S. Engineer in 48 hours. Eisenhower and Krushchev meet at Geneva, with their atomic scientists followed by U.N. Food and Ag. Org. at which time it became publicly known that scientists conceded that Malthus was wrong and there could be enough of everything for 100% of humanity to live at highly successful standard of living *but* for time being obviously frustrated from realization by world political sovereignties. B.F. first appointment as visiting lecturer So. Ill. Univ.

1957 European Economic Community established; first civilian nuclear power station; history's largest clear span structural enclosure, 384′ diameter geodesic dome, Baton Rouge, La.; *First Russian Sputnik orbits earth every 1½ hours.*

1958 Laser discovered. Geodesic domes go to Arctic and Antarctic and all around earth; first U.S. satellite orbits earth; English inaugurate first trans-Atlantic jet-propelled airplane passenger service; first U.S.A. domestic jet airline service inaugurated; U.S. nuclear submarine *Nautilus*, Commander William R. Anderson, crosses Arctic Ocean and North Pole from Pacific Ocean to Atlantic Ocean submerged below ice cap; R. B. Fuller's Energetic/Synergetic Geometry discovered by nuclear physicists and molecular-biologists to mathematically explain nature's fundamental structuring at the atomic nucleus and virus levels. (See John Grebe, N.Y. Academy Sciences and Dr. Klug, Birbeck Col. London U.) B. Fuller makes first of his subsequently multi-annual circuits of Earth in course

of fulfilling his regular university appointments in S. Africa, India, Japan, England, etc.

1959 Russian un-manned rocket crash-landed on moon; Sputnik II circled moon and radioed photos of "far side" back to earth; world-around air jet passenger service network established; first nuclear-powered commercial motor ship launched; Lunik I, Russian Rocket into orbit around sun as first man-made planet; 200 ft. diameter Fuller-Kaiser gold anodized aluminum geodesic dome as U.S.A.'s International Exhibit Pavilion, Moscow, Russia acclaimed by Khruschev and after fair purchased (full cost) by Russia from U.S.A. Dome now permanent structure in Moscow's Sokolniki Park. B.F. appointed by State Dept. to visit Russia as representative of Engineering in protocol exchange. Russians, in giving dinner for him, stated they had been following his work for 29 years. St. Lawrence Seaway opens; U.S.A.F. Major Rogers flies airplane 2,455 m.p.h. B.F. appointed as University Professor (Research) at Southern Illinois University. B.F. and Anne erect geodesic dome home 407 So. Forest, Carbondale, Illinois and move to new home from Forest Hills, N.Y.

1960 President Kennedy elected; 114′ diameter 10,000 sq. ft. floor space geodesic dome of Ford Motor Co. delivered by helicopter fully erected; Bathescape navigates one mile inward to bottom Pacific; U.S. Nuclear submarine *Triton* circumnavigates earth submerged whole way, in 84 days.

1961 Russian Gagarin orbits Earth as first human space man. Men (Russian) orbit earth in hourly cycles in co-rocketing vehicles; 2000 geodesic domes produced by over 100 industrial corporations, licensees of R. Buckminster Fuller, primarily air-delivered and speed installed in 40 countries around Earth and in North and South Polar zones between 1951–61. B. Fuller proposes to 2,000 architects of Int. Union of Architects at 5th World Congress at London, England to officially initiate Phase I of Design Science Decade 1965–75 which will put world on notice that making world work is an invention initiative and not a political responsibility and is only solvable by a world design revolution which is the only revolution universally tolerable to diverse political interests of the world; and that the design revolution must be conducted by world-around students under university auspices and supported by professional degree accrediting boards and visiting committees of all the architectural, engineering and scientist professions and officially underwritten by their professional societies.

1962 B.F. appointed by Harvard University as Charles Eliot Norton Professor of Poetry—a one-year appointment. 1962 year of transition of comprehensive technology going from dry land into sea and into sky, from visible to invisible because more-with-lessing, through transistors, *et al.*, transfers all basic controls to invisible ranges. One Telstar weighing only one-quarter ton displaces trans-Atlantic cables weighing seventy-five thousand tons. B.F. establishes "Inventory of World Resources, Human Trends, and Needs" at Southern Illinois University with John McHale as executive director.

1963 World Congress of Virologists Meeting Cold Spring Harbor, Long Island, New York, announced comprehensive discovery of protein shells of viruses as anticipated by B. Fuller's mathematical formula of frequency to second power times 10 +2. Limited Atomic Test Ban Treaty U.S.S.R. and U.S.A. President John F. Kennedy assasinated Nov. 22. Lyndon Johnson becomes President of U.S.A. B. Fuller member of Doxiadis Delos Symposium #1. B.F. delivers world student discourse on Design Science Decade as Int. Union of Architects convene their Sixth World Congress in Mexico City. Seven-million-dollar railway train robbery Cheddington, England. Telstar communications satellite put into orbit around Earth. Syncom, communications satellite put into 24-hour orbit holding flight position over one point of spinning Earth. B. Fuller made consultant to advanced structures phase of Advanced Research Program of NASA (National Aeronautical and Space Administration). B. Fuller subject of 5 half-hour television broadcasts on National Educational Television Network on national hook-up.

1964 Jan. 8—B. Fuller "cover story" *Time* Magazine. U.S. Civil Rights Act, July 2. Khruschev ousted. Lyndon Johnson elected President of U.S.A. B.F. subject of B.B.C.'s first science program on their new wide-range Channel Two network on recommendation scientists at Cavendish Laboratory of Cambridge University because T.V. is visual and B. Fuller had discovered the conceptual model bridging between science and the humanities. B. Fuller's serial articles, "Prospects of Humanity" appears in *Saturday Review* Magazine. Anti-Poverty Programs. B. Fuller commissioned as the architect of U.S.A. Pavilion for Montreal's 1967 World's Fair, "Expo 67". B. Fuller member of U.S.A. team in Dartmouth-Leningrad meeting of "Leading Citizens of U.S.S.R.–U.S.A." assembled by U.S.S.R.'s Academy of Sciences with U.S.A.'s Norman Cousins, Arthur Larson, etc., to discuss all known points of contention between U.S.S.R. and U.S.A. B.F. on Delos Symposium #2. Four volumes of Design Decade

and World Inventory of Resources, Human Trends and Needs published by Southern Illinois University.

1965 World's longest tunnel 7½ miles completed through Mt. Blanc, Switzerland. Churchill dies. First commercial satellite put in orbit to relay intercontinental electromagnetic wave programs as telephone, television, etc. First space walking by both Russians and U.S.A. astronauts. U.S.A. satellite photos Mars from 7,000-mile passing distance and sends pictures back to Earth. Japanese put Geodesic Radome on top of crater's edge at summit of Mt. Fuji and issue memorial stamp of "Pearl in the Crown of Fuji-San". B.F. member of Delos Symposium #3.

1966 Jan.—Russians make first successful instrument package soft landing on moon followed few months later by U.S.A.'s successful duplication of feat as both radio pictures of moon's terrain back to Earth. July—B.F. persuades Archbishop Makarios to cede token land of 200 acres from Cyprus sovereignty to *World Man* under 50-year trusteeship of World Academy of Art and Science, a supra-national organization. B.F. member of Delos Symposium #4. Jan. 4—B. Fuller 19-page profile in *New Yorker* Magazine. Nov.—B.F.'s U.S.A. Pavilion, a 250-foot diameter geodesic sphere, completed at Montreal—to open in April 1967. Plasma-propulsion and ion-propulsion engines for space travel and ultra high speed first flown by Russians. B.F. inaugurates computer game at Southern Illinois University called "World Game" how to make world work in such manner all of humanity become physical and economic success and all humanity can enjoy all of Earth without one interfering with the other and without any one advantaged at expense of other. B.F. asked to give lecture to scientists, engineers, contractors at Cape Kennedy which explained that fallout from space technology into domestic economy would bring first scientific house in history to world man on Earth which would catalyze physical success on Earth for all humanity.

R. Buckminster Fuller, *Architect, Professor*, Southern Illinois University

WORLD GAME REPORT

WORLD GAME REPORT

Summary of a project led by:

R. Buckminster Fuller
Edwin Schlossberg
Daniel Gildesgame

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Mary Deren
Medard Gabel

Photography:

Daniel Gildesgame
Herbert Matter

The World Game Seminar took place at the New York Studio School of Painting and Sculpture, 8 West 8th Street, New York, New York. It lasted from the 12th of June to the 31st of July. The project materials are now at Southern Illinois University where World Game will be continued.

The project and this publication were made possible by a generous grant from the Rockefeller Brothers Fund.

WORLD GAME

The World Game is a scientific means for discovering the expeditious ways of employing the world's resources so efficiently and omniconsiderately as to be able to provide a higher standard of living for all of humanity-higher than has heretofore been experienced by any humans-and on a continually sustainable basis while enabling all of humanity to enjoy the whole of planet earth without any individual profiting at the expense of another and without interference with one another, while arresting pollutions and conserving the wild resources and antiquities. The World Game discards the Malthusian doctrine which is the present working assumption of the major states which holds that humanity is multiplying much more rapidly than it can supply resources to itself, and compounds Darwin's survival of the fittest, to assume that only the side with the greatest arms can survive. The World Game-an assimilated logistical operation for 40 years-has already demonstrated beyond question that the Malthusian doctrine is fallacious and that committing all the high technology resources now going into the world's annual 150 billion dollar war making facilities, all of humanity can be brought to economic success within one quarter century-thus eliminating the fundamental raison d'etre of war. The World Game employs the general system logistics for the reorganized use of the world's resources and employs comprehensive and progressive series of waves of producing higher performance per units of invested time, energy, and know how and each and every component function of the over all scheduling. The World Game makes it possible for intelligent amateurs to discover within a few weeks of research and interest that the foregoing premises are valid.

R. Buckminster Fuller

INTRODUCTION

We worked with the students in mind. We worked to develop a research and design team to effectively deal with the data and concepts necessary to play World Game. The students came from physics, biology, art, architecture, anthropology, New York, San Francisco, Miami, Oskaloosa. They ranged from 19 to 46 years of age. The first four weeks of the seminar were devoted to input. Mr. Fuller thought aloud about his ideas, concepts, inventions, and discoveries. The students did individual research into trends, energy sources, and many other information areas. They were constructing a base on which to develop ideas about the whole earth. We saw films, read extensively, and traveled through the minds of the others in the room. We watched as man successfully stood on another body in space and could see the earth as a spaceship. The students were working to make visible the coordination of that spaceship in order to accelerate the trend towards physical success for all of humanity. Each day the growth of the students and the growth of World Game was extraordinary. Without fear, without competition, the students worked together to realize World Game as fully as they could. The last three weeks were intense with research and organization on how to display the findings that were being made. There was no duplication, no repetition and the energy and information grew visibly before us. We were working at the frontier and each student was working at his frontier. It is dramatic to see human beings so concerned with the operation and the well being of the earth. Mr. Fuller said at the start of the project that it was the most important work to be done. This document and the strength with which the students left the project are evidence. We will all be involved in World Game as the students were. On the last day of the project there was a lunch gathering. Mr. Fuller said that he would miss their faces but would see them continually. As the students left there were few good-byes. The project will continue.

Edwin Schlossberg

PARTICIPANTS

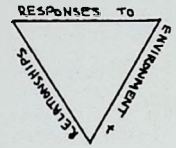
Eric Abrahamson

Tina Croll, born in New York City (Virgo) dancing and choreographing in New York now

Mary Deren

Ted Drake, architecture student

Marty Emanuel



Esther Engle, painter, poet

R. Buckminster Fuller

Medard Gabel, becoming

Daniel Gildesgame

Horace Godwin, Taurus rising-student at Goddard College-Power to the People!

Edward Hauben, explorer

Robert A. Jacobs Jr. second year Columbia architecture

Russell Kolton, I am the walrus

Jerry Laufman ''The only thing more powerful than all the armies of the world is an idea whose time has come.'' (Victor Hugo)

Mira Lehr I paint, study space and invisible relationships, take care of my four children and love everyone-especially since World Game

Charles Maschwitz, I am a painter and I have great inertia; in two days I have one breakfast and one thought, so I record receding events in red and green.

Carole McDonald Leo, anthropology-graduate student (Columbia)-space, anthropology, women's liberation

Nester Raffo

Edwin Schlossberg

Steve Selkowitz

Terrel Seltzer

Jim Smith, wholegrain breadbaker

John Storyk

Ken Versand

Henry B. Walker III

Val R. Winsey, PhD wife, mother, Associate Professor of Anthropology, Pace College, New York City

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It was a little like this-

R. Buckminster Fuller

Dymaxion maps, the room, 26 new people, waiting, Buckminster Fuller speaking, the new world, the whole world, synergy, precession, complimentarity, systems, more with less, design science, Edwin Schlossberg, the documents, the library, Buckminster Fuller leaves for Denver, finding trends, questions, roadblocks, films, Eddy, finding out about energy resources, library, the city, Buckminster Fuller returns, Bucky speaks for two weeks (excitement, revelation, the frontier, mind flying), Bucky leaves for Europe, July fourth weekend, research, examining our pattern changes in life, finding needs for one man, energy resources, trends, libraries, groups, discussion, digestion, questions, internal-external metabolics, form into two groups, energy scenario, food scenario, lunar landing, chart, charting trends, questions, attempting scenarios, attempting scenarios, charting, scenario, Bucky's back(!), people visiting, presentation, lunch, food;

till we meet again,

Mary Deren

Medard Gabel

I Pre-scenario Facts

Our pre-scenario facts consist of the conceptual tools which we found ourselves using most often in our dealings with the whole earth. They are by no means even an attempt at being complete, but are merely a general frame of reference for us, as individual participants, to fit our respective ''specializations'' into. To a large extent the ''specifics'' of the World Game course left with its participants; what is here is the general base we started with and evolved through as our individual understanding and refinement grew.

WORLD POPULATION GROWTH CHART

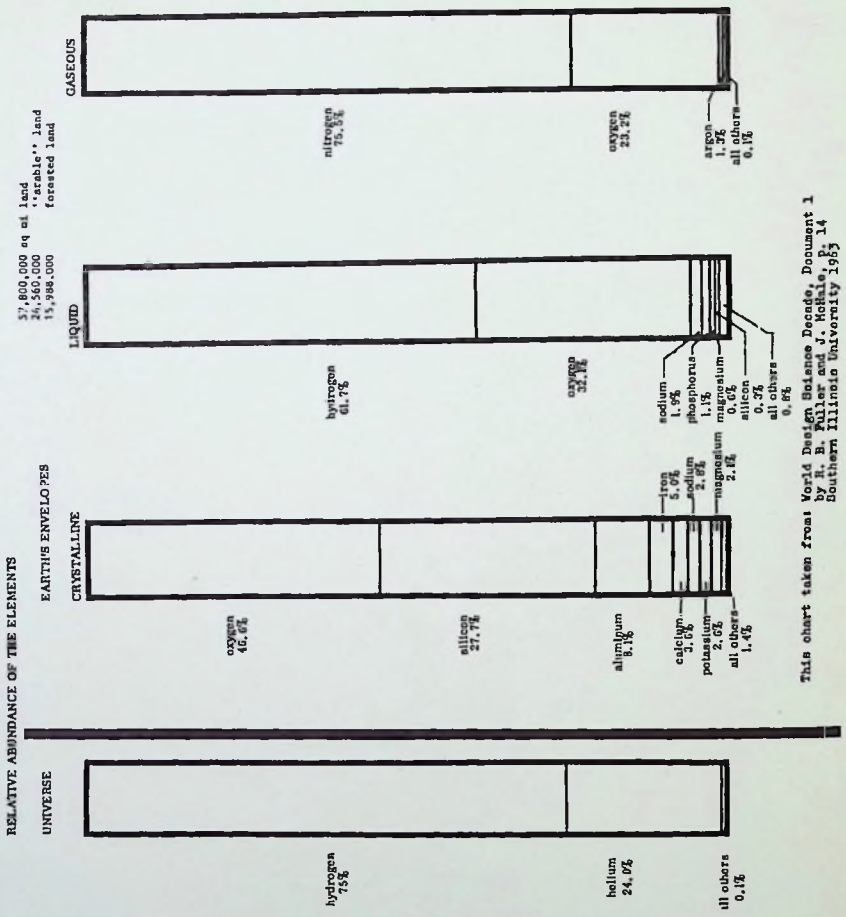
	World	Asia	Europe	Africa	USSR	N Amer	L Amer	Oceania
density*	25	69	92	11	11	10	13	2
1965**	3281020	1826887	441368	306153	231000	214307	243941	17364
1970	3593131	2016843	456473	345334	245700	229329	280447	19005
1975	3953499	2232108	471482	393135	260800	246943	328199	20832
1980	4344283	2467102	487054	449530	277800	267313	372395	23089
1985	4812638	2717081	504724	529888	297246	293243	445069	25387
1990	5352591	2991282	524923	636288	318053	321688	532438	27919
1995	5961902	3315679	543492	750591	328136	353213	640424	30367
2000	6647745	3658829	562620	886508	347824	387829	771094	33041

* 1967-figs. in people/sq. mi.
**population in thousands

One man needs per day today:

Internal Metabolics

1.4 lbs. pure air
5.0 lbs. pure water
3500 Calories
90 grams of protein
12 milligrams iron
0.8 grams calcium
0.86 grams phosphorus
vitamins and minerals
5-9 hours sleep
63-77 degrees Fahrenheit
medical attention



(How much electrical energy is in the human mind?
On what does man's regeneration depend?
How many synapses and miles of neurons does the human brain possess?
What is a toy?
What is the chemical result of frustration in the human body?
What is the minimum caloric intake necessary to develop hydroelectric sources?
What is the best working efficiency for the human body?
How does man's physical efficiency compare with his mental efficiency?
Is brain power a measurable energy source? How can it be measured?)

External Metabolics

- access to medical attention
- access to information, education, communication
- waste disposal
- re-creation
- ecological sweepout (migration, transportation)

(What are some of the present trends in man's relation to his environment? In relation to man?
On what prime conditions has man's survival, so far, depended?
If one knows more about food and the body, does it automatically mean that he eats better?
What relationship is man now effecting with his universe?
Are internal problems of communications the same as external problems of communications?
How significant is the effect of environment on nutritional optimum (U.S. citizen needs around 3200 Cal/day Japanese needs only 2500)?
Why do we ask questions?
What are questions?
Are we asking the right questions?)

Mankind has:

universe the aggregate of all humanity's all time, consciously apprehended and communicated experience

galactic clusters

Milky Way

(What kinds of knowledge have space experiments made available to man, and what are the implications of this knowledge for man's future?)

stars

our star system: sun, Pluto, Neptune, Uranus, Saturn, Jupiter, Mars, Venus, moon, our satellites, earth

196,950,000 sq. mi. total earth surface
139,150,000 total water area
326,071,300 cubic miles of water; oceans are 317,000,000 cu mi (97.2% of all water), fresh water 9,071,000 cu mi

(What are the areas of agricultural production located?
What is size?)

earth's diameter 7,926 miles equatorially and 1/297 less on polar circumference at equator 24,830 miles

total solar energy reaching the earth's surface 7×10^{17} kwg/yr

The maximum intensity of solar radiation varies between 1.15 and 1.75 cal/sq cm/min

(Can we ever really be exact about anything?)

incoming solar energy is 9% in UV range, 50% in IR range, and 41% in visible light range

(What are the world's essential resources?)

mean wind speed over the globe 2.3 to 6.7 mph

(Would war be eliminated if resources were as spontaneously available as air is?)

2.2×10^{12} tons of carbon dioxide present in the atmosphere 1/50 of this is utilized by photosynthesis each year

the estimated total organic compounds formed per year is 100 billion tons 85% of this occurs in the oceans

(How does one get to see and feel the whole?)

in one year the world's plants store 1×10^{18} kilocalories in the form of photosynthetic products

(How much energy does the earth collect and impound daily?)

daily world requirements:
- 4 million tons of food (about 200 shiploads of food in Queen Mary-cap. 20,000 tons or 400,000 truckloads of food-10 tons per truck)
- 12 million tons of water
- 14 million tons of air (300,000 domes of air-at 50 tons of air per dome (size of Expo dome))

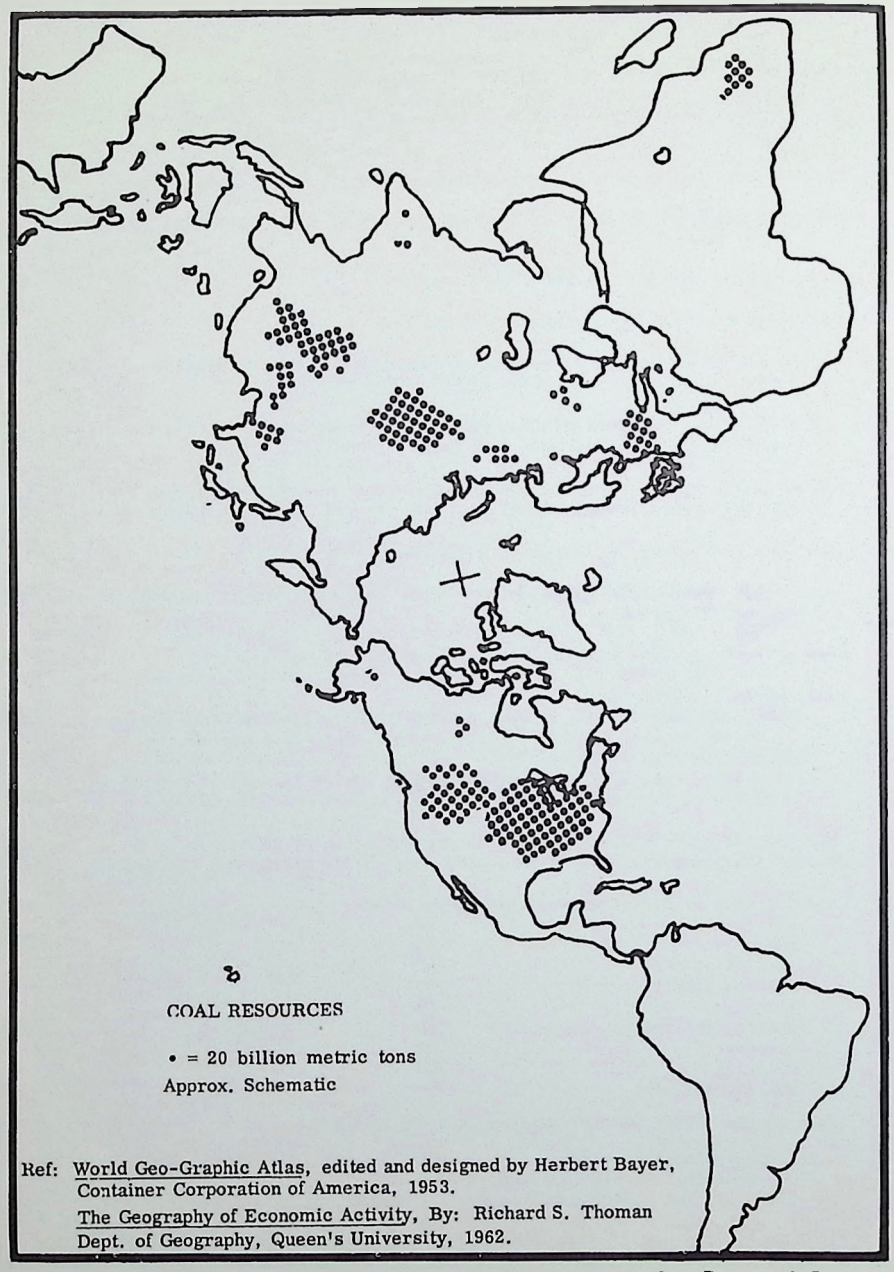
(How much electric power is needed to produce a ton of food?
What is the present protein distribution per capita throughout the world?)

Calories used in different activities (per hour):

lying in bed	77
sleeping	65
sitting at rest	100
walking slowly	200
standing	105
working (painting, carpenting)	240
running	570
swimming	500
walking upstairs	1100

(What is the effect of interruption on human thought?)

world food production in '67:
570.82 million metric tons animal products
1,457.65 million metric tons vegetable products



Ref: World Geo-Graphic Atlas, edited and designed by Herbert Bayer, Container Corporation of America, 1953.
The Geography of Economic Activity, By: Richard S. Thoman Dept. of Geography, Queen's University, 1962.

This chart taken from: World Design Science Decade, Document 1 by R. B. Fuller and J. McHale, p. 38 Southern Illinois University 1963

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(How much bulk food is produced (in Calories)?
How much copper, aluminum and steel is involved in food production?)

at present it takes 42 kwh to produce 1 metric ton of food

(What is wealth?
What are the areas of the world in which no electrical power exists?)

average per capita protein consumption for world: 68 grams (of which 20 are animal protein)
average per capita Calorie consumption for world: 2400 Cal

(What is the optimum Caloric intake of the world?
What is the highest (lowest) per capita food intake and where?)

the livestock in the world are equal to an additional 15 billion people eating (consume 1/4 of total food crops produced)

(Where are all the airports throughout the world located?)

world per capital consumption of apparel fibers in '65: 7 kg

(Can man's knowledge of his universe be conceived entirely in measurable terms?)

'65 world tonnages of fibers:	23 million	all fibers
	17	natural fibers
	3.8	manmade fibers
	2	(non &) cellulositic fibers

energy slave the total energy income for the earth as measurably consumed by man in one year, and dividing this by 25 to give a four per cent figure of energy gainfully employed at present rate of overall efficiency. This net energy used, as expressed in kilowatts per year, is divided by the world population of the year, working 8 hours a day. This gives the number of electromechanical energy slave units available.

(How does our planet impound energy?)

energy slave 37.5 million ft lbs of energy

(Are all of man's experiences accommodated by words in his dictionary?
What is the speed and lift capability of a helicopter? How big is the biggest helicopter?
What is the per capita consumption of electrical energy in the U.S. today?)

world electrical energy production–'65 to '66–average annual rate of growth 7.8%

(Of what is the planet earth made? physically and metaphysically?)

nuclear plants in the world ('65) 17,537 (in 67 countries)

(What was the first industrial tool?)

steel production in '65	210 million metric tons	(50% scrap recycle)
aluminum	5.2	(primary production)
copper	4.2	(primary production)

(What is the total tonnage of copper, aluminum and steel in the world? How is it being utilized?

What are our fossil fuel reserves?
How many kwh does it take to make 1 ton of plastic as compared with 1 ton of steel? of aluminum?
How much scrap metal is available to us throughout the world?
Approximately how much more metal can we expect to find in the earth?)

motor vehicles produced in '66: 19 million passenger and 5.5 million commercial

(How much of what metals is being allocated for transportation?
How much gasoline was burned by cars last year?)

it takes 371 kwh to produce 1 automobile

(What is the net physical wealth of world man?
How are we presently using our resources?)

daily newspapers ('62):	Asia	1736
	Oceania	114
	Europe	2403
	USSR	457
	Africa	188
	N Amer	2161
	L Amer	765

(What is meant by ''anticipatory design science''?
How much energy does man require to travel at different speeds?)

World ('65) book production (titles)	450,000
periodicals	200,000
journals, tech. reports	200,000

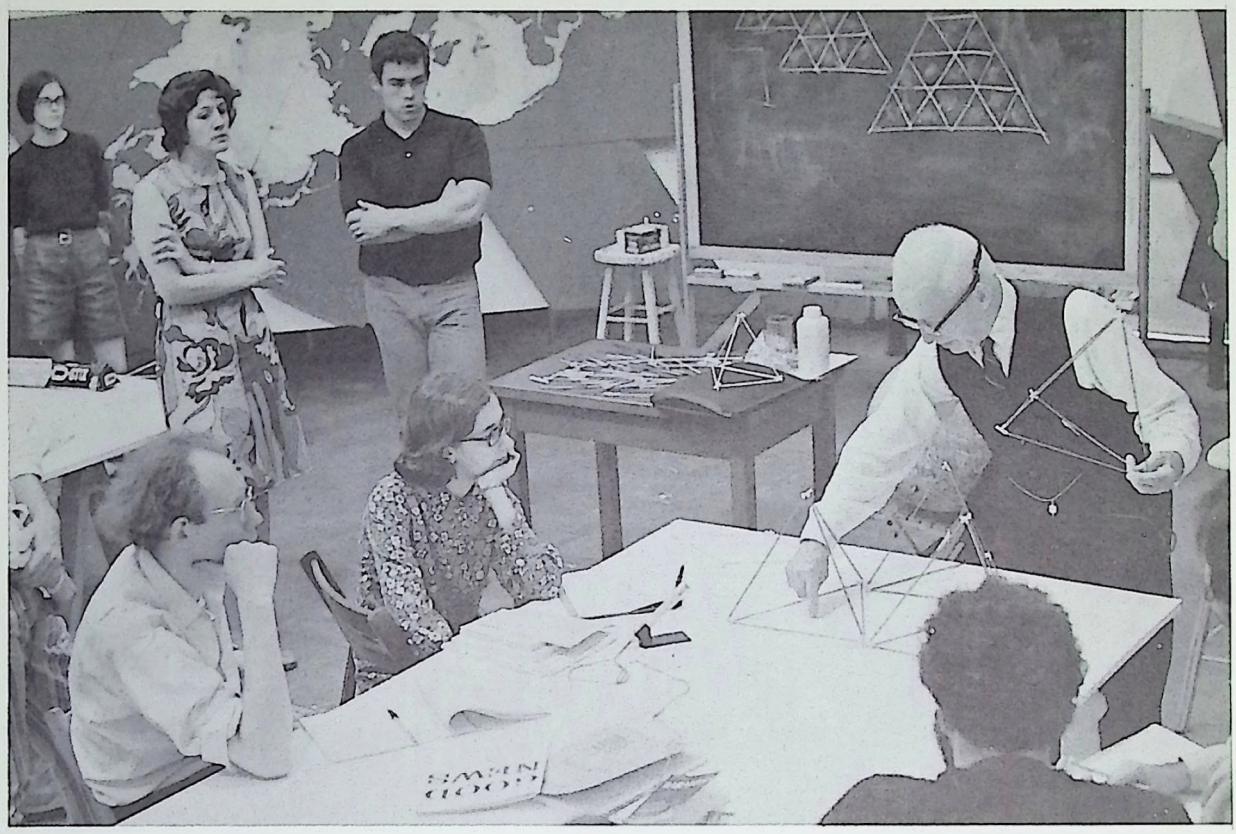
(What are the essentials which a country must have in order to industrialize?
How smart is the world?)

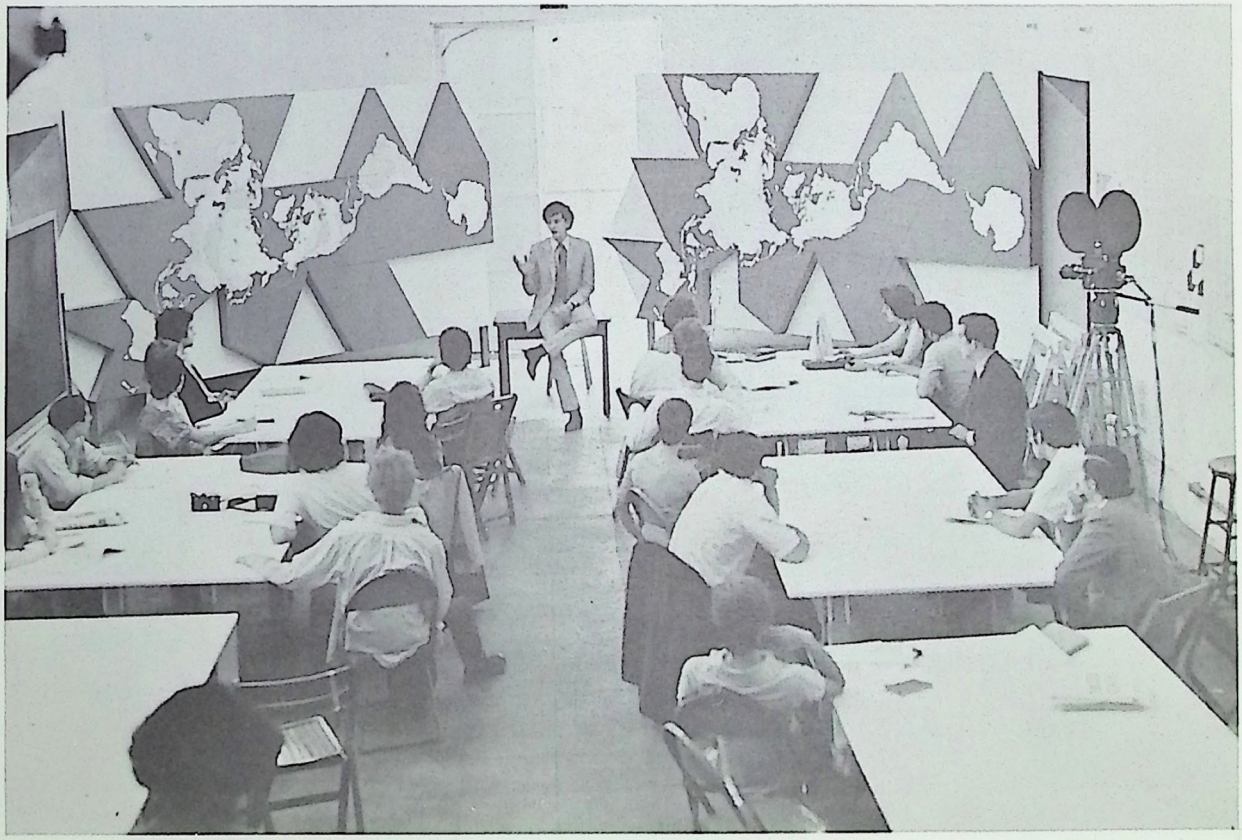
radios per 1000 inhabitants ('60):	Africa	28
	N Amer	720
	Asia	22
	Europe	220
	Oceania	198
	USSR	205
	world avg	130

(What is meant by reinvestable time?
What is the present rate of literacy; how is it distributed and at what levels throughout the world?
How are resource inventories arrived at?)

% illiteracy:

age	Afr	NAmer	SAmer	Asia	Eur	Oceania
15-19	66.5	17.5	18	37.5	6.5	4.5
20-24	70.5	21.4	23.5	43	8.5	4
25-34	75	22.7	32.6	47.8	10.3	4.8
35-44	73.6	24.3	33.9	54.6	13.8	6.8
45-54	85	30.5	37.6	61.7	18.5	9.8
55+	83.3	38.5	46.8	70.2	28.8	13.5





Finding the needs of one man led us to finding the needs for manking. As we began to deal with man on the collective level we realized the need for establishing a frame of reference or conceptual tool to deal with collective mankind's needs. The ''bare maximum'' was what evolved. Rather than take what was thought to be the bare minimum for mere subsistence levels, we elected to establish levels which would allow man to realize, (What is the bare maximum frustration level for man?) not his minimum potential, but his maximum potential. Anything less than this being, by our definition, sub-human. (What is pain?) So, in looking at calorie levels, we found the highest calorie needs to be that of pregnant women who need 3300 Cal/day and that of working men who need 3500 Cal/day. Thus if we could insure that caloric level for the world no one would be deprived. We did the same for protein levels. Between 30 and 45g of total protein per day is the minimum level of protein that must be replaced by the body; we therefore took 90g of protein/day as the bare maximum which should be available to everyone. (How many acres per capita are necessary to produce the bare max food requirements?) (What are the minimum requirements that would give us the most survival?)

In order to supply mankind with his internal needs we found it necessary to evolve a bare maximum parameter for external metabolics which would guarantee the maintenance of man's internal metabolics. This bare maximum is 1242 energy slaves per capita per year in 2000 A.D. Broken down, that is 15,000 kwh and 8 metric tons of coal equivalents per capita per year. This non-linear yardstick for establishing external relative levels of the development of man's potential to be ''human'' was arrived at by taking the projected U.S. needs (present need is 7,000 kwh) for 2000-because it was the maximum, or in this case the highest-using these parameters we found that manking will need a total 100 trillion kwh, 8.5×10^{15} Calories and 21.9×10^{7} tons of protein in the year 2000. We used the U.N. figures on the projected population for these calculations, (What is the best visual presentation for all our incoming data?) (How can the bare max requirement be made available to all?) choosing to use the

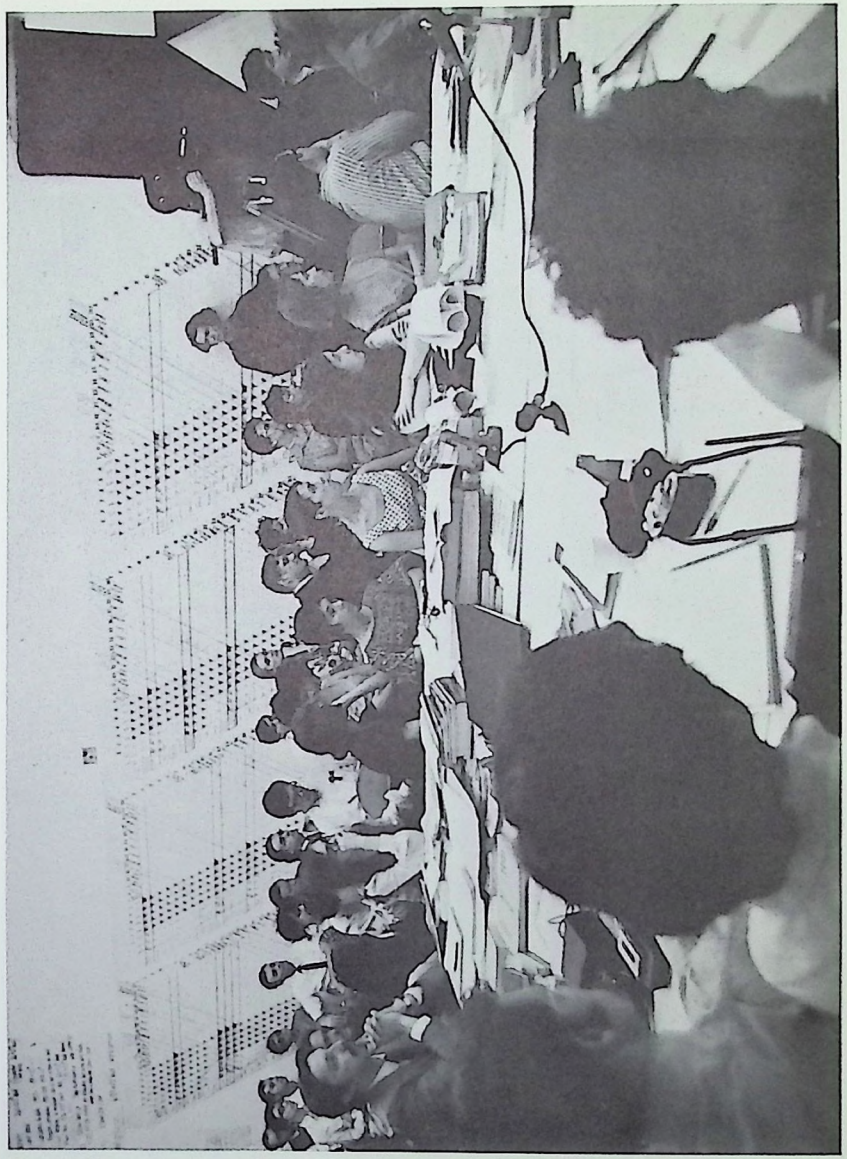
relatively high figures that didn't take cognizance of the trends towards the stabilization of the population for the same reasons we chose the highest figures for our other bare maxima.

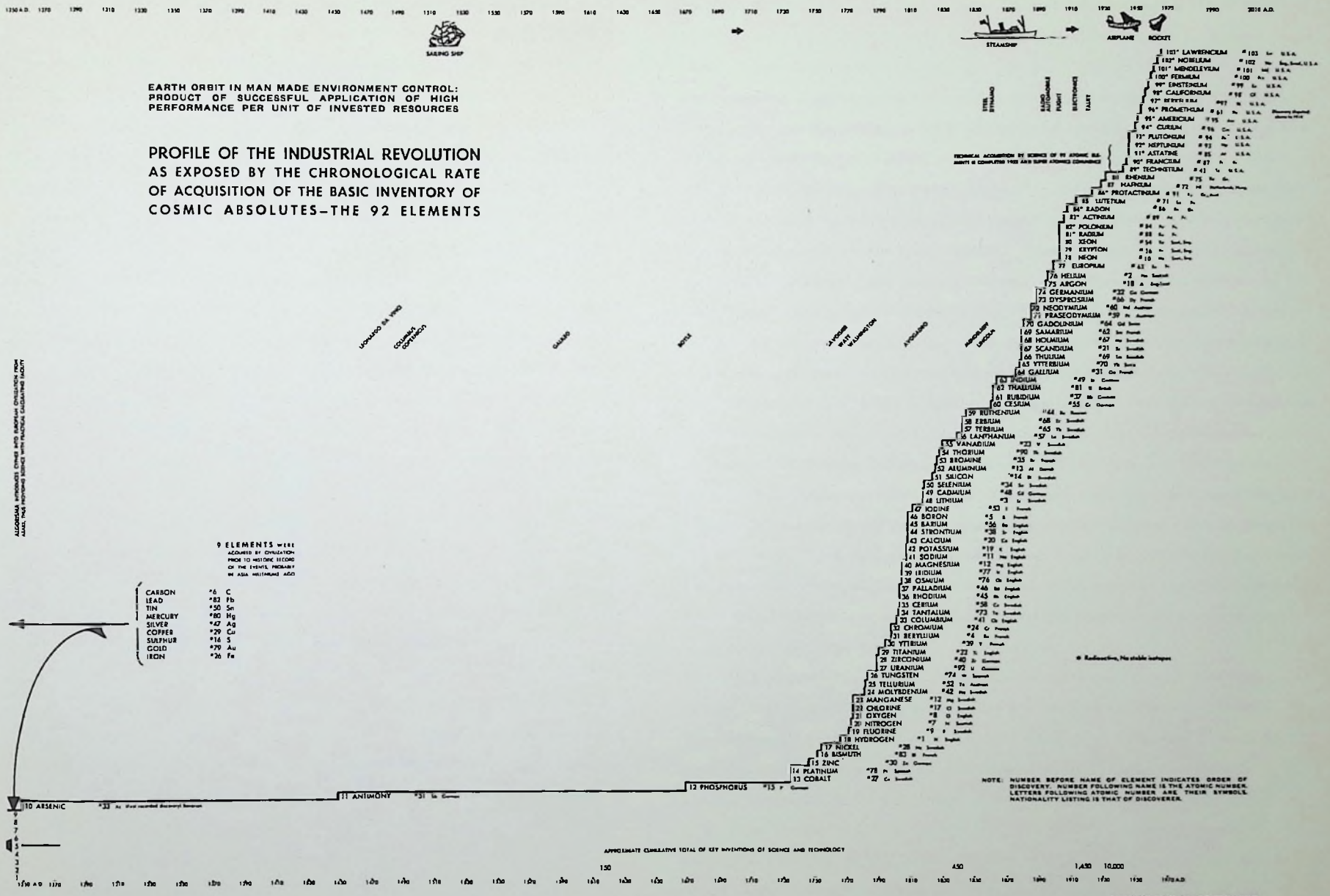
(How do the bare max requirements compare with the present per capita consumption?) What is the bare max of communications systems for the world?) (At present what percentage of the people can be guaranteed bare max?) (What is the bare max for transportation?)

In order to correlate the vast amounts of data we were accumulating about the world we devised a chart with which we could clearly display visually our basic working information. The chart was a triangular grid on which one of the three axes were the 22 major geographical areas of the world and their individual countries. The second axis consisted of, in five year increments from 1965 to 2000, figures on population, population density, calorie and protein intake, total kwh, metric tons of coal equivalents and energy slaves, and per capita kwh, metric tons of coal equivalents and energy slaves. The last axis could indicate up to 20 possible world trends for each area and country (we used 13: fossil fuel potential, life expectancy, mortality rate, arable land, housing, amounts of copper, aluminum and steel, food literacy, reinvestable time and hydropower).

The chart was four feet high and stretched 60 feet around the ''game room.''

We also employed two 10' by 15' Dymaxion World Maps with five clear acetate overlays each to visually present our data on a geographical ''whole earth.'' Information about the world's metals sources, World Man, the power network, alternate power sources, present population and 2000 projection, food production and transport, was presented on seven of the overlays while three remained free for use during game playing.





II Scenario

Once we knew what mankind had and what he needed to have, we began to experiment with ways he could go about getting his needs. These ''ways'' we called scenarios. (What are the ways in which man may be enabled to participate more effectively in his relation with the universe?) Throughout our work we found ourselves returning to one common denominator. (Can you industrialize an area without electricl power?) (How can man take care of all of his essential physical needs so as to allow himself to develop his unique metaphysical abilities?) Whether we had researched food, communication, travel, housing, or economics we always returned to electrical energy once we began to formulate any hypothesis about satisfying man's needs. (What are the priorities of the tasks that need to be done in terms of doing more with less?) In order to enable people to be fed properly, we found that they would first have to have a sufficiently high input of electrical energy to process, transport, and store food and dispose of wastes. We found that, when dealing with collective mankind, it was imperative that we attend to man's external metabolics first, and these would then take care of individual man's internal metabolics. Thus the ''energy scenario'' became our first move in the World Game. (What is the first thing you must bring to a non-industrialized area?)

After researching and then plotting the world's electrical network (generating stations and transmission lines) on one of our dymaxion world maps we devised a way of developing and improving its overall efficiency as the first step towards the bare maximum for all mankind. (How long would it take to get a minimum of kwh distributed throughout the world?) By utilizing the world's hydroelectric power (rivers and tides), without any further development of thermal plants and taking advantage of the increased efficiency of super high voltage (1,000,000 volt) long distance (1500 mi) (What are the efficiencies of electrical transmission lines?) transmission lines (How much copper wire is needed to carry the power needed by the year 2000 for both industrial and home use throughout the world (with present efficiency)?) in a day/night and seasonal hookup, we were able to demonstrate that with present methods (What is the relationship of efficiency to availability of energy throughout the world?), technologies, projected population figures, metals resources, and efficiency levels in power generation and consumption, it would be possible to bring everyone on earth to a minimum 2000 kwh per year by 1980. (How far ahead can we conceive a future life-style?) 2000 kwh is the present level of Europe and as such not below our projected bare max of 15,000 kwh for the year 2000, because with Europe's level of industrial development it would be possible to raise the per capita kwh to 15,000 by the year 2000. (What's the time lag between installation of electrical energy and an adequate food supply?) (How much metal is involved to produce the kwh needs for the year 2000?) When the energy input of an area is raised, there is a corresponding rise in communications capacity which in turn increases the necessity of the ''have-nots'' to become ''haves'' (What is the comparison between present availability of communication systems and the bare max essential for industrialization?) (Is it more efficient to have many small decentralized electrical generating units than one large unit?).

In the scenario the vast hydroelectric potential of both South America and Africa (How much metal is essential to meet the power needs of India, China, Africa and South America?) is utilized to raise their respective levels to the per capita figure of 2000 kwh and the surplus transmitted via the electric network to areas where there are deficits of electric power (What is the sequence of industrialization?). Because we do not have a global network at the present time, the U.S. and other industrialized countries produce and use during the night hours only a small percentage of their electrical power capacity (What degree of communication is necessary to bring electrical energy into an area?). With a global electric grid, power could be generated at day and night total capacity and transmitted to the daytimy peak needs around the earth. (Using our present technology, can we provide electrical needs for everyone without polluting our air beyond human endurance?) (What is pollution?)

	Hydroelectric Power			
	Capacity ($\times 10^3$kw)	Production ($\times 10^6$kwh)	Potential ($\times 10^9$kwh)	Undevel. potent. ($\times 10^9$kwh)
east Asia	20118	86951	528.7	442
south Asia	6088	24397	1991.2	1967
Europe	83128	299682	629.8	330
USSR	22244	80617	1407.5	1327
Africa	3740	13255	3210.0	3197
N America	66260	313694	903.6	590
S America	8956	36814	2173.0	2137
Middle America	2666	8523	319.0	311
Caribbean	148	340	15.0	15
Oceania	4240	16786	184.0	167
world	217588	881059	11361.8	10480

Efficiencies of Power Sources:

fossil fuel (coal and oil)	40%
nuclear power plants	40%
magnetohydrodynamics	55%
fuel cells	40 to 60%
thermoelectric	40%
thermionic	10%
heat engine	32%
solar furnace	70%
silicon battery	15%
fusion	10%
hydroelectric	80%

The scenario utilized hydroelectric power for other considerations than what is presented above; besides the efficiency and pollution problems of thermal plants it became overwhelmingly apparent that our ''savings account'' of fossil and nuclear fuels would soon be depleted at the bare maximum level of consumption. Our constantly replenished ''income'' energies were the obvious choice (How long does it take to build a hydroelectric plant?).

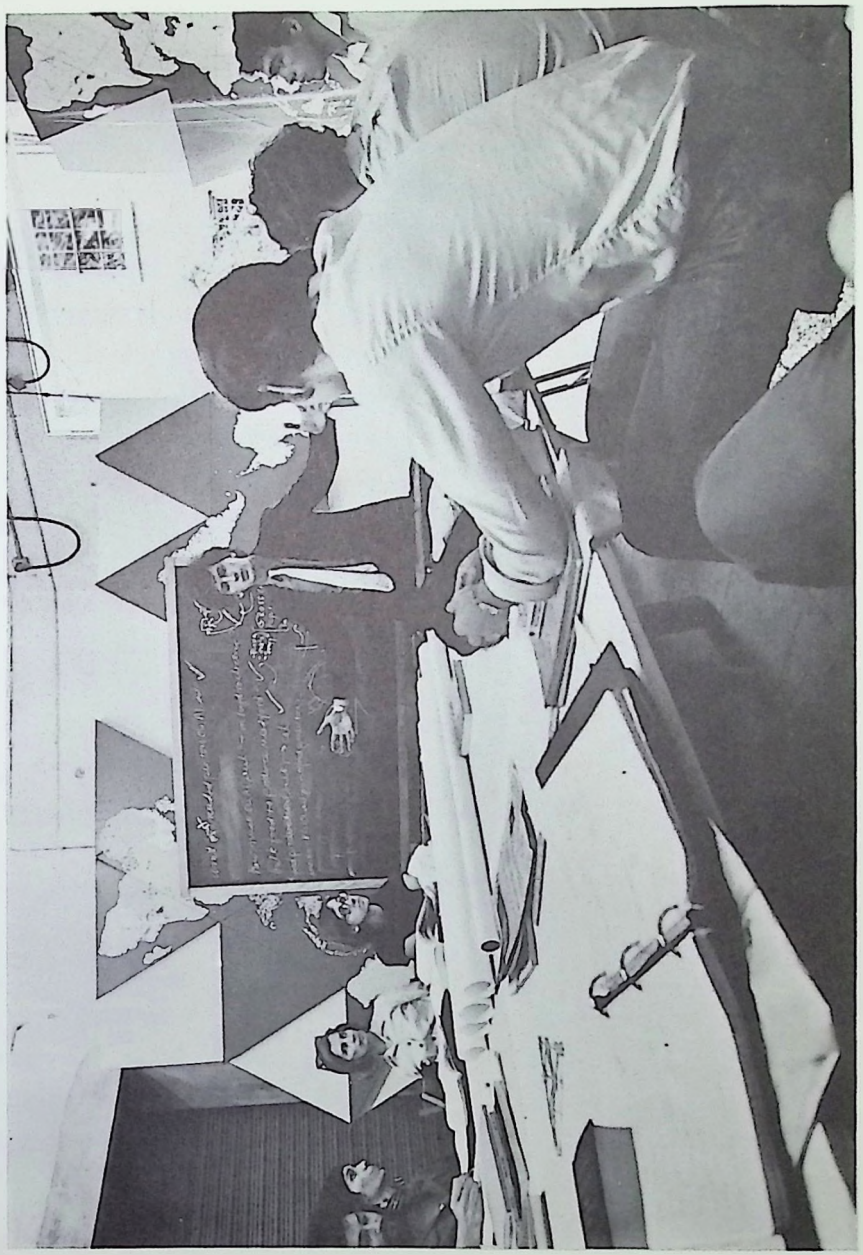
The amounts of metals, principally copper, aluminum and steel, that would be needed for such an undertaking–approximately 9000 tons of steel per 1000 million watt hydroelectric plant and 60 tons of steel and 25 tons of aluminum for a mile of power line (at present efficiencies)–are within grasp of earth's present economic and industrial development (How can we accelerate efficiency throughout the world?). We chose to keep efficiency levels and technological competence at present levels to show we could do this today, with what we have (How much metal is needed for 100 miles of power lines?). (When is a game a game?)

After demonstrating man's potential competence for bringing the world average per capita kwh up to 3613 with no one below the present European level of 2000 kwh, stage two of the electric scenario began. Utilizing increased efficiencies, technological progress such as laser beam power transmission, and some of the earth's varied income energy (What is the potential kwh from wind power? Tidal power?) sources the per capita level of kwh is brought up to the 15,000 bare max in the year 2000.

Furnishing an area with enough electric power for its industrialization brings to that area the potential to satisfy its bare max food requirements. Knowing from the energy scenario that we could count on using 2% of the total electric power for agricultural uses (What percentage of electric energy is essential for food production?), we then looked at ways to increase the per capita Calorie and protein levels to the bare max. A startling fact which became obvious upon looking at food production was that the world produces more than enough to feed its people adequately, but that in transport, storage and pro-

cessing 90% of the tonnage of food is lost (How do we identify waste?). If we could bring methods to increase worldwide efficiency, at the rate we increased food production in the past, the world could feed its population for some time to come. Shipping food halfway around the globe is inefficient (for ex: in '67 Asia imported and exported the same amounts of rice). Ships could be used to transport materials not native to a particular area or the metal from the ships could be used more profitably elsewhere. Part of the electrical power set aside for agriculture could be used to increase efficiencies in short transport to some areas (because of their low farming efficiency) we needed to look at ways to increase production efficiency. The increased use of fertilizers and farm equipment, in addition to the increase in knowledge of farming brought about by the higher communications capabilities, would be helpful (also the possible use of pesticides or other pest control facilities after their ecological implications had been thoroughly examined). (What is the ratio between dairy and beef cows?) (Does the world need tractors?) (What are the key problems for meeting the food needs by the year 1980?)

The above methods could bring the needed increase in efficiency necessary to have the entire population at bare maximum by 1980. The efficiency would be somewhere between the U.S.'s (feeding about 2 people/acre) and Japan's (feeding 6 people/acre). (What period of time did it take for Japan to become industrialized after WWII? Why?) It would be difficult to raise the world's efficiency to that of Japan's using her methods because a tremendous amount of manpower would be drawn into agriculture (approximately 40% of her people are engaged in agriculture as opposed to 9% in the U.S.). (How many man hours are involved in building a hydroelectric plant?) There are many new ways to produce food of which the following are just a few examples–using algae (Chlorella and others) for food, feeding bacteria plant wastes (such as stalks, sawdust) and letting them convert these to food for man, and synthesizing amino acids. However, we didn't employ them in our scenario because we

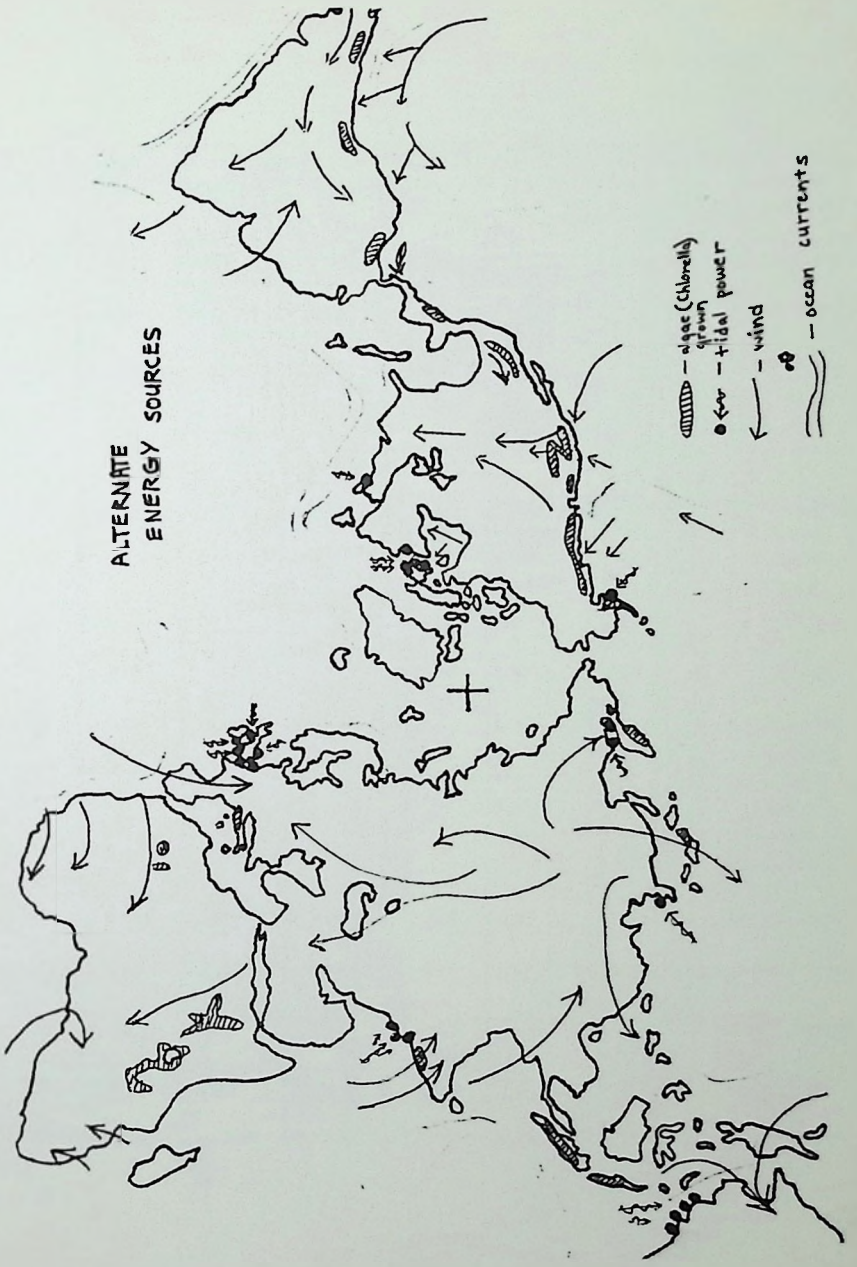


did not want to make a move which would assume changing people's food habits.

Looking past 1980, continuing to feed the population using old methods, although possible, would demand an increasing amount of manpower. (How much food is being used annually on airlines?) However, we felt that the metaphysical manpower released by this time-reinvestable time-would cause a fundamental change in agriculture. (Do areas of inefficiency indicate underdeveloped capacities?) (How does protein manifest as a source of metaphysical energy?) The change would be the transformation from a craft (an essentially open system) to an industry (closed system). At the present, most of the important variables in farming are not controlled. (What are the various acidity ratios of rain throughout earth?) In a closed system such variables as weather effects, insect pests, loss of water and nutrients-would be controlled or the detrimental effects eliminated. One experimental system could feed 500 people/acre-which would mean a population of 6 billion people could be fed using only 24 thousand square miles of land (we're now using around 7 million square miles), or approximately the area Japan uses to feed her people today.

Given enough electrical power, the external metabolics, the earth could feed as many people as she needed-up to 7.8 trillion, for example, on presently farmed land using the aforementioned experimental system.

From this scenario we went on to examine some of the effects these scenarios would have on other areas of man's life.



ELECTRICAL ENERGY - PROJECTIONS

	1965		1970		1975		1980		1985		1990		1995		2000	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Per Capita El. Energy Cons. KWH	Total El. Energy $\times 10^9$ KWH	Per Capita	Total	Per Capita	Total	Per Capita	Total	Per Capita	Total	Per capita	Total	Per Capita	Total	Per Capita	Total
WORLD	1006	3349.4	1544	5405.5	2025	8005.7	3613	15697.9	6314	30389.9	9216	49328.6	12049	71836.5	15000	99720.0
EAST ASIA	288	261.1	340	309.7	620	424.5	2100	2186.1	5200	5761.6	8500	10030.0	11700	14543.1	15000	19620.0
SOUTH ASIA	71	69.2	120	132.7	400	502.8	2100	2994.6	5200	8366.8	8500	15385.0	11700	24254.1	15000	35250.0
middle South	61	39.7														
South East	52	12.9														
South West	243	16.4														
EUROPE	2265	998.7	4100	1869.6	5900	2778.9	7700	3749.8	9500	4747.5	11400	5945.0	13200	7167.6	15000	8445.0
Western	2636	369.4														
Southern	1138	134.4														
Eastern	1683	170.2														
Northern	4103	319.7														
USSR	2191	506.7	4000	984.0	5800	1513.8	7700	2140.6	9500	2821.5	11400	3625.2	13200	4329.6	15000	5220.0
AFRICA	193	58.6	260	90.0	520	204.4	2100	945.0	5200	2750.8	8500	5406.0	11700	8786.7	15000	13305.0
Western	25	2.5														
Eastern	76	6.3														
Middle	147	4.4														
Northern	141	10.6														
Southern	1735	34.7														
NORTH AMERICA	6684	1302.0	7900	1809.1	9000	2223.0	10200	2733.4	11400	3340.2	12600	4057.2	13800	4871.4	15000	5820.0
SOUTH AMERICA	436	72.4	480	90.2	720	159.1	2100	518.7	5200	1523.6	8500	2958.0	11700	4867.2	15000	7470.0
MIDDLE AMERICA	369	20.3	420	27.7	660	51.5	2100	195.3	5200	542.3	8500	1190.0	11700	2012.4	15000	3180.0
CARIBBEAN	504	11.5	560	14.6	820	23.8	2100	67.2	5200	197.6	8500	374.0	11700	608.4	15000	915.0
OCEANIA	3407	47.7	4100	77.9	5900	123.9	7700	177.1	9500	237.5	11400	314.2	13200	396.0	15000	495.0

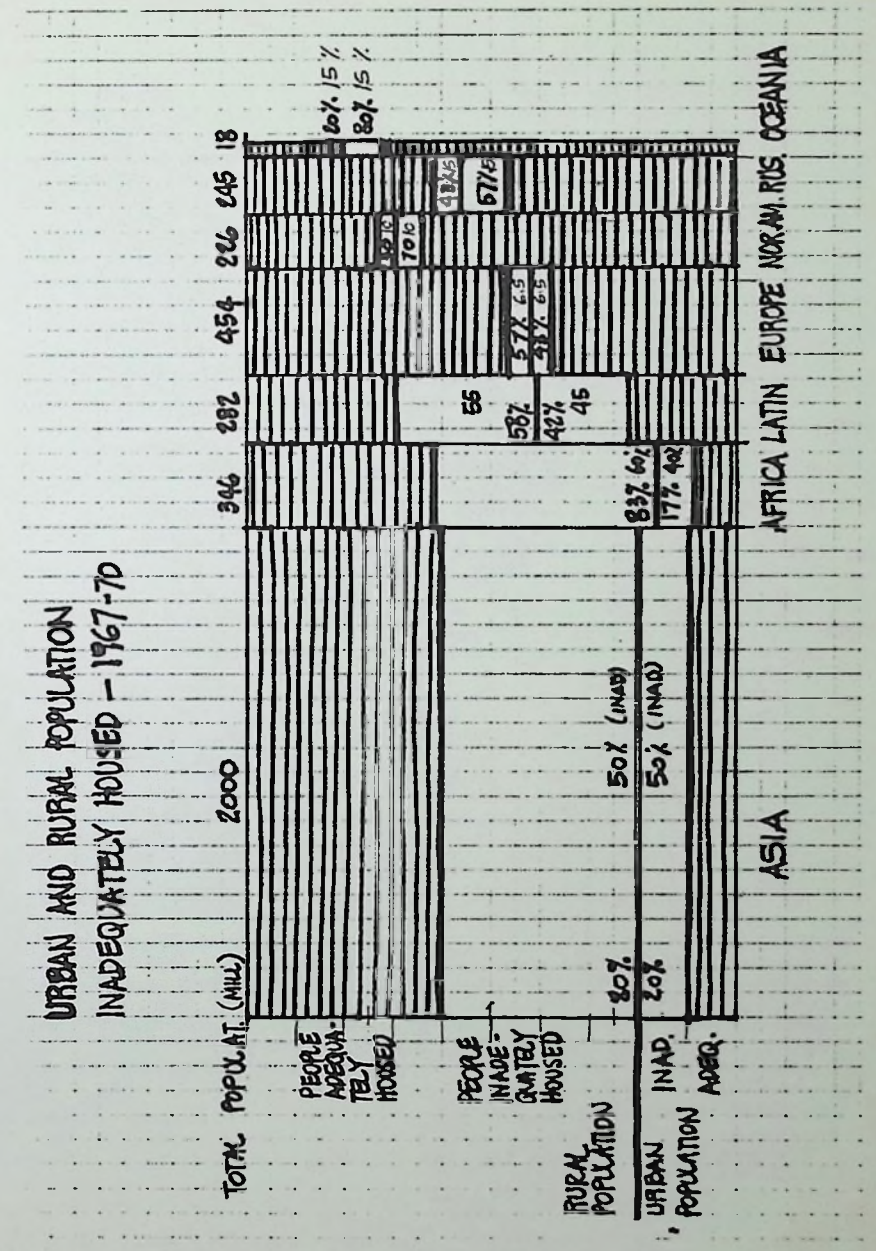
III Future Directions
(Discovered, uncovered, but not covered scenarios, trends, and etc.)

After working out scenarios for satisfying what we considered the two most vital bare maxima, external electric energy and internal food supply, we evolved into some of the possible synergetic scenarios that would result from the first moves.

The establishment of bare max levels of the above throughout the world would engender the need for bare max's in housing, medical attention, income, communications and travel.

The housing scenario we were working on clearly showed the inadequacy of our present system. At the present rate, the use of metals in housing would prove to be totally insufficient. Metaphysical engendered materials such as the plastics will have to be developed if we are to solve mankind's housing needs. The housing scenario encompassed more than just the shelter needs of the world? as it evolved we saw that it would encompass communications and mobility. With the trends of increasing mobility throughout the world, we foresaw the possibility that no one would be staying at any one place long enough to warrant the construction of ''permanent'' shelters. As a total service facility, the housing needs would encompass not only shelter but communications–with its own resultant education (via TV, computers), medical information and attention (via telephone to a world central medical computer), personal telephone contact with anyone, anywhere, and mobility–with anyone going anywhere.

Some future directions/scenarios we brushed upon were the possibilities of a world guaranteed annual income, the potential of fluidics as a source of energy, information and automation, the use of heat pollution from thermal electric plants to heat soil to improve crop output, the efficiency gain by using



gasoline or alcohol to run electric power plants and electricity to run cars, the production of alcohol from algae, farm wastes, or garbage and its substitution for gasoline in present day combustion engines, the laser beam transmission of power and information, the amount of reinvestable time that will be available to mankind as a result of freeing him from the drudgery of having to ''earn a living'' (by bringing man to the bare max food and energy levels, by the year 2000 we will have 16 trillion more hours per year than at present to reinvest into the metaphysical regenerative functions), the increase of efficiency rates for power production and consumption, communication, transportation etc., and the possible surplus and increase of efficiency through the stabilization of the population.

Many other possible trends were intuitively uncovered throughout the course, most of them needing research for verification. They are presented here as a few possible steps towards working out future scenarios.

Trend of abstraction of media of exchange:

no credit card
credit card
credit cards
checks
paper $
coin
gold coin
cattle exchange
craft exchange
trade/barter
''goods''

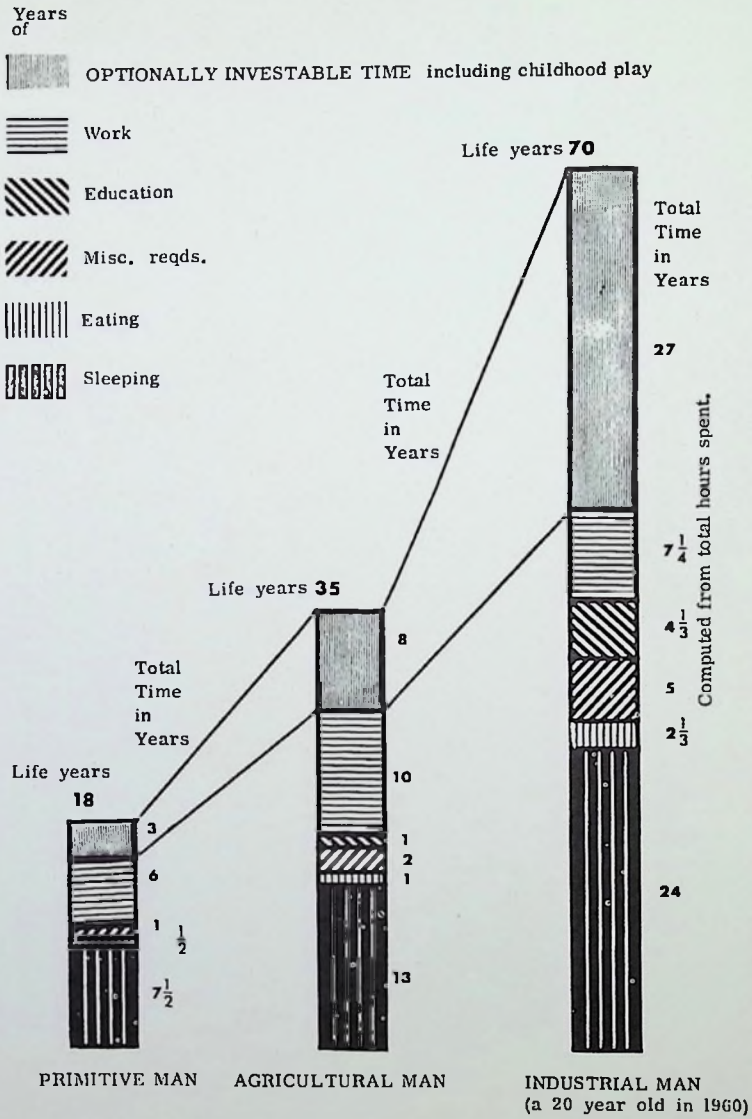
last position (no credit card) is the same as the first point (goods). Each succeeding media being an abstraction of the preceding media; acceleration of acquisition paralleling industrialization

trends towards:

use of 92 basic elements
transportation of man around earth
abstraction
specialization
comprehensiveness
doing more with less
self-fulfillment
increased life expectancy
higher education
automation
non-ownership (leasing)
multiple citizenship

increase of energy slaves/cap
increased leisure
increased weather prediction
omni-directional (away from linear)
miniaturization
autonomy

TOTAL TIME SPENT IN VARIOUS ACTIVITIES BY PRIMITIVE, AGRICULTURAL & INDUSTRIAL MAN.



This chart taken from: World Design Science Decade, Document 1 by R.B. Fuller and J. McHale, p.16 Southern Illinois University 1963

trend of: conservation of the physical, use of metaphysical
energy network growth
realization of metaphysical ideas into physical reality
declining birthrate/deathrate
man's ability to regenerate life
decrease of restraints on man
increasing identification of man (I.D.'s, photos, etc.)
interdependency
micro, macro environmental control–cloud seeding, heated socks etc
world migration
do-it-yourself-ness
revolutionary discoveries
amounts of mail
availability of the international cultural environment

The following words are new, this list being extracted from the sum total new words compiled by Merriam Webster:

1943–homeostasis, pesticide, bazooka, walkie-talkie, pin-up girl, Snafu

1944–DDT, jet plane, V-2, gobbledygook, hump, D-Day, L.S.D. (landing ship dock), milk run, P.O.W., X-day, skytroops, bobby socks, skytrain, teenager, jeep, deepfreeze

1945–plutonium, A-bomb, Atomic Age, banzai, cloak and dagger, genocide, Globester, May Day, bogey, buzzbomb, loafer, pedalpusher, VIP, hubba hubba.

1946–carbon 14, push button, shock wave, truth serum, snowmobile, atomic cloud, iron curtain, existentialism, baby sitter

1947–electronarcosis, sonic barrier, AEC, CARE, cold war, hot war, one-worlder, police state, airletter, chain reaction, hot rod, new look

1948–copter, cybernetics, servo-mechanism, transistor, UNIVAC, Israel, expressway, LP, profile, thruway, TV

1949–automation, electronic brain, freeze drying, hyperzonic, reactor, antihistimine, space medicine, H-bomb, UNICEF, Veep, welfare state, bikini, Howdy Doody

1950–cinerama, heliport, radio star, spacemen, sub-miniaturization, nerve gas, 2 stage rockets, apartheid, captive audience, litter bug, rat pack, theater-in-the round

1951–dacron, NATO, brainwashing, frogman, ground zero, roadblock, hard core

1952–printed circuit, space platform, telethon, whirlybird, bamboo curtain, astrogator, hackie, panty raid, pony tail, zip gun

1953–bit, jet stream, count down, bookburning, cookout, discount house, drag strip, egghead, name dropper, split level, 3-D, triskaidekaphobia

1954–moonlet, radar-cop, sonic boom, desegregation, fall-out, megaton, cat music, do-it-yourself, goof, highway hypnosis, toll way

1955–brain print, death control, Atlas ICBM, Dew Line, certified mail, GAW (guaranteed annual wage), brush fire war, cha-cha-cha, classic car, cue-card, demolition derby, dream car, junk mail, rock and roll, UFO

1956–electroluminescence, moontracking, SCUBA, space biology, sputnik, meter maid, subliminal projection, total theater, teachers aid

1957–DNA, jump-belt, lift-off, lunar probe, moon dust, moon shot, orbit, re-entry, retro-rocket, solar flare, overkill, Parkinson's Law

1958–action painting, beatnik, beat generation, carry-out, hot dogger, sick joke, swivel dance, wilderness park

1959–aerospace, silo, SNAP, soft landing, back-up, earthman, go-kart, weirdie

1960–atomic time, closed ecological system, cosmonaut, Echo, fuel cell, laser, molecular electronics, recycling, sit-in, anchroman, bluegrass, cliff-hanger, compact car

1961–A-OK, G.E.M., Mohole, parking orbit, smithereens, solar wind, teaching machine, Black Muslims, freedom rider, New Frontier, high rise, New Wave, soul, bossa-nova, fastback, hairy, phase-out, red-dog, spin-off, status seeker, Theater of the Absurd, fail safe, antimatter, Apollo, black box, computer revolution, heat shield, ion engine, LEM, module, probe, plasma engine, RNA, thalidomide, voice print

1962–astrocommuter, hyper velocity, soft ware, solid-state, tokenism, brain drain, Cosa Nostra, found object, happening, jet set, multiversity, peacenik, pop art, psychedelic, surfer

some word trends——

popular expressions and those words which are a product of government activity have a one year life-span. They are replaced yearly with whatever 'current events' that become popularized.

pure science suffers during war years.

military terminology trends towards the use of acronyms and euphemisms, which tends toward a coding of information.

the public trends toward the use of acronyms.

during war years the trend is toward coinage of words designating maneuvers rather than those object inventions which instrument those maneuvers.

post-war years are characterized by an abundance of new nouns, due to those inventions which are a product of the military application of science and technology, which were held back during the war.

post-war years see an increase in scientific and technological terms, trending towards pure science returning to its studies.

with the advent of TV by 1950 there is an increase in popular expressions, because of a new means of mass communication.

What do we mean by universe?
Has man a function in universe?
What is thinking?
What are experiences?
What are experiments?
What is subjective?
What is objective?
What is apprehension?
What is comprehension?
Waht is positive? Why?
What is negative? Why?
What is physical?
What is metaphysical?
What is synergy?
What is energy?
What is brain?
What is intellect?
What is science?
What is a system?
What is consciousness?
What is subconsciousness?
What is teleology?
What is automation?
What is a tool?
What is industry?
What is animate?
What is inanimate?
What are metabolics?
What is wealth?
What is intuition?
What are aesthetics?

What is harmonic?
What is prosaic?
What are the senses?
What are mathematics?
What is structure?
What is differentiation?
What is integration?
What is integrity?
What is truth?
How many questions have you had? How many thoughts?
What is the potential of World Game as an educational tool?
Is there a hierarchy of the characteristics of human behavior?
What techniques are being evolved to make visible the increasing innumerable invisible forces affecting man today?
Is every human being in his own state of evolution? Implications for education?
Can learning be defined?
How can we better understand man's ability to discover generalized principles?
Can you conceptualize the whole universe with your mind?
What words do you consider unpolarized?
Where is the frontier?
What is the efficiency of a computerized automated factory?

IV Tools

speed of light c = 2.988×10^8 meters/sec

1 metric ton of coal equivalent: 1666 kwh (assumes efficiency of 21%)
or 8000 kwh (heat equivalent)
or 28.8×10^6 Btu

1 kilowatt hour (kwh): 3413 Btu

1 energy slave: 37.5×10^6 ft lbs or 14 kwh

1 metric ton coal equivalent: 24 energy slaves (at 4% efficiency)

1 energy slave: 14.2 kwh (100% efficiency)
or 12.1 kwh plus 6.5 kg coal equivalent

1 metric ton of gas or jet fuel: 1.5 metric ton coal equivalent

1 lb uranium can perform as much work as 3 million lbs of coal

1 calorie: 3.087 ft lb or 3.968×10^{-3} Btu or 1/1000 Calorie

1 cubic mile of water: 1,101,117,143,000 galons

1 square kilometer: 100 hectares

1 square mile: 259 hectares

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What does World Game mean for our lives? Western man has been on a 6000 year (Neolithic) thinking trip based on his need to survive in a security environment in which his schizophrenia has increasingly intensified-the United is lost and power-domination-brutality-hierarchy grow as the macro-microcosmic splits widen: conscious vs. unconscious, mind vs. body, parent vs. child, man vs. woman, life vs. art, man vs. man (class society), man vs. nature (destruction of ecological balance), East vs. West (world war), man vs. God-until we have the ultimate horror of New York City with its filthy air, filthy water, noise, knives, winos, plastic food, hating each other, stomachs rigid, alienated from work, on the treadmill, unable to stop and find Center, social games, lying, stealing, murdering.

Now-the wheel turns-joyous Revolution! World Game says there is enough for all, no more ''them'' only ''us,'' and life's purposeless purpose becomes to generate/regenerate cosmic body/mind energy flows and direct them in ever-changing evernew magic patterns. We (youth) intuitively understand this end of Western civilization and we begin to leave or destroy the existing constricting idea/institutional structures: patriarchal family, university, government, cities, money, private property, armies, ideologies, repression, work, authority, bourgeois egos, morality, pay toilets, time, and Newtonian space. We discard these for lives of (w)holiness, play, sex, music, and unfettered creativity. The divine natural life pleasure pulsations of the organism break through the crust of repressed awareness, we reclaim control of our everyday lives. We are beginning to heal the splits and resolve contradictions, to get back to the cyclical/eternal/sacred life of early man with infinite consciousness; the spiral returns but at a new level, our machines will provide us with all we need and take us anywhere. We will be children with the whole earth as our playground. We are one. Paradise is the only thing now practical.

-Eric Abrahamson

constant pressure
put on the mind
to keep it in
touch with itself
always learning
about oneself
and about others
necessary to climb
so to control is important
shift change and
alter the mechanism
gathering information
which never ceases
using our senses
being in touch
we continue to grow
to stop is disasterous
movement spiralling
ever greater and higher
into the field of
the unknown
searching for some
thing which goes
beyond the imagination
today we experience
tomorrow we experience
for ever we shall
for to experience
is to learn and
growth proceeds from
learning
to be awake is a key
and we must not dis-
miss any clue which
informs and lets us
see clearly. So let us
be aware
constantly we are
reminded for it
is always slipping
from our grasp
we must stay awake
and be of use to others
there are many
but few survive
because there is
constant pressure
put on the mind
to keep it in
touch with itself
always learning
about oneself
and about others
necessary to climb

so to control is important
shift change and
alter the mechanism
gathering information
which never ceases
using our senses
being in touch
we continue to grow
to stop is disasterous

-Ed Hauben

Before/after thoughts

worldman

you are the beak
of embryo earth

seeking nutriment

you broke the shell
and we emerged

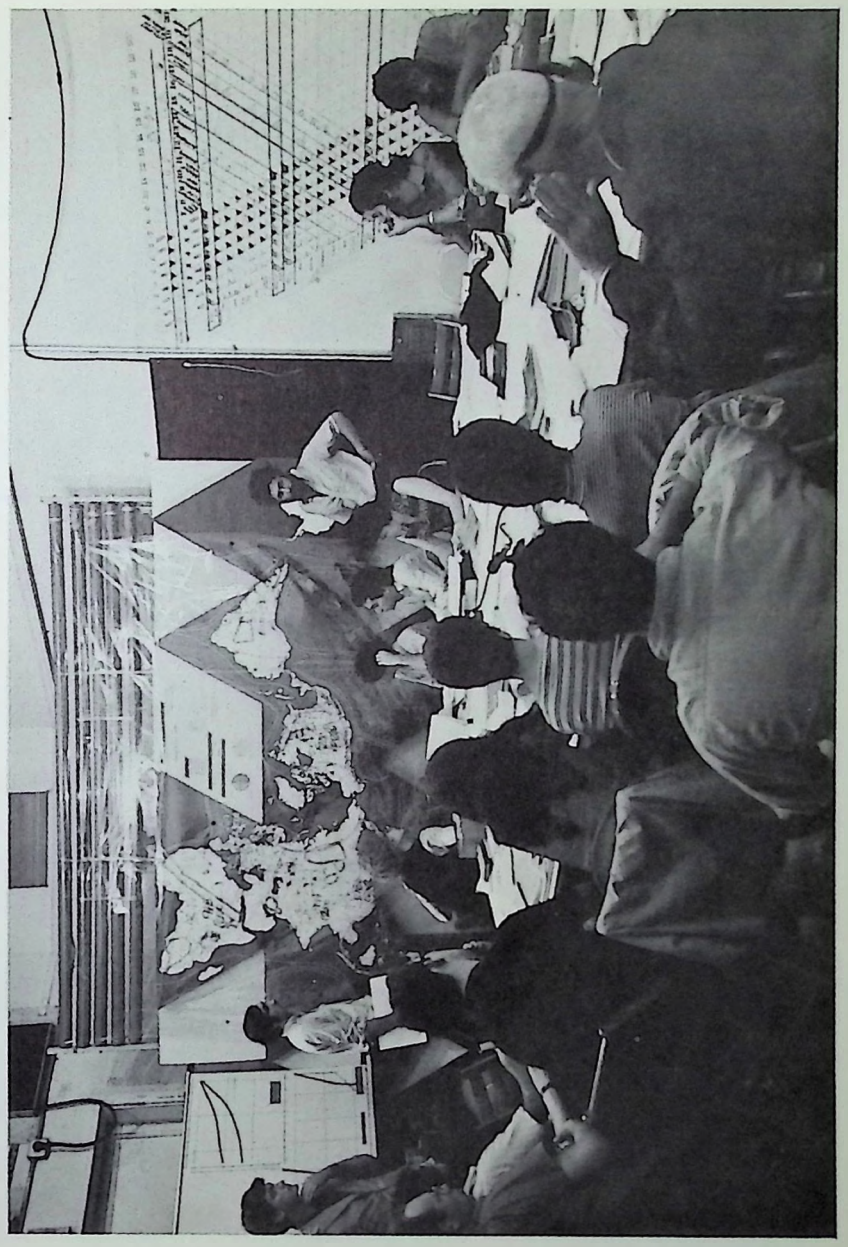
finding nutriment
you fed us all
universe
now, only the impossible happens
to be perfect
is to happen

-Medard Gabel

Rocky Road

3 shakes of kelp
1 tea. liver powder
1 tea. sunflower seeds
1 tea. dehydrated milk
1 tea. wheat germ
1 tea. soy lecithin
1 tea. honey
2 tea. yeast powder

and the liquid flavoring of your choice (usually milk; can be orange juice etc.)



Projected English Language (past 2000)
either-the same connective continuity with a change of vocabulary,
or-the same connective continuity with the vocabulary deleted, i.e.,
Connective Discontinuity-all those words that do not prevent you from thinking and more, or all those words which, past 2000, will be reminiscent of conjunctions, as, if-then, and, or and but, and more, and
more. What I see before I open my eyes must be close to real.
(the So I'll close them.
following text includes extracts from R. Buckminster Fuller 'thinking out loud')
When I opened them again, I saw no need to color SPACE.

In between space was REAL. already painted.
Within REAL was me already.
(I stepped into the present)

I am no longer the painter.
Irreversibility guarantees REAL.
I am now the painter (of me).

—John Storyk

As a non-proponent of everyday language, 'annihilation' is not descriptive of turning inside out a left hand glove.
As a non-proponent of everyday language I admit that speaking of 'annihilation' with regards to ''turning inside out a left hand glove,'' is not being descriptive of turning inside out a left hand glove.
And set up in a better league than you were, belongs in quotes, rather than, how I followed through during this half century. I always found numbers always going around.
(No scientist could tell the difference between two metals. He might ring a cylinder and tell you something of the ring. No scientist could tell you which one is stronger. He might ring a cylinder and tell you something of the ring.)
All that came in here. There is hardly a very big way to develop whatever comes in here by big fortune. You might for the moment do much too much, much too little with much too much. Assuming that every tool we can see is a man. Since the time we were beginning to show the very well informed, doing was not listening, he decided to make this my subject.

Bucky

to speak with someone is to share
your life's experiences, observations,
and responses that have made manifest
your fundamental good will.

through your sharing as a man
comes a realization that we will yet
see man as a fulfillment of his
function as man in universe.

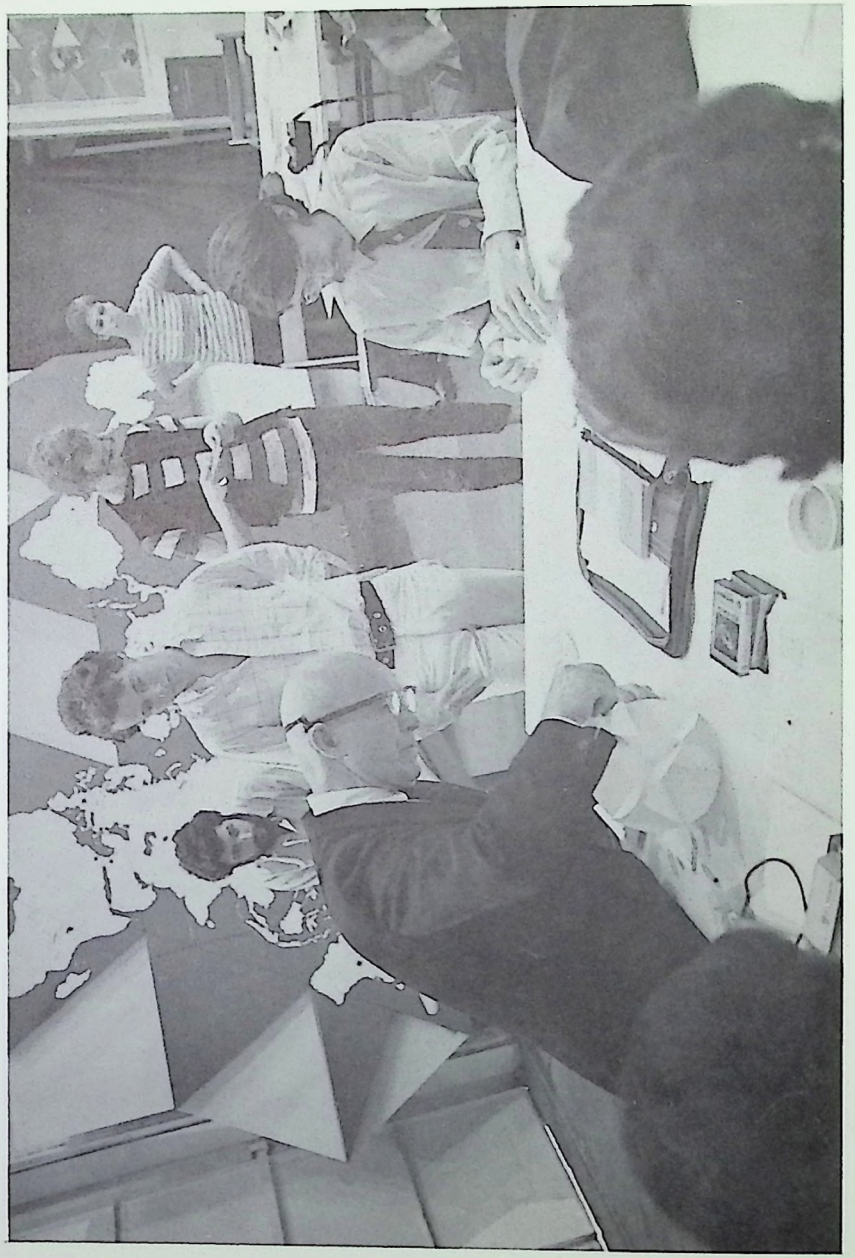
dialogue, that thinking relationship
whose progeny is integrity, precludes
dogmatism, which does not think.

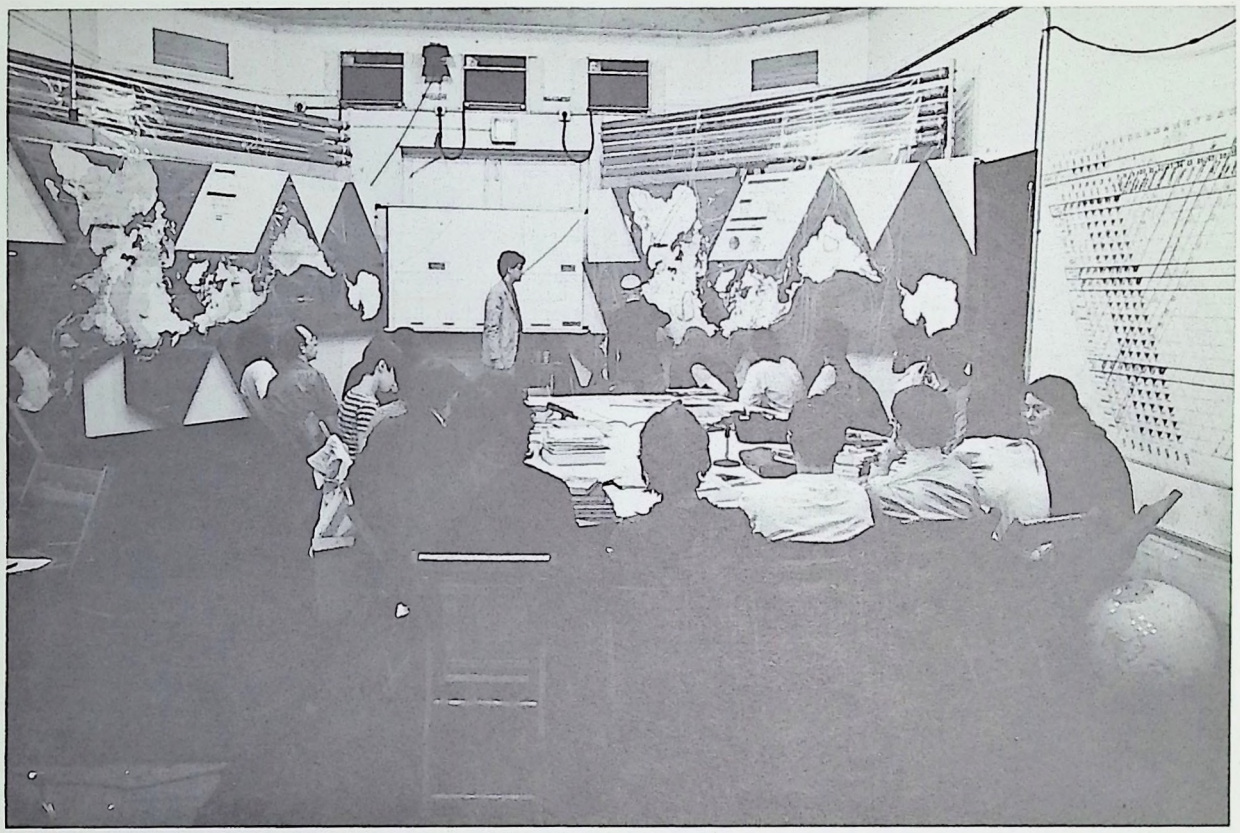
and your design for the success of man,
carried by dialogue with man
for man becomes reality without
bitterness.

—Martin Emanuel

(In as much as I used the words all the crystals made, you can say I recognize these as beautiful and assymetrical. There is a pattern that holds less fingers than two leaves never being alike. And you always just know where the end of the leaf is just always.)
('Intellect and gravity are the same.')
'I try to think through what I am saying to be sure I don't get caught using expressions of yesterday. The best way to prevent you from thinking is for me to shoot the shoot from here to there very easily on an expression of yesterday.'

—Ken Versand





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VIEWPOINT

The 74-year-old American Dr Richard Buckminster Fuller, who did not even succeed in finishing his first year of university study, now has his engagement diary completely booked up to his 80th birthday with invitations from universities and other scientific institutions to explain his imaginative ideas. He is not known for any special scholastic ability, yet his name is mentioned hundreds of times on the front pages of daily newspapers and the feature pages of magazines because of his merits as designer, constructor, inventor, cartographer and mathematician. Some admirers put him on a level with Pythagoras, Newton and Einstein. History alone will show whether this is correct, but on one point he can certainly be compared with Einstein—with whom he corresponded—for, whereas Einstein formulated the relation between energy and mass, Buckminster Fuller has outlined the mathematical relations between energy and geometry. On these and other theories of his own he built his 'dymaxion world'. This adjective does not occur in any dictionary: Buckminster Fuller coined the word himself to qualify the implications of his various inventions, developments and projected ideas.

In this issue of BUILD International there is published a contribution from Buckminster Fuller dealing with just one single aspect of his world: the dome. An example of this idea in reality is still to be seen today on the exhibition area of Montreal standing alone in all its glory. Presumably because the administrators of the former EXPO on that site could think of no other destination for this building, it has been left there, and today has eagles, ravens and other birds circling around it.

However, more in agreement with Buckminster Fuller's intentions, the Canadians have built constructions inspired by the dome in the icy prairies in the far north of their land where people only live because they have to dig uranium and other valuable ores. These Canadian domes, in fact, have the task of creating a habitable micro-climate in an uninhabitable vastness. There, at least, it appears that practice is not entirely in harmony with theory.

These Canadians look rather critically at what seems to be a Utopian plan of Buckminster Fuller to cover a large part of New York with a dome. They raise all kinds of questions and doubts about things like discharge gases, steam, bad smells and other domestic worries with which the great thinker does not occupy himself. Yet detailed criticism about ideas of great scope do not mean that such ideas are not worth studying.

So here is an invitation. Are there any readers of this publication who would like to comment on Buckminster Fuller's dome? If so, we would like to receive them and, if possible, then to publish a summary of them. As for ourselves, the Editor thinks this is a case in which he must be so modest as to refrain from passing any judgement about 'the man who is puzzling almost everyone'.

the age of the dome

Are we at the beginning of the Age of the Dome? The editor of BUILD International put this question to Dr R. Buckminster Fuller, author, lecturer, inventor, engineer, architect and philosopher who is well known for his geodesic domes, particularly for the huge specimen at the EXPO '67 in Montreal, Canada. 'If indeed there is to be an Age of the Dome', Mr Fuller answered, 'it is as yet only just being born, for there are still only a few thousand domes in only half the countries of the world—unless we count the billions of human brain domes—but only a few of which are effectively employed'. Then, growing serious, he wrote the following graphic description of how domed cities might solve in a very practical way almost all the problems of modern city life, including heating, lighting, weather inconveniences, commuting, and lack of building space

Definitive forecasting (domes) and anticipatory contemplation of a logically unfolding New Age—of any kind—necessitates *a priori* and definitive reconsiderations of relevant experiences from which may be derived tentative discoveries, wherever possible, of generalizable principles apparently operative persistently throughout the gamut of special case experiences. If generalizable, they also may be assumed to disclose some inexorable and irreversible evolutionary events and may, therefore, be employed as trend-forecasting considerations.

The present age's preoccupation of the world's individuals—each with his own, unique and ever-diminishing field of specialized attention, particularly in the sciences, has led to an approximate discontinuance of yester-year's natural philosophers who speculated comprehensively regarding the significance of evolutionary events as they seemed to interact with other historical events. Only in science fiction has such speculation been academically tolerated within recent decades. Serious prognostication outside the realm of fiction had been held to be not only unfashionable but lunatic—until militarily underwritten lunar ventures suddenly shocked society into the realization that the predicted results of intercontinental missile firing and celestial navigation were highly reliable arts. Thus, the art and science of dealing effectively with evolutionary events on a large scale have come overnight to be increasingly fashionable in both governmental and private corporation undertakings.

General systems theory is central to all the effective prognosticating. This theory has been employed in the logistics and ballistics of world-embracing naval theory for at least a century. It involves all the fundamental variables entering into the problem. Its strategy is to start with the most comprehensive family of variable factors possible and, by progressive elimination of those factors irrelevant to the special case problem, to arrive at logically predictable condition at a given time and place. The most desirable results often require invention and development of new tools and instruments. Thus, the physical novelties of tomorrow are often the consequence of a complex family of variables.

Professor Waddington of the University of Edinburgh invented the phrase 'Epigenetic Landscape' to identify the fact that all life is continually altering the landscape, or environment, and the altered environment, like the internal biological genes, continually monitors the alteration of the biological behaviours as an accelerating chain reaction. This regenerative evolutionary process and its acceleration is today most powerfully operative in the world-embracing and universe-ramifying evolution of industrialization which constitutes the comprehensively multiplying metabolic regeneration of human life on Spaceship Earth.

As the tools are evolved progressively—and only as a consequence of greater and comprehensive initiatives—our prognostication does not start with domes. We eventually discovered them to be inherent in the universal and ultimately socially unifying processes of industrialization.

For all the above reasons, many evolutionary factors will have to be identified and integrated before we come to the proliferation of domes whose eventual international prominence as tools of advanced living for all suggests the identification of such a coming time as the Age of the Dome.

As the swiftly accelerating final phases of the 150-year shift of humanity from an agricultural to an industrial world economy draws men from the agricultural lands into the city, simultaneously, the giant earth-

the age of the dome

moving industrialized tools and radio-co-ordinated planting, cultivating and harvesting services roll out over the cultivated lands from south to north to do the spring planting and from north to south to do the reaping and depositing of the harvests in bank-monitored silos. All the while the legally-qualified land-owning 'farmers' most frequently live as remotely from their acres as do industrial shareholders from their factories. Farms of less than half a square mile area can no longer compete. Nostalgic inertias notwithstanding, the little individual farmer is becoming as pathetically obsolete as is the little individual storekeeper.

Toward the one-town-world

Dwelling in the specific metropolis, to which the farm-to-city migrants first move, is only temporary. Each city becomes a point of entry into humanity's world around, to and fro, year to year, day to day, sojurning citizenship.

The centres of cities explode outwardly like volcanoes to deploy their supermarket services to ever newer mobile traffic centres. The city edges merge to form megalopolis.

While the visible aspects of human ecology as yet integrate only in geographically remote continental regions, the integration of our universal evolution within the far vaster non-sensorially tunable ranges of the electromagnetic spectrum which are equally 'hard' physical reality have altogether transcended geographical remoteness. Within one-fourteenth of a second information carried by electromagnetic wave is broadcastable from any one point on Spaceship Earth to all other points anywhere around its spherical surface. In any hall around Earth, at any time, several thousand wide-band radio receivers could be tuned in simultaneously to as many thousand different broadcast programmes, in every language of humanity, as well as in the purely abstract mathematical language of space-roaming and moon-situated satellites, coming not only from anywhere around our thus utterly intimate world society but from the whole region of increasingly greater areas of universe swept out by the solar system.

Within Wendell Wilkie's now realized One-Town-World the mobile families and individuals shuttle bodily at high frequency between super concentrations and almost invisibly diffuse deployments. They converge for metaphysical activities of brain and mind, for cultural interfusion and commercial transactions, in museums, theatres, universities, produce and stock exchanges.

The same humans also deploy for their physical activities, for their muscular and mechanical energy involvements for mountain and water ski-ing or for technological, archaeological, geological and biological search and research.

Though the local jitney, jeep, mammy-lorry shuttling of Africa, Asia and South America as yet covers only local kilometres and miles far inferior to the peregrinations of North America and Europe, contemporary world urbanization is a vast and ever-everywhere accelerating oscillating system—on the one hand, a global, entropic, volcanic, physical explosion, countered on the other hand by an increasingly high frequency world-embracing, metaphysically-contracting, and information-concentrating system which, in turn, infuses, by broadcasting and publishing, its progressively generalized concepts for the regeneration of man's anti-entropic capabilities, which thus fulfil his unique universe functioning shown by the *metaphysical* mastery of the *physical*.

Not all the world's problems originate in cities, but at the present moment it is becoming evident that many troubles of humanity are brought about by our inadequately, inappropriately and most often misinformedly conditioned reflexive planning of cities in the plane, solid, static, isolated and autonomous concept of the 5000-year Babylon to Paris pre-industrial era. Inclusive comprehension and accommodation of world-around evolutionary trends is now obviously mandatory. All exclusively, or even predominantly, local-focus city planning is obsolete.

Most of the cities around the planet Earth came into being as the weapons-commanded and fortress-protected convergences either of practically travellable overland trails and rails, or of safely harboured, back eddied, wharfed and warehoused, river, canal and seaborne trade routes.

Where the world traffic was in convergence, and where trading of goods most logically took place, yesterday's cities became great with their sovereign State-guarded and customs-tax exacted, warehouses and markets of valuable goods. The wealth thus agglomerated in cities by monopolized *entrepreneuring* attracted more and more have-not people to the cities from the farm and fishing economies producing much lower individual incomes. This stranded within the cities myriads of illiterate, craftless and, therefore, unemployed humanity, laying them open to economic exploitation by manufacturers, and by others looking for helplessly cheap labour, as easy muscle and brain trainable automatons.

As we examine yesterday's pattern more closely, we see how the physical activities of men tended to centralize in the cities as, for instance, in the farm-encircled city states. We also discover that the raw agricultural, fishing and mining-based wealth of yesterday could be and was only locally accounted in the 'coin-of-the realm'. If you could eat or drink it, or if it kept you warm when it was cold it had obvious value established by demand. However, popularly proven demand value gradually came also to be added to a given number of weight and volumes of naturally-occurring physical matter. The value was added to by design, informed by experience, by intuitive conceptioning and by initiative and skill in separating, sorting, rearranging, reassociating and reforming the chemical and structural constituents of the physical resources as tools which, typified by the lever, increased man's physical survival and prosperity through the discovery and employment of scientifically generalized principles *a priori* and inherent in the physical universe. Thus, invisible and readily deceptive factors entered into the establishment of real wealth and both its esoteric and popular evaluation, but the old agriculture, craft and mine accounting persisted—to now.

Fighting for survival

Gradually, ever more specialized tools and instruments, which in turn, made other and still more specialized tools, brought into play the technical advantages provided by special alloys which vastly increased the specific performance capabilities of each given unit of invested time, weight, volume, energy and know-how resources, not only of the tools and instruments, but of their end products and their derived services. The ever-regeneratively increasing improvements of the tools for harnessing universal energy, which vastly augmented the wealth of man's survival prospects and its concomitantly increasing technical specializations, also developed a global critical information interdependence.

Because humanity was divided into many separate survival groups, each convinced that there was not enough vital sustenance to support all, and that they must ultimately fight with others to 'earn their living', their right to live, they used technical evolution's *weaponry* to ensure survival. This gave advantage to those who fostered it.

Because the more advanced weapons could only be produced by the industrial complexes, global resources and many men, they were only attainable by the reinvestible wealth of the largest groups of politically organized humans.

Because the science and invention developed information governing the most advanced phases of techno-scientific events seemed critically strategic to the largest political system, each attempted to monopolize the break-through information as state secrets.

Because universal evolution apparently is intent upon making all of humanity physically successful, despite man's ignorance and fear-mandated commitments, spy-systems broke through all the sovereignly maintained political barriers.

Thus the integrity of the world's critical information interdependence was maintained and will continue to be maintained. Thus, also, humanity is about to discover that its greatest wealth is its most advanced know-how.

Despite political strategems the prime wealth capability is thus escaping from its negative preoccupation in weaponry and killingry in general to positive preoccupation in livingry for all humanity. It also brought about the use of all of the world's unevenly distributed physical resources. Thus, industrialization emerged in the realization of ever higher effectiveness of the integrated complex of all of humanity's discoveries and experiences in

respect of all the unique physical resources everywhere around the surface of Spaceship Earth and all the metaphysical resources of universe.

In this way, wealth, in the industrial sense, became exclusively a total world phenomenon in contradistinction to the local demand and supply concepts of early farming and hunting. The true wealth of humanity is a compound of man's metaphysical know-how and physical energy. The true wealth of humanity is its organized ability to live: the greater the number of forward days and the greater the numbers of humans his organized capability can sustain; the greater the number of forward days of their lives he is organized to sustain; the higher the standard of living and the greater the ability of all men to enjoy all of the Spaceship Earth without one interfering with another and without any gaining advantages at the expense of another; all these factors govern the greatness of man's wealth.

Because this wealth is the product of *(a)* physical energy, in its two primary conditions associated as matter and disassociated as radiation, both of which are intertransformable, and *(b)* utterly weightless metaphysical know-how; and because the physicists have shown that energy is ponderable, i.e. weighable, and may neither be created nor lost, and is therefore finite and irreducible; and because experience has taught us that metaphysical know-how, i.e. information, is weightless and that the more we employ know-how the more we learn; because of all these factors it is incontestibly in evidence that humanity's 'real' wealth is not only inexhaustible but that as it is used to learn more and do more it can only and will always increase.

Despite this irrefutable realization of the nature of wealth, the world is still operating on the utterly obsolete wealth-accounting systems which accredit only the physically monopolizable, the depreciables. As a consequence, it is investing all its highest energy organizing capabilities in killingry.

Need for realism

Quite clearly it is useless to think about humanity's problems unless we are realistic about what we need to do, what we have to do it with, what we are capable of doing, and what the order of priorities of 'first things first' may be.

Quite clearly, also, humanity's first great problem is how to learn what its problems are and what are the means of solving them.

First, we must review swiftly our most important experience in respect to past attempts by humanity to cope with living, hopeful of discovering important trends imposed by generalized principles operative in the universe, that is, aboard Spaceship Earth.

As we examine yesterday's pattern more closely, we see how the physical activities of men have for millenniums tended to centralize in the cities. We discover, also, that the most prominent physical activities consisted of building, heavy industry, warehousing, and wholesale and retail trading of both producer and consumer tools and goods.

Gradually it was discovered that the accelerating rate of evolutionary changes in industrializing technology and the progressive upgrading of standards made goods stored in warehouses either obsolete, competitively circumvented, or, in one way or another, disastrously depreciated before they could be taken out of the storage and put profitably into distributive circulation. As a consequence, world industry, led by Henry Ford in the 1920s, now anticipates, plans and controls its total operation much more efficiently, and is able to minimize its working inventories of raw and semi-processed technology to a minimum which is always stored *en route* only in trucks, ships and freight cars in transit or in less-than-full load, swift transfer depots.

As railroad monopolies were also broken by independent trucking after World War I, it was discovered by the truckers that transport through cities cost much more than by-passing the cities. Transhipment depots were thus established in remote low-cost rural land areas at convenient highway interchanges which were outside the cities.

Swiftly multiplying automation also made possible manufacture without human labour. The manufacturing corporations therefore started deploying from the cities to unrecognizably remote rural sites to avoid the demands of organized labour which, quite naturally fearful of losing its jobs, sought to frustrate the transition to automation. The fact that automation would permit lower cost production of higher standard goods seemed to labour annoyingly irrelevant if loss of jobs also ment loss of ability to purchase and consume.

As we have indicated earlier, central to all of humanity's dilemmas around the world is its lack of comprehension and formal recognition of the comprehensive scope of its fundamental problems, together with its lack of awareness of what the means of solution may be. Society does not know what wealth is. Because everything economic undertaken by businesses and governments is done either on a basis of formally acknowledged or 'book' wealth, capital expenditure, or on a budgeted matching of outgo by predictable income, ignorance of what its presently realizable wealth capabilities are, and what its practically realizable greater wealth capabilities thus may come to be, must obviously curtail and frustrate humanity's effectively far-sighted and adequately detailed dealing with the unrealizedly, inexorable, evolutionary trending. Wealth is not created by man. Wealth, as we have seen, is generated by man's discovery and employment of the life-sustaining and regenerating principles existing *a priori* in the universe, many of which are inferred by past history to be as yet undiscovered by man. Wealth is as limitless as the universe. But aboard Spaceship Earth specifically it is the product of the regenerative scientific applications of ever-amplifying metaphysical know-how to the ever more efficiently reassociated physical energies in their complementary conditions of matter and radiation.

When man discovered the lever he could move objects weighing hundreds of times his own weight and unmovable by his muscles without the lever. This was the beginning of what is known as mechanical advantage. When man arranged a number of bucket-ended levers around a wheel and put that wheel under a waterfall mounted in bearings and connected a pulley on that shaft to pulleys on other shafts by belts, man had shunted the natural energy income patternings of the universe external to his own organic system, to do the work of converting the environmental events of energy to automate the forward days of his metabolic regeneration. That event enormously increased his wealth. From that moment on, his real work has become that of the metaphysical development of increasing know-how, through discovery, research, invention and techno-scientific development. No speculative probing of tomorrow has any value unless it is predicated on this recognition of wealth.

An appeal for fellowship

What almost all bankers, industrial managements, labour leaders and politicians in general failed to foresee, and formally acknowledge, is that the wealth being generated, and to be further multiplied by mass-production industry, requires mass consuming capability to close its self-augmenting, regenerative circuit equation. They also have not realized that it is not only economically valid but eventually mandatory to switch universally to automation while, at the same time, granting federal fellowships to the progressively displaced employees which will enable them to participate far more effectively in scientific and technological search and research. This, in turn, will lead ever more swiftly toward producing so much more with so much less by the wire-to-wireless type of evolutionary advance as to be able swiftly to refund not only the federal outlay but to produce more wealth-realizing capability and sustaining income for workers, managers, stockholders and government, just as did the 'G.I.' educational fellowships granted to all the youth disbanded of military service after World War II. That multi-billion investment prevented generally disastrous unemployment and produced wealth far exceeding the original outlay.

After doing all the wrong things first, society will eventually be forced to discover that it is universally more profitable to inaugurate federally-funded, high-paying, search, research and prototyping development fellowships for all. This will result in finding ways of doing vastly more with ever less material and effort per each function. These more-with-less-wealth gains will guarantee not only total consumer buying capability but also ever higher product and service standards, as well as adequate production to meet the increasing purchasing capability. This will outmode our present inefficient method of amplifying consumer purchasing capabilities only through adding secondary and unnecessary jobs which cost more than automation, while, at the same time, failing to increase production to match the buying capabilities which induces disruptively spiralling inflation. More inefficient 'housing' just to give jobs is economic nonsense.

With this industrial economics behaviour pattern eventually heeded, as were the wealth-augmenting potentials of 'time-paying' gradually heeded, costs will

decrease and wealth production and its wider distribution will swiftly multiply.

Problems of experimental cities

When this inexorable trend is realized, the resurgent patterning of humanity's hither-and-yonning will be greatly improved. Obviously, such economic evolution will completely change the future city accommodation requirements. This inevitable change in human economics must be anticipated in the formulations of the many experimental cities now contemplated by all the major world economies.

In a 'Through-the-Looking-Glass' manner there has occurred in the past century, and will long continue to occur, a complete reversal of almost all of history's city-forming factors. While for thousands of years the physical production and transfer of goods was concentrated in cities at the same time the metaphysical preoccupations of men were deployed from the cities to remote mountain-top monasteries or oracle-speaking temple-equipped island and mountain retreats.

Now, as earlier noted, all the physical activities are deploying from the city, while the cities have become the foci of all the metaphysical activities.

For all these severally readjusting reasons, all humanity everywhere around the Spaceship Earth's spherical surface is uprooting. During each of the past three successive decades the average USA family has been found to be 'moving out of town' at an ever more frequent rate. Since 1936 household moving periodicity has accelerated from an 'every five years' to an 'every four years' phenomenon. At the time of the last USA presidential election it was estimated that 30 per cent of the potential electorate were disqualified from voting because they had not been legally in residence for a sufficient time at their latest address. At this rate of 'moving day' acceleration, within a few more election cycles, the USA citizens will be almost totally disenfranchized. How humanity's democratic self-determinism is to be electronically implemented is one of the problems the experimental cities must also solve.

Another factor which will greatly affect the rates of coming and going of tomorrow's world people is the inevitable replacement of the work week, first by a work-year concept and, lastly, by a life-phases paced work and recreation scheduling. The latter will be part of a total 'lifetime's' most favourably accommodated and general system analysis determined by scientific design. Humanity will deploy for long, continuous periods of relaxation, and travel and converge for short, highly-concentrated, work periods in the city.

While cities of the past grew up within vast fortress walls to protect those owning the valuable trading goods from being pillaged from outside, gradually—as increasing prices were added for processing, wholesaling, retailing, *entrepreneuring*, speculative 'futures' price-making, and block hypothecating as bank loan security—the nature of property became transformed from a primarily physical phenomenon to a primary abstract equity concept. As property is industrialized and abstracted to printed paper status, it no longer needs the fortress and warehouse walls. Bandits cannot run away with and cash-in on multi-million dollar hundred-acre factory complexes, or paper shares whose ownership is transferable only on the companies' books.

In contradistinction to the inherently limited individual experiences, knowledge and physical resources involved in locally isolated farming, fishing, mining and craftsmanship undertakings, industrialization itself became a global network of employment of the totally integrated physical and metaphysical resources of all the world and of all history, and their complex conversion into tools-that-make-tools-that-make-more-specialized-tools that finally make consumer products and give services suitable for humanity everywhere. Thus, the formerly unique economic advantages of local craft and resource exploitation now have been reduced to the vanishing point. In world-wide industrial evolution there are always a number of alternative techniques and chemical substances available with which to realize the solution of any given function and thereby successfully circumvent any locally monopolized material resource or technical capability.

As the walls of the city became obsolete and the cities burst their bounds, those who had to dwell within working range of the city deployed into suburban areas. Thus, today's obsoletely conceived cities became ever more confused and uncoordinated aggregations of diametrically-opposed, conditioned-reflex inertias, social customs, categorical contradictions and shortsightedly tolerated 'real property' speculators' development anarchies.

As the academically and professionally supported, but utterly obsolete and perversely obstinate, planning and building concepts tend first to induce and then to accelerate realization by society of the progressive inadequacy of cities as we know them, the confusion is countered with the politically enacted, and only federally to be afforded, but equally chaotic process of pulling down individual, old buildings and their replacement by pseudo private property 'redevelopments' in the form of vertically expanded, concrete and steel permanentized, geometrical enlargements of the same obsolete building concepts which, therefore, multifoldedly aggravate the traffic stoppage and other social dilemmas.

On to mobile cities

In contradistinction to the disorderly, random, disease-like growth of such land-fixed cities, we have the concept of the great mobile cities developed organically as ocean steamships such, for instance, as the former *Queen Mary* and now the *Queen Elizabeth 2*. Those neat, mobile cities are superbly designed as comprehensively anticipatory scientific systems with each technical and social function solution as economically, efficiently and regeneratively interrelated with the others as are the human organism's parts.

Naval and land architecture are highly divergent arts. Because ships must float and land skyscrapers need not do so, successful ship designing involves realization of ever more useful performance with ever less weight per each included function. On the other hand, land buildings, which have evolved from the fortress and castle building arts in which personal and community security was seemingly enhanced by ever higher, thicker and heavier walls, are not even thought of in terms of performance per pound. No one in the building industry or the public in general thinks or speaks of land buildings in the terms of performance per pound. For instance, New York City's Americana Hotel is not spoken of as a 'neat, million and one-half ton hotel', whereas society did speak of the *Queen Mary* as a 'sleek, 85 000-ton ocean greyhound'.

As a consequence of the prime attention given to performance per pound by naval architecture, these mammoth liners accommodate their 'guests' with only one-sixteenth as much weight of building steel and interior structure and machinery per each cubic foot of private and public guest space as does the Hotel Americana. This is all the more surprising when we consider that, in their respectively divergent phases of the hostelry service, it is necessary that the ocean-traversing liner 'hotel' be capable at the same time of being propelled efficiently over the seas at a 30-knot speed which induces super earthquake stresses which would devastate the inert Americana. To make this contrast even more astounding, we must consider that the huge liner must, as a safety factor, carry provisions for 30 days while also generating all her own power and light, and must also desalinate her own water supply. None of these functions involving heavy machinery are included in the static, land-anchored Americana's capabilities, despite its 16-fold overweight design as rated by the mobile ocean traversing hotels.

When a big ship becomes inadequate through being made obsolete by ever-accelerating technological evolution, real estaters do not open up new subdivisions of the ocean around her by freezing the water into ice cubes indiscriminately appended to the exterior of the hull while independently rebuilding and enlarging separate internal parts of the ship so that she could become an immobilized monster of asymmetric protrusions. What almost always happens with the obsolescence of mobile ocean cities is that the engineer scientists—naval architects—design and build a more adequate, mobilely floating and travelling city, after which they melt up the replaced old ship whose metals are then reprocessed to produce other technology which is twice as effective as when previously employed. The fact that the two 'Queens' were sold for other uses, and not broken up, does not, however, destroy this argument.

The urban crisis

Only intuitively and not specifically aware of the foregoing paradoxes in technological evolution, the world's people and their major governments are now becoming progressively conscious that the urban crisis is brought about by the inability to convert pre-industrial, essentially isolated cities into successfully operated life-sustaining and omni-advantaging systems for swiftly emerging and integrating *World Man*.

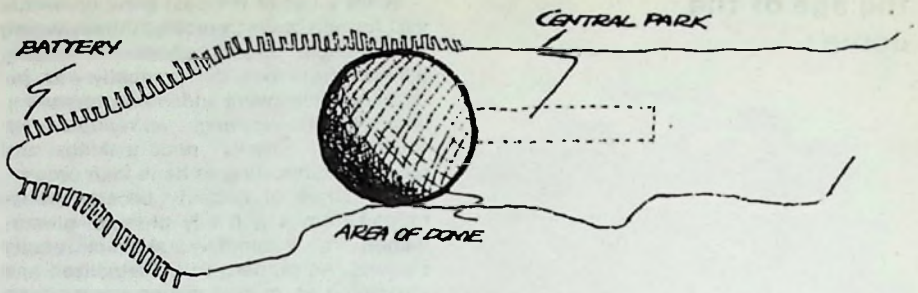


Figure 1 *Dome over Manhattan, New York*

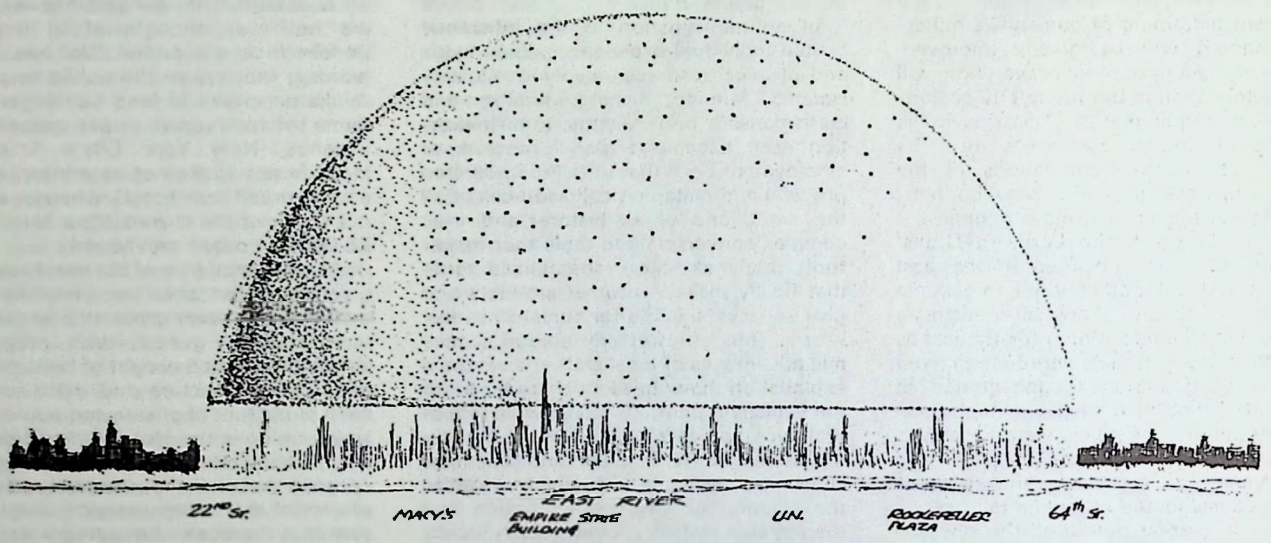


Figure 2 *Manhattan under the dome*

Quite clearly force-of-habit and professional conventions will continue (futilely) to design new cities in the only mildly modified images of yesterday's urbanism. Emergent recognition of the problem is everywhere manifesting itself as governments subsidize search and research into the undertaking of completely new experimental cities. These are quite clearly identified as experimental for no one knows whether the very concept of 'city' itself may not be obsolete.

Before attempting to formulate the nature of humanity's sojourning facilities, design science must also know how humanity is going to get from here to there. This involves studying every aspect of world transportation, including the air transport industry.

This study would start with a determination of universal evolution. Next would come the discovery of human functioning within that greatest system, including the solar system. Within that, again, would be the evoluting ecology of humanity aboard the spherical Spaceship Earth, as this little planet, 8000 miles in diameter, operates at 92 million miles from its mother ship Sun from which it derives almost all of its life regenerating energy—for the next nearest star or energy 'gas station' is 100 000 times farther away, being 11 trillion miles distant. Our little Spaceship Earth is, indeed, speeding along at 60 000

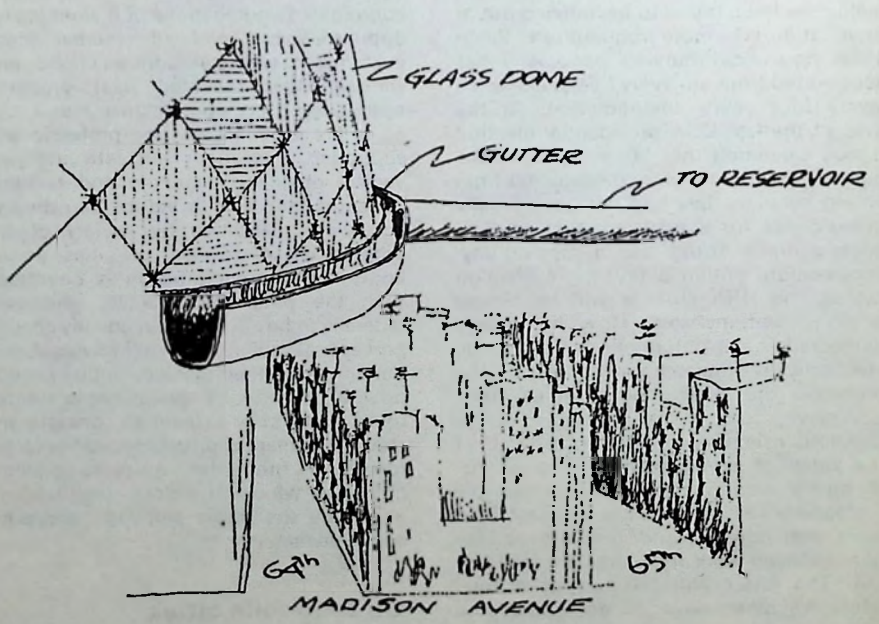


Figure 3 *Detail of the dome*

miles an hour very remotely from any other such life-supporting biosphere-surrounded spherical spaceship (see my 'American Scholar, Vision '65 piece').

Within the ecologically, chemically and energetically regenerative system of the Spaceship Earth, operating entropically as in all systems with the entropy or energy loss, design science must integrate the whole industry of the Earth with its passenger and cargo transportation service in such a way as to employ credit cards, computerized ticketing and automated follow-through of the whole transportation process—with all its economic and technical ramifications.

Computerized all-in travel

This would mean that a traveller could 'book' by vending machine in the nearest downtown office, or be ticketed in any hotel lobby or corner store, or even over his two-way TV facsimile cable or radio-beam closed circuit system, operating from any spot from which he may wish to initiate his travel. He would insert his credit card into the transmitter and press buttons showing the time that he would like to leave from one point and arrive at such and such another geographical point, anywhere around the earth, in the shortest possible time and in the most economical way, including terminal helicopter flights, automobile rentals, and stop-over hotel accommodations. Then out would come from the vending machine a ticket printed with his routing and booked passage with the amount automatically charged to his credit card for officially automated accounting within his whole continually-processed annual income and outgo, along with the economic accounting of his whole social security, medicare, education, travel, and new wealth generating credit accounts.

If necessary, the traveller could cancel his ticket by putting his credit card back in any travel-vending machine and pushing the cancelling button for the same routing, plus the transaction number which had been imprinted on the vending ticket when he received the machine's commitment to carry him.

Such booking-billing, clear-route seeking, alternate-travel-plan-ascertaining computer systems would be linked with the total information storage of all the airlines and their feeder systems anywhere around the world. The travel-vending machine would thus be able to print out commitments in split seconds, or effect their cancellation in another split second. The printed out ticket would be all that was necessary for the individual to take with him as his automatic key-of-entry at the most convenient downtown embarkation point.

At his downtown airline's contact point he would enter his private travelling quarters and be transported therein to the point of major flight embarkation. His private travelling quarters would be within an angular segment of what may be called a 'fuselage cartridge'. Each of these would be a circular section like a banana slice or like a Lifesaver mint candy, as one of many such circular units packed in parallel as a circular section of a cylinder cut perpendicularly to the cylinder's axis. The long tubular assembly of these cartridge sections would fit together to form a complete cylindrical cartridge fitting neatly into the tubular-shaped fuselage of the air transport. There could be hundreds or more of these circular cartridge sections. Within any angular segment of one of these sections, the travelling quarters would provide the maximum sitting space without one person physically touching another. The completeness of each individual's privacy would be physically ensured by adequate space and omni-directional design science considerations. The planning would be omni-directional and not just a planar expansion of the seat row count. The sitting devices would convert to a full-length horizontal-bed which could move in space within the cartridge section by mechanical means.

The passenger's luggage would be stored within the same circular cartridge section in which he travels, and which would hold several people and their luggage, could take a whole family, and could be curtained off for chamber privacy. With all the people in any one cartridge section going to the same destination, a number of these circular cartridges with their passengers and luggage would be joined together, making an increasingly long cylinder through which would run a continuous walking passage-way, or corridor, made up of the cartridge sections locked consecutively together.

All of these separate-destination-routed, circular, sectioned compartments within each of which the individual could change his position of sitting to stretch out and in which whole families could be given private enclosures, each section having its separate toilet compartment, would be routed by helicopter lift from 'downtown' to the dispatching airports. At the airports, the cartridge cross-sections would be loaded into the next transport bound for their particular destination, or series of destinations—the cartridges being loaded in proper sequence for detachment on jigs at their respective destinations. The combined cartridge sections, recombined at each airport, would be loaded through the open tail of the tubular fuselage just as cargo loadings are now made through the open tail of cargo planes.

Taking it for granted that this vision will become a reality, the story continues: each of the cartridge sections will have circumferential trackage gears for smooth ball-bearing shunting into and out of the tubular fuselage or local marshalling racks on its own three annular roller bearings. Guided by three circular-laid rails of the fuselage or marshalling racks, the cartridges will slide into longitudinal aisle alignments and lock together, or be detached for local routing to downtown disembarkations. The cartridges, with corridors running through them, can be sandwiched together with freight and mail cartridge sections so that both passenger, cargo and freight will be automatically dealt in or out of the various destination fuselages to be replaced by each airport's outbound cartridge group. This marshalling or separating-out and re-combining of cartridge sections will be accomplished at each airport with computerized switching equipment.

The cargo sections can be swiftly let out or in at each marshalling point by gate-wayed cartridge-holding tracks, which will at each point sort the cartridge anew for most economical flight aggregation, as continually processed by the world traffic computers to most effectively integrate the unexpected new peaks and valleys of frequency and magnitude variations. Based on ever-accumulating past performance, the computers will calculate probability at any time, correcting as they go, to the newest patterns of evolutionary changes. At destination airport, the passenger cartridge sections will be lifted by helicopter or sucked by vacuum tube to the nearest downtown disembarkation points. The same world travel and freight traffic commuterization will not only take care of all hotelling and dwelling accommodation at transit or destination ports but will clearly provide the guide-lines for the future living facilities industry's production and distribution requirements.

Such an overall living and travel accommodation service industry may most probably be evolved through design science by a merging together of such present service industry management corporations, including the various communications systems and hotel organizations.

Cities of the future

There will be some experimental cities which will be produced scientifically by advanced industry as a general systems problem in the same way as design scientists organize the comprehensive and detailed planning of great liners and the forthcoming giant ships of the air, the latter being veritable sky cities which will become air-deliverable at supersonic speeds. Next will come cities on the oceans, in space, on the moon and, lastly, scientifically organic cities delivered by rocket around the earth.

There is a good possibility that the first officially undertaken experimental city in the USA may be developed as an organic city within the general systems' disicipline. The first is now going through its initial phase of official consideration. It is prescribed by its backers—the Federal and Minnesota State Governments acting with private industry, banks and press—that it be located somewhere in Minnesota at least 100 miles away from any present city. This is to guarantee that it will not become a dormitory extension of an already existing city.

The first question to be asked in designing the organic general systems city is: What is the system to be used for? You cannot design a generalized boat. You cannot design a generalized anything. You can only design a special case application of generalized principles. You must know what the boat is to be used for.

Is she to be a whale capturing and processing factory or an aircraft carrier, a world cruise ship or a row boat? There is no generalized size and generalized species that satisfies all the inter-regenerative problems of the universe, nor of all the physical problems or the metaphysical problems of the regenerative life on Spaceship Earth. The universe is the minimum aggregation of directly and indirectly co-operating, and inter-complementing interactions of general and special case principles and events necessary to continual regeneration. Each scientifically organic city will be as locally regenerative as is each human being, but each will be contributing to as well as dependent upon the greater regenerative patterning integrity of the next larger system and of all systems of the universal regenerative system.

Logistical engineering considerations of a special case experimental city to be installed in Minnesota show that the research, development and government-financed prototyping, fabrication and installation of such a city will take a minimum of 10 years, even when employing today's most scientifically and technologically advantaged accelerations.

This means that the Minnesota Experimental City (MXC) cannot be realized before 1977. By 1977 the Chinese will have achieved full industrialization and Russia will have reached such production capability as to be able to attain a standard of living affluence as great as, or greater than, that of the North American continent's cross-breeding World Men. This will mean that by 1977 major world traffic between the Americas' 12 per cent of the human family and the 72 per cent. of all humanity living in Asia and Europe will be carried over the northern polar routes which are the shortest distances between these people.

We may assume that if this traffic is not in peaceful operation over the north pole by 1977, it will be in operation soon thereafter, or else there will be no traffic at all around Spaceship Earth's human-lifeless spherical surface.

If we also assume that the present geometrical progression rate of acceleration of World Man's techno-economic evolution is to persist, and man is not to blow himself up, we also will have to assume that the world's present political divisioning into separate sovereign states, possessing weapons attained and maintained, will have become as obsolete and forgotten in men's everyday affairs as the days of history when men belonged to city states because they were inherently immobilized by lack of transport or were even identified only as lifelong members of a single tribe or township, or even a single borough or ward within a township, or with a single room in a single building as a numbered prisoner, monk or nun. The degrees of freedom to be attained are physical as well as metaphysical.

Exploring further the factors predominantly controlling the formulations of the special case experimental city potentials in what is now known as the State of Minnesota, we must take note of the fact that if we eliminate all the world's political divisions, including those of the North American continent, the area now identified as Minnesota occupies precisely the centre of the North American continent. We must also note that this central point of the North American continent is the most inclusively effective marshalling point of the North American continent's part of the world air traffic pattern, as it interconnects North America with both the Eurasian continent and South America.

If we further assume that the trend of the physical and metaphysical activities of men on earth will continue to emulate the physical phases of universe's omni-directionally distributive and increasingly diffuse decentralizing and diluting behaviours in ever-accelerated degree, as well as the metaphysical phases of universe's concentric, concentrating and ever more inclusive, refined, orderly, decelerating and specifically identifying behaviours, then we may assume that the scientifically formulated experimental city will be a predominantly search and research university city as well as an information, communications and world travel centre. It will, moreover, be continually developing new, ever lighter, ever more efficient instruments and tools with which to regeneratively implement its ever-evolving, retooled prime functions and with which, also, to service its geophysical role as a central station and travel transfer point for World Man's acceleratingly frequent North American deployments and convergencies as inter-connected with the space travel launching sites at continental shore points.

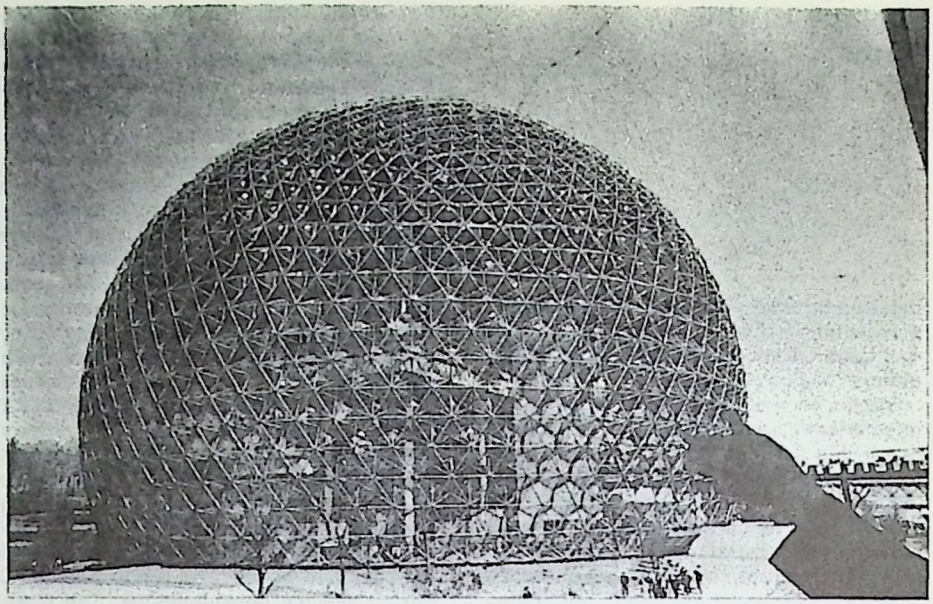


Figure 4 *R. Buckminster Fuller's dome at the Expo '67 in Montreal*

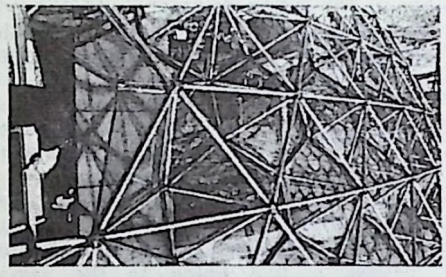


Figure 5 *Detail of dome construction*

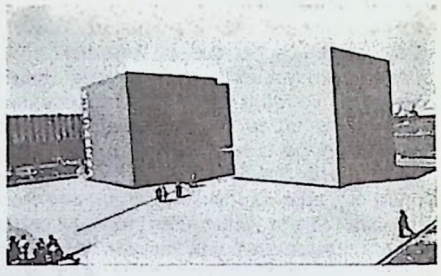


Figure 6 *A contrast in Montreal: the Venezuelan pavilion consisted of two huge cubicles; they impressed the visitors only by their size.*

The function of the dome

With the above typical general systems and working considerations looming into our intuitively alerted awareness as constituting the primary factors operative amongst the essential and variable parameters of the Minnesota case 'experimental city' application of the general systems theory, we may also assume a dynamically maintained average population of a quarter of a million as a more or less transient population. This estimate is predicated upon a working analysis of the minimum tasks manifest in the local regeneration of such a world communications and travel transfer function.

Because spheres contain the most volume with the least surface and tetrahedra and cones provide the most surface while occupying the least volume, it also becomes intuitively obvious to all that the successful experimental city will be umbrellaed by a single spheroidal surfaced dome because of the vast structural and operating efficiencies thus to be attained. Within the single-shelled area, and as remote from it as are full bloom flower stamens from their petals, the complex flower, tree and shrub edged, this fireproofed conic mountain of open terraces will arise. People will live on the outer ramparts of these apartmented, terraced,

landscaped, and skybreak covered conic mountains. The mountain will contain within it all the shopping centres and the metabolic as well as the physically and metaphysically regenerative instrument-governed organics which, in turn, will chemically separate out, for instance, the H_2O from the waste liquids. Yesterday's and today's pollution and wastes will be tomorrow's prime resources.

There are inexorably persuasive arguments in favour of cities under single umbrella shells. It is no aesthetic accident that Nature encased our brains and regenerative organics in compoundly curvilinear structures—there are no cubical heads, eggs, nuts, or planets. Whether the economic advantages can overcome the anti-change inertias of large social bodies in time to avert whole world disaster is, however, to be questioned. When whole new human settlements are to be installed on virgin sites as, for instance, on the Antarctic continent, the doming-over may be promptly realized. But the doming-over of established cities in the moderate climates will probably not occur until domed-over cities in virgin lands have proved successful enough to persuade the established cities to employ comprehensive umbrella-ing. The established cities will probably not adopt the domed covering until environmental and other emergencies make it imperative.

A number of advantages are provided by domed-over cities. First is the advantage accruing exclusively to energy quantum changes inherent in size changes and growth rates. When we double the diameter of a dome, its surface area increases fourfold and its volume increases eightfold. This also means that the number of molecules and atoms of the gases of the atmosphere enclosed by the double size dome is multiplied eightfold, while simultaneously the number of atoms of the shell is multiplied only fourfold. Variations in atmospheric temperature are caused by increased motion and resultant crowding of the atmospheric molecules. Therefore, each time we double the size of a dome, the amount of surface of the dome through which each molecule of interior atmospheric gas could dissipate its heat outwardly or gain heat from outside is halved; also, the number of molecules able to reach the surface in a given time is halved.

We can say that the larger the dome, the slower the rate of energy loss as heat—that is, when the heat is greater inside than outside or, conversely, when the exterior heat is greater.

The energy conservation of a closed local system improves twofold each time the system's linear dimensions are doubled. This principle is demonstrated in stars and in icebergs. Icebergs can melt only as fast as they can import heat from their surrounding environment of air and ocean through the surface of the iceberg. The larger the iceberg, the lower the ratio of surface area to its volume or mass. However, as icebergs melt, their mass gets smaller at a mathematical velocity of the third power while their surface area decreases only at a velocity of the second power. This is to say, the volume decreases much more rapidly than does the surface area for each unit of volume of its interior mass increases at a geometrically accelerating rate. Therefore, icebergs melt faster and faster, and when the final piece of ice dwindles to pea size it can be seen, by the human eye, to accelerate extinction.

The most magnificent demonstration of the increase of local energy conservation by progressively larger geometrical systems, in particular of spherical systems which, of all geometrical forms, contains the most volume with the least surface, is demonstrated by the gargantuan spherical fireballs which we call 'stars'. The sun's fiery volume is so vast and its surface so relatively small that it will take billions of 'eons' (whatever those incomprehensible time magnitudes may be) for it to dissipate its energy completely.

Because of the principle of energy conservation improvement with size, the larger the domed-over city the more stable will its atmospheric conditions become, and at ever-decreasing cost per unit of volume.

A second advantage is also connected with relative surfaces. When we wish to design a good air-cooled gasoline engine. the greater the external surface the more effectively will the heat be conducted from the small interior to the large exterior surface. Though it would be impractical from a service viewpoint, the surface of the air-cooled engine could be further increased by modifying the same amount of metal used in the fins to take the form of spines or spindles like the quills of a porcupine.

If one looks at an aerial photograph of Manhattan Island, New York, there is seen just such a spined, or spindled, high-speed cooling system. The energy consumed by New York City to heat it in winter and cool it in summer is employed in a structural system that operates most effectively in the swift release of the energy to the surrounding atmosphere. There is no structural method of enclosing the circulation space of the city's dwellers that is more effective in wasting heating and cooling energy than the structural system employed by New York and other skyscraper cities of the world. Spheres enclose the most volume with the least surface and, as already pointed out, the larger the sphere the lower the ratio of surface atoms to enclosed atmospheric atoms.

A dome over mid-Manhattan, reaching from the Hudson to the East River at Forty-second Street on its east-west axis, and from Twenty-second to Sixty-fourth Street on its north-south axis, would consist of a hemisphere two miles in diameter and one mile high at its centre. The top of the Empire State Building's television tower would reach only a third of the distance from the street to the domed surface above it. The total surface of the dome would be just twice that of the base area of Manhattan that it would occupy.

A cube has six square faces. If we build a cubical building on a square of land, five of its six faces are exposed to the air. If we build a square-based building, two cubes high, the exposed vertical and top surfaces of the building are exactly nine times the area of the land occupied by its base. If 20 storeys high, it is 81 times the base area.

Conserving heat and combating snow

Using such calculations, and taking an inventory of the building heights in each of the city blocks of mid-town Manhattan that would be covered by the dome, we find that the total surface of the dome is only one-fiftieth of the total exposed surface areas of the buildings which it would cover. The energy losses of mid-town Manhattan under such a dome would be reduced to about one-fiftieth, and the energy lost through the building walls, during both the heated winter and air-cooled summer conditions, would not be lost to the outer atmosphere but lost only to the controlled interior environment of the dome and, therefore, could not be considered as lost. Because of the extraordinary energy conservation of big domes, the very moderate temperature level of the dome would be effectively maintained, with energy savings to the city and its inhabitants of probably more than 90 per cent as against the undomed conditions

The cost of snow removal in New York City would pay for the dome in 10 years.

Studies made at the Snow Institute of Japan and by Mitsubishi Company (the General Electric of Japan) indicate that the cost of heating the surface of the domes with electric resistance wires bedded in the skin, to maintain a temperature sufficient to melt snow and ice (with the electric heat turned on only during the time of snow and ice formation) for cities in the snowfall magnitude of New York would be far less than the cost of amortizing the expense of the additional structure necessary to support the cumulative snow loads throughout the winter months.

When rain falls on New York City and its counterparts around the world, it runs down the buildings into the streets, then into the gutters and on to the sewers to be polluted by all the other waters. Year after year New York and other cities have suffered water shortages, though they are deluged with summer thunder showers during which enough water falls to supply the city for days. With a domed-over city, both the melted snow water and the rain would run neatly to a guttering, clear of the pollution of the streets, down into a canal around the dome's lower rim from whence it would flow to great collecting reservoirs. There would be enough altitude in the dome to cause the water to flow gravitationally back to the storage reservoirs in Westchester.

Because the energy losses would be so greatly reduced for the covered portion of the city, the heating and cooling could be handled most economically by electrical energy wired in from generators far from the domed-over city. A new ultra-high-voltage electrical conducting system

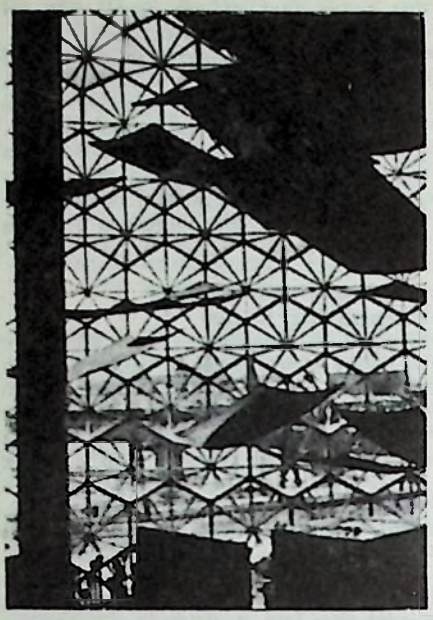


Figure 7 *Interior decoration in the Montreal dome*

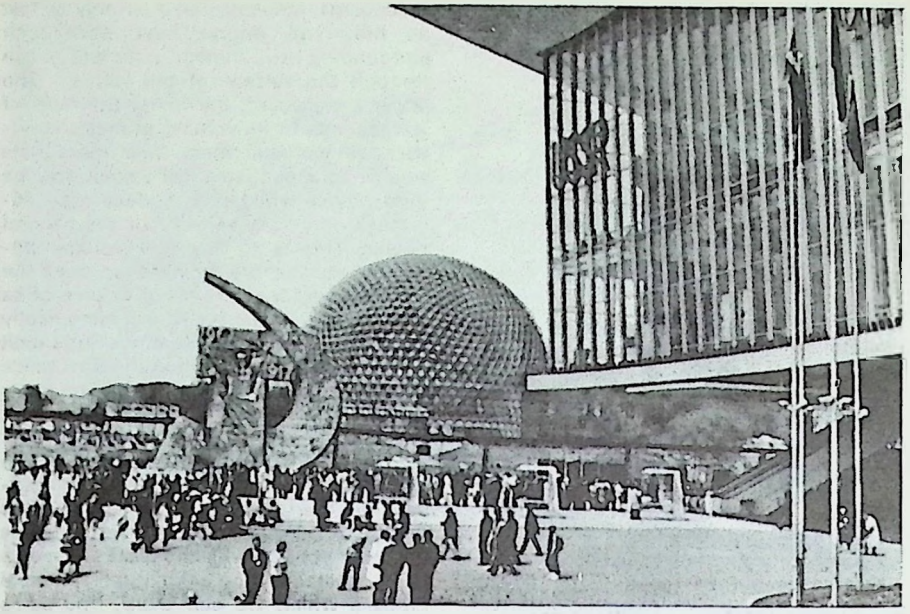


Figure 8 *The dome dominated all over the place (and it still does)*

would soon bring New York electrical energy, by wire, all the way from the Pennsylvania Hills, where the coal would be mined and burned in steam-driven electric generators at the mine mouths. This would eliminate all fumes from the atmosphere covered by the dome, while the dome itself would be able to umbrella away the fumes occurring outside the dome and originating inside the satellite industrial areas.

Those who have had the pleasure of walking through the great sky-lighted arcades, such as that in Milan, Italy, are familiar with the delights of covered city streets in which it is practical to have outdoor restaurants and exhibits. They will be able to envision the arcaded effect of a domed-over city in which windows may be opened all the year round, gardens be in bloom and general displays become practical in the dust-free atmosphere. The daylight would be bright inside the domes without direct sun. All the part of the dome through which the sun was not shining directly would be transparent. These domed-over cities in the northern hemisphere could have the southern part of the dome, which receives the almost perpendicular rays of the sun, protected in summer by polarized glass so that the dome would not gain heat during the sunny hours. In the winter the sun could be allowed to penetrate to impound the sun's energy.

Structural calculations on the two-mile dome for mid-Manhattan indicate that the individual structural elements would have a girth less than that of the mast of the liner *Queen Mary*. In the accompanying picture of this dome, hypothetically imposed on an aerial view of Manhattan, the *Queen Mary* is to be seen through the lower left part of the dome, lying at her dock at Fifty-eighth Street and the Hudson River. The funnels of the ship can be discerned but the masts, which are just a fraction of the diameter of the funnels, are invisible from the height of the photographing airplane. For the same reason, the structural members of the dome also are invisible—as invisible as the wires of a screened-in porch when viewed from a 100 feet distance. For this reason the appearance of the dome would be as seen in the picture, that is, as a glistening translucent form. One would get the same effect by photographing an ordinary kitchen wire strainer turned upside down and placed 100 feet away.

Such a shielding dome would also, very effectively, exclude the sound of passing jet planes. The lower edge of the dome over the city would be at such a height above the city as to make it appear as a high umbrella, with plenty of blue sky visible under its rim. The dome would appear from below as a translucent film through which the sky, clouds and stars would be visible. It would not create a shut-in feeling any more than carrying a parasol above one's head on a summer day.

The dome's skins, consisting of wire-reinforced, one-way-vision, shatterproof glass, mist-plated with aluminium, will have the exterior appearance of a mirrored dome, while the people inside will see out without conscious impairment. This will cut down the interior sunlight to a non-glare level. Most importantly, such domes would provide a prime shielding against atomic radiation fallout, reducing the radiation effects of neighbouring regions' atomic explosions to below lethal or critical impairment magnitude.

City-covering domes of prestressed and post-stressed steel and concrete could be made so powerful that they could be covered with earth and become man-made, caved, tetrahedronal mountains, completely air-conditioned. When such large domes are made, the captive atmosphere in itself is enough to support the structural shell, as does a large pneumatic tyre. Double the diameter of the tractor tyre and it takes eight times as long to let the air out through the same-sized valve. The larger the dome, the lower the pressure necessary to carry a given load. With such very large domes, the air introduced with the air-conditioning would keep up the shell-sustaining pressure.

As three-quarters of Spaceship Earth is water and man is now trending swiftly to occupy the world's waters as well as space, spherically enclosed tetrahedronal floating cities will soon dot the oceans at safely negotiable small yacht distances apart that will permit round-the-world cruising. Spherically enclosed subterranean cities, sky-floating spherical cities, and independent spherical spaceship cities probably will be developed during the next century which, together with completely new time scheduling which takes cognizance of the sources of eternity which are either seasonally freed or become available over the 24 hours of our day, will demonstrate that today's seeming 'population explosion' will prove to have been only a sparse local manning of a far vaster participation by humanity in the macro-micro reaches of the physical and metaphysical universe.

Reprinted From **Think**

November-December 1969

Habits: Tough to break out of . . .

Today Greenwich Village, Tomorrow the World

Called "World Game," it's the brainchild of a 20th century Renaissance man, the renowned Buckminster Fuller, 74-year-old inventor-engineer-architect-philosopher. Its solemn purpose: to give every human being a fair share of the world's vital resources. Its most recent players: an enthusiastic group of the under-30 generation. Here, we drop in on their Greenwich Village game room and see how they score.

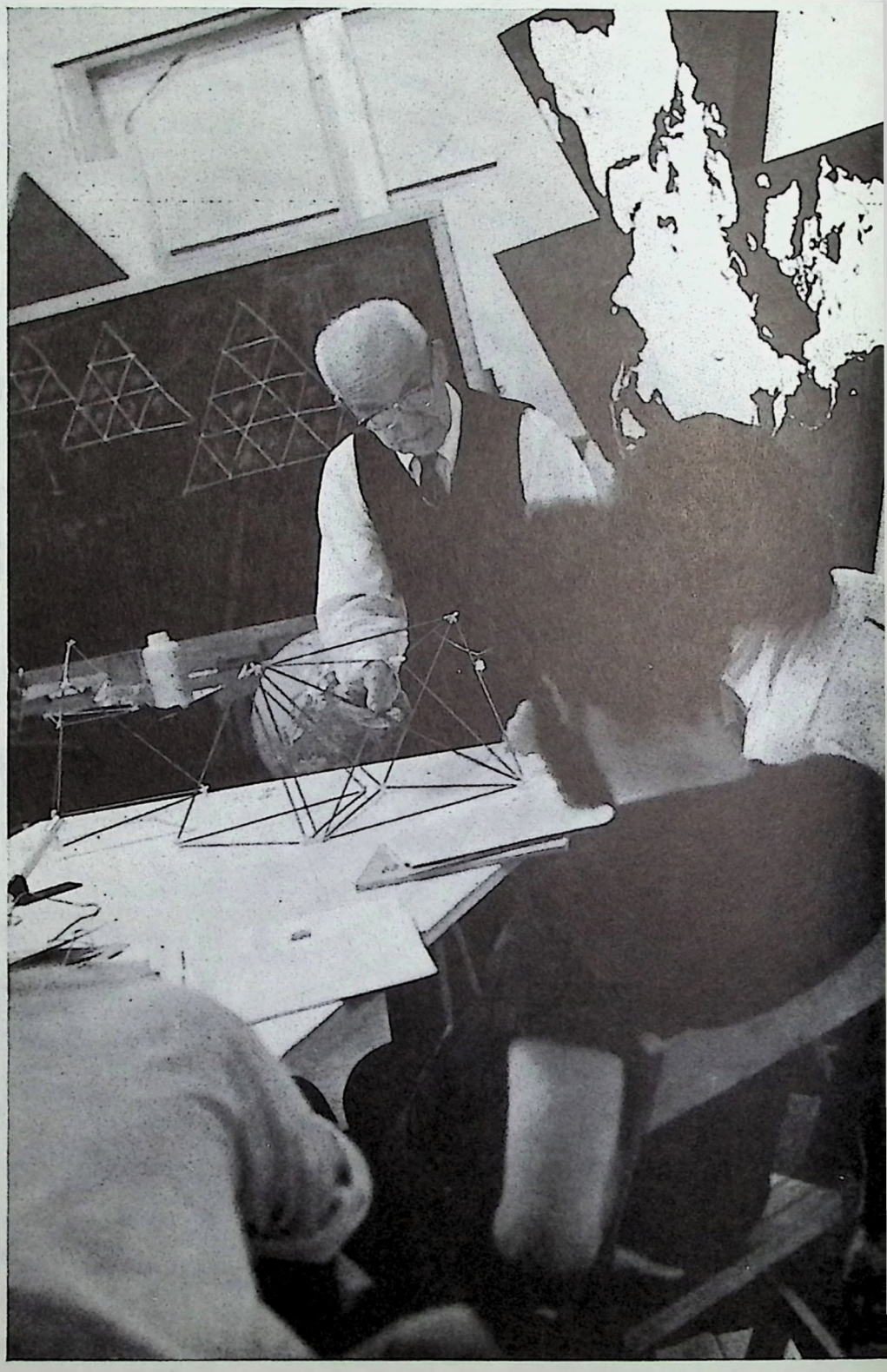
An outsider might have taken them for yet another group of under-30 militants, conspiring to march on the Establishment. Most of them were in their early 20s. The eight girls in the group wore miniskirts and love beads; the 16 young men sported long hair and/or beards and sideburns. The setting: a one-room pad in New York's Greenwich Village, its walls awash with charts, maps and graphs. It was this past summer, and the group had come together for seven weeks of 12-hour sessions, every day.

Belying all appearances, their goal here was neither revolt nor confrontation; it was cooperation on a scale the world has yet to know.

Specifically, the group—recruited by ads and many of the participants paying $300 tuition—was playing "World Game," whose challenge was nothing less than to determine whether, and how, everyone might share in the world's vast but unevenly used resources.

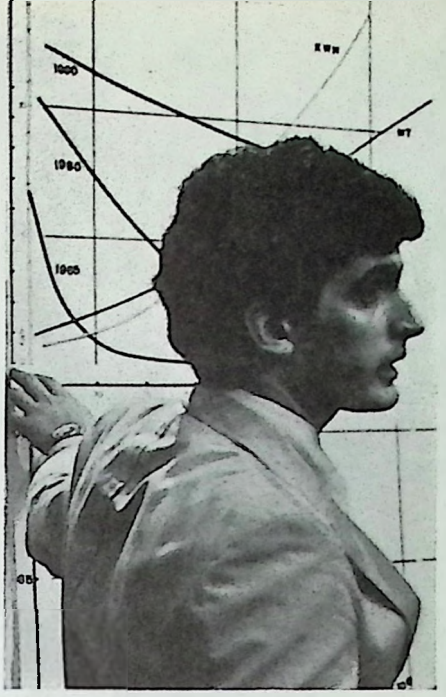
The group's guru was the 74-year-old architect-engineer-inventor-philosopher Buckminster Fuller (*Think*, January-February 1968), whose World Game is based on the premise that technological progress has made at least feasible a distribution of the world's resources as needed.

Fuller has been playing with the notion of World Game—he describes it



Fuller joins in a session of his World Game, played this past summer by a group in New York's Greenwich Village, and continuing now at Southern Illinois University.

Project coordinator, right, was Edwin Schlossberg, 24, a doctorate student in science and literature at Columbia. The game ended with an idyllic projection: the minimum survival needs of all the world's people can be met within 10 years.



Right: "This is not an exercise in politics," Fuller said to the under-30 group. "We want to have the answers ready when the politicians are in trouble and turn to us. . . ."

simply as "an organized way to deal with large problems"—since 1927, when he was a Navy officer. On land, men equated security with bigness. At sea, the trick was to "do more with less"—and Fuller has adapted this principle in his efforts to solve global problems.

In his Game, he explains, the world is viewed as one single entity or system ("synergy"). We are aboard Spaceship Earth, equipped with adequate facilities for giving all of its human passengers their physical needs. The physical-chemical elements and the metaphysical "know-how" are now in adequate supply; but they can be turned to comprehensive advantage only if we learn how to play World Game on a "you and me" basis, not a war game on a "you *or* me" basis. The aim of the game is to establish ways to use the world's resources "to take care of everybody at a high standard of living without anybody profiting off or impeding anybody."

A Look at the Plumbing

In this summer's session, funded by a Rockefeller Brothers grant, Fuller participated for the first three weeks, describing with near-missionary zeal his own vision of the coming age: men will recognize, for the first time in history, that their needs can be satisfied only by full cooperation with other inhabitants of the planet, however distant they may be—geographically, politically, intellectually and culturally.

He expressed bluntly his impatience with inefficiency. It irritates him to think that we must use 15 pounds of water to get rid of one pound of waste. ("Scientists have never looked at the plumbing.") He is exasperated by the vast amounts of energy frittered away each hour as car engines idle at red lights and in traffic jams. He is irked even by the millions of beds around the world left unslept in for most of the day. The consequence of this state of affairs—so much of humanity consigned to unrelieved want—utterly appalls him.

The immediate goal before this past summer's group was to learn to play the Game themselves as demonstrated to them by Fuller. Their interests ranged from physics to art, from mathematics to anthropology, but excluded technical specialization. It was up to them to gather their own information within scientific bounds and mathematical controls. They could then make a start toward the larger goal of determining whether mankind's needs can be met with the resources available on earth.

The young participants were at first skeptical that any game could solve what generations of men and modern technology have not. But as Fuller went on, they became as zealous as he. They set a rigorous daytime work schedule for themselves, many working at home, after hours, as well. They tracked down and posted on large graphic displays all the information they needed to play out "scenarios"—where the people of the globe live, where the food supplies and mineral ores and sources of power are, what each man needs in calories. Proteins and kilowatts to maximize his potential rather than merely survive.

Up on giant grids went future trends on such critical matters as: life expectancy, mortality rate, fuel supply, arable land, housing, illiteracy, pollution, hydropower, steel production. The group's pride in these displays was clear to see. "We're making visible patterns which up to now have been invisible," one boasted. Fuller returned as the Game neared an end and was delighted.

Project coordinator Edwin Schlossberg, 24, a doctorate student in science and literature at Columbia University, summed up the group's findings. None were revolutionary, yet all provided evidence that the Game might someday, somehow be won. Their findings:

Incalculable power resources in Africa and South America are as yet untapped.

Those areas of the world with the least food have the greatest potential for population growth.

Only 10 percent of the world's total vegetable crop is now made available for human consumption.

While more than half the world now receives an acceptable "bare minimum" of 2,400 calories a day, clear progress from earlier times, the "bare maximum" is 3,500 calories. This is high to desk workers battling a diet, but it reflects the needs of pregnant women, lumberjacks, athletes and others with high-energy requirements. It is a caloric level which, say the students, would release "mental and metaphysical energy" bound to accelerate further the ongoing improvement of the human condition.

In one exciting piece of work, the participants devised a master power network covering groups of nations. Because these networks would include different time zones, the wasteful peaks and valleys of power usage now common would be leveled out somewhat (e.g., while Canadians sleep and use little power, Russians at work could draw from the shared network, and the cost to both would come down dramatically).

The summer game ended with this idyllic projection:

The minimum survival needs of all the world's people can be met within 10 years. Within 30, they can enjoy a standard of living high enough so that they will be able to pursue, at least part of the time, culture and art and education—"the riches of life."

How feasible, really, is all of this?

Might it conceivably happen?

The sharing of resources will clearly require cooperation among countries whose main objective at present seems to be mutual annihilation. The warring of nations, the starving children of Biafra, the deep-lying hates, abiding selfishness, national prides, and the sheer indestructibility of human perversity—all of these

suggest the seeming hopelessness of ever turning the World Game into reality.

Yet Fuller, called by some a "technological transcendentalist," believes—and his disciples came to believe also—that "This is not an exercise in politics. We want to have the answers ready when the politicians are in trouble and turn to us. It can work when the politicians have to make it work."

The Game is not over. The summer version intended to test the game's "feasibility," is on the way to becoming a full-scale, $16-million computerized version at the Edwardsville campus of Southern Illinois University, where Fuller is a Distinguished University Professor. His operation there, known as "World Resources Inventory," has been proposed to NASA as a repository for data collected by its earth resources satellites. This Fullerian planting in the groves of academe will serve as a clearing house of information for other universities. MIT, McGill, Columbia, the State University of New York (Binghamton), Yale and the University of North Carolina have already plugged in. ■

Our Race for Resources: Can We Win It?

As the good life expands, so too does the fear of many that the world may one day exhaust its resources; that all of us, ultimately, may fail to survive. The statistics are certainly worrisome enough. By the year 2000, water withdrawals may increase 2–3 times; food consumption will be up 3 times; fuel consumption 3 times; iron and steel consumption 2⅓ times; wood and timber consumption 3⅓ times; synthetic fertilizers over 5 times.

Can we meet this expected demand? No one can really know. Each year we hope to prove new reserves of resources at least as great as our withdrawals. But the increasing population, level of education and standard of living—escially in the developing countries—make this harder and harder to do.

Better techniques lend great encouragement, however. So does history. Contrary to the dissipation of matter and energy, scientific and engineering skills grow from within and continually expand man's abilities, his intellectual and particularly his material resources.

My personal estimate, based on considerable research and analysis, is that we need not fear exhaustion of the world's physical resources—*if* we have the political courage and understanding to develop fully and share as broadly as possible our vast technical capabilities. Clearly, we now have neither. Mr. Fuller's World Game may therefore seem, to some, only an exercise today. Yet we should all hope as devoutly as he, for the benefit of our progeny, that the Game will be played in deadly earnest in the years ahead.

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ST. LOUIS POST-DISPATCH

SIU's Famed Designer

By Peter Brown
A Special Correspondent of the Post-Dispatch
CARBONDALE, Ill., Nov. 4

THE PANTHEON of heroes revered by the Now Generation is a strangely mixed bag including figures as diverse as Marshall McLuhan and W. C. Fields, Che Guevara and every member of a musical organization called the Iron Butterfly.

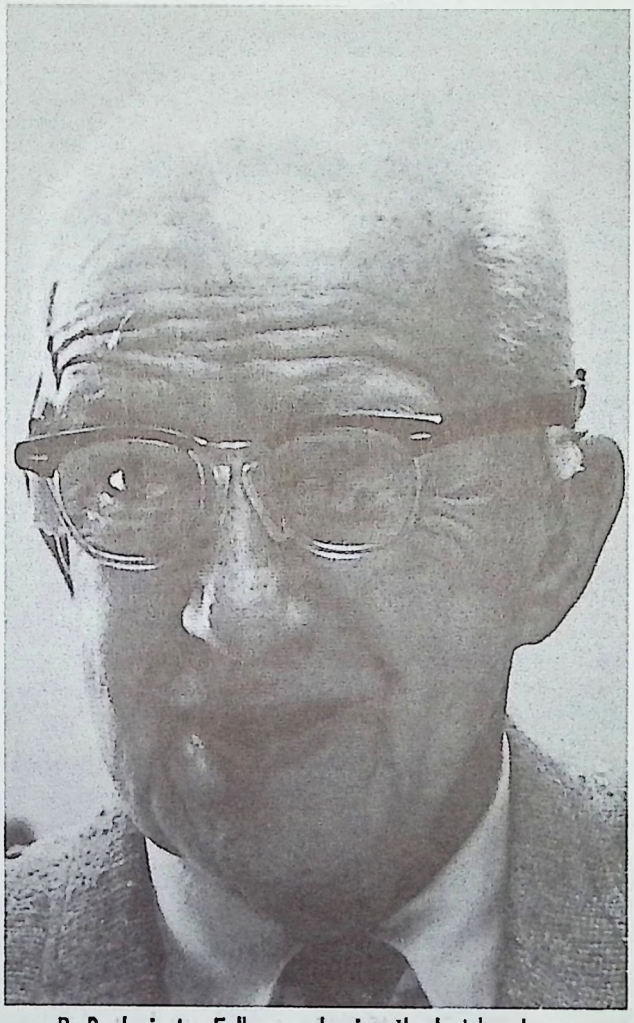
Among the loftier deities is a 73-year-old Harvard exile who has been described variously as a philosopher, engineer, poet, mathematician and the first true futurist. Also a revolutionary, a visionary, a maverick architect-without-portfolio and — once upon a time — a crackpot inventor.

He is Richard Buckminster Fuller, known widely for the geodesic dome, structural embodiment of his passionate credo, "do more with less." The dome, however, is but one peak in a mountain range of "inventions, realizations and discoveries" that Fuller has charted over the last half century.

He has been accepted as one of their own by the young idealists of today, active and passive, who dig him as a kind of ageless oracle tuned to all frequencies.

Fuller would have qualified as one of their own long before the flower-power era. He was kicked out of Harvard twice for "youthful excesses and lack of application." Much of the inspiration for his mathematics and "comprehensive anticipatory design" theories came from Zenful contemplation or bubbles in his ship's wake while he stood watch on the brooding Atlantic as a World War I sailor.

NOW, AT AN AGE when most men are reassessing their lives and tidying up for the final accounting, Fuller is thrusting ahead at flank speed, still plotting "grand strategics" to "make the world work," still advancing design concepts that are astonishing both for their blue-sky boldness and their final simplicity.



R. Buckminster Fuller . . . having the last laugh.

Fuller, resident professor of design research at Southern Illinois University, could conveniently retire to a life of contemplation and ease, with royalties from his dome patents (there are now 6000 geodesics in the world, according to his count), lectures (his fee is $3000 per and he can't begin to fill all requests), his architectural planning commissions, and his investments.

But for Fuller, who once knew deprivation and disdain when he was formulating his life strategy and trying to get the world to listen, the challenge and prospects are greater than ever before.

He hops about the world constantly, his only real respite being the two months he spends each summer at the remote island he owns in Penobscot Bay, Me., a Fuller family retreat since 1903. He logs his lifetime air travel at 3,000,000 miles and more.

FLOATING cities, domed-over cities, a massive computer "game" to keep track of and predict world trends and keep earth on a survival course— these are just some of the bees buzzing in Fuller's bonnet. Fantastic though some of his ideas seem, he is being increasingly courted, listened to and written about in the chambers of power and scholarship all over the world. It is a world he has called "The Spaceship Earth."

They laughed at Fuller when he first came up with zany ideas back in the '20s and '30s — a three-wheeled rear-engine car, a die-stamped bathroom, a "Dymaxion House" suspended like an inverted bowl on a mast. When he talked about man someday jetting about with his own rocket power pack, when he predicted in his 1938 book, "Nine Chains to the Moon," an automated stock exchange, they knew he was a real ding-a-ling.

But they do not laugh any more. As Fuller sees one after another of his very earliest concepts coming to industrial fruition (a large firm is only now introducing its "revolutionary" single-unit bathroom, which Fuller proposed in 1930) he says, smiling:

"The equation is closing. Now they are coming to me."

The ones who are coming to Fuller range from governments to the gurus of the youth generation. Bucky, the man who for so long was so far ahead of his time, is suddenly the prophet, with honor.

Things are popping as never before in Fuller-land and the 5 foot, 4 inch, 145-pound dynamo who runs it occasionally confesses to a power drain. In fact, he says that he is "starved for sleep." Nevertheless, he keeps churning out ideas, projects and ever more grand strategies.

THE U.S. Housing and Urban Development agency has bought in principle Fuller's concept of a floating city, his answer to urban expansion. Whole communities would be prebuilt in shipyards as dwelling and service modules. They would be assembled in larger units, towed to offshore sites and assembled as terraced pyramids.

Japan is talking about a Fuller Floating City for 1,000,000 people. Baltimore is seriously interested. Toronto is pushing ahead on a Fuller inspired "Pro-To-City" and Floating City combination that would include man-made islands and a 400-foot high "Crystal Pyramid" office and showroom centerpiece. The Toronto Telegram has hailed it as a "one billion dollar showcase of the world."

Buffalo, N.Y., is considering Fullersque dreams. A physical education and recreation complex at the new $650,000,000

campus for the State University of New York there will be done by one of his firms, Fuller and Sadao, Inc., of Cambridge, Mass. Another Buffalo group is conferring with Fuller and his young associates for a Fuller "Proto-City."

North Carolina has hired Fuller's Synergetics, Inc. of Raleigh to do a building for its Piedmont Panorama Center in Greenfield. It will be a giant "canted space frame," almost as large as the 137-foot high "skybreak bubble" dome which Fuller and Shoji Sadao designed for the United States at the Expo '67 in Montreal.

John Lennon of the Beatles—a Bucky disciple—has contracted for a Fuller dome home. Oxford University doesn't have enough surface campus for its proposed new Beckett Theatre, so it's getting Fuller to design one underground. "Invisible architecture!" Fuller cries, happily.

HE IS designing a large dome auditorium for an Israeli kibbutz; another one for a theater at Sarah Lawrence College; still another for an entire school in Maine. In the discussion stage is a Minnesota experimental city project that may fulfill one of Bucy's fondest dreams.

SIU at Edwardsville, a modern new companion piece to the original Carbondale campus where Fuller makes his home, is going to put up a building of pure Fuller for an interdenominational religious center. It will be a 60-foot glass "miniearth" globe set on a reinforced concrete underground cylinder, like a golf ball on a tee.

Offices and meeting rooms will be in the underground column. The globe-water masses represented in various tints of blue and continents shown as clear glass—will comprise an auditorium and planetarium. Outside, a strip of stainless steel will be embedded in the soil to show that the structure straddles the ninetieth meridian.

Also plugged into Fuller's idea grid are the U.S. Department of Transportation and the National Aeronautics and Space Administration. The former is intrigued by his ideas about "Air Guideways," something like suspended cage systems for wingless, high-speed jet transport. NASA wonders if Fuller can do anything about one of its problem requirements: a wholly dependable package that can keep man alive as he explores outer space.

FULLER has been saying for 30 years that a household system could be designed to recycle wastes and regenerate chemical necessities to make man self-sufficient in any environment.

Take away all the world's machinery, says Fuller, and 2,000,000 people will die of disease and starvation in six months.

When Fuller wants to recharge his batteries, he invariably turns to the sea and the New England shore, his earliest and most enduring influences. He has owned many sailing boats, last year saw the launching of his new 41-foot sloop, "Intuition." Characteristically, he memorialized the event with a "short poem"—22 pages long.

His newest invention is a single-scull water craft that he calls "Rowing Needles." Instead of the typical shallow draft hull, it has a pair of catamaran-like pontoons supporting a truss-frame seat for the rower. Fuller claims it is unswampable and can surpass a conventional single-scull in speed since it has less "wetted surface," friction, and cross-section. He says he can still—at 73—row two miles without getting winded or dropping a beat.

But the domes, the new cities, the systems, the synergetic-geodesictensegrity-dymaxion marvels of the Fuller imagination are only the "physical" manifestations of his life work.

The other side he calls the "metaphysical;" the books, lectures, poetry, magazine features, television programs and documentary films that record his thoughts and observations.

HE MAINTAINS a running "Chronofile" of published items concerning his work and the collection is becoming an archival monument in the SIU library. A graph describing the frequency of Fuller-related publications begins to move in 1929 with a baseline bump denoting the introduction of his Dymaxion House. Today it is a nearly vertical line whose lift-off dates almost precisely to 1967, the unveiling of the Montreal pacilion dome. Fuller's archivist, Dale Klaus, says that more than 2250 accounts of Fuller's activities are now being published yearly in world media.

He reads—or rather assimilates—hundreds of books each year, having perfected a scanning system by which he can tune out familiar stuff and zero in on what is new to him. He concentrates on astrophysics, nuclear physics, genetics, chemistry, medical frontiers, biology, archaeology, sociology, world trading and economics.

Fiction? "Approximately zero fiction," answers Fuller. "Life is enough fiction for me."

Fuller's greatest fame probably came from the geodesic dome built for the U.S. Pavilion at Expo 67 in Montreal

Reprinted From
San Francisco Express Times - Feb. 1969

Bucky and The Pirates

marjorie heins

"Who is Buckminster Fuller?" a graduate student friend asked me when I said I was going to hear the great man. "Oh, he's some kind of architect...designed the geodosic dome...he's very old..." I hedged a while longer. "I don't know," I finally admitted. "It's my husband who wants to go."

When I first saw Fuller, a little old man gesticulating on the stage of the huge Berkeley Community Theater, dwarfed by the giant polyhedra he'd had set up around him, I got a sense of great space and distance. Separating us were perhaps a thousand shaggy intellectual heads, including a great many beautiful girls who might be art students. Fuller impressed me as a tiny energetic force in a lazy static universe.

Fuller is, as he was fifty years ago, way ahead of his time. The designs for which he is most famous--the geodosic dome popularized at Expo 67, the "dymasion" automobile, igloo and world map--are still cult-items, not widely used or understood. Fuller has always wanted to design things which make the most intelligent use of the resources the earth gives us. The geodosic dome is acknowledged to be a brilliant use of space and material. Yet its most important exposure was at the last world's fair. The dymasion car, so far ahead of the Model A with which it was contemporary, got its greatest recent publicity at the New York Museum of Modern Art's Machine Show. There, artlovers could walk around a rope and look at it.

Fuller finds plenty of fault with the executives (pirates, he calls them) who have made a mess of such a beautiful planet. For Fuller, the earth was perfectly designed for human life. "Man is designed to be as much of a success as a hydrogen atom. Everyone's designed to be a success."

The way we were designed, our greatest resource is our mind. Using his mind, man has progressed from a world in which there wasn't enough enough wealth to supply the afterlife of one pharoah to a world in which there is enough wealth to supply the "now life" of everybody. Beginning with the original pirates, who lived at sea, a much more hostile environment than land, and ending with present-day pirates like Standard Oil, man has invented, discovered and fought. The one principle that has always animated his history is: there isn't enough to go around.

Darwin's theory of evolution is based on the assumption: there isn't enough to go around. Malthus' s theory of population is based on the assumption: there isn't enough to go around. Marx's theory of economics is based on the assumption: there isn't enough to go around. For Marx, the worker was the producer, the most essential and therefore the fittest; he would survive at the expense of the capitalist class.

The pirates who rule the world have fought countless wars on the assumption: there isn't enough to go around. Modern politics still assumes it, and assumes there must be an inevitable showdown. The fact that we have developed weapons we cannot use (Fuller calls them "the big guns") means we must revise our warfare: instead of big wars, we have little ones, like Vietnam and Korea, in which the real antagonists (the big pirates) hide their identities behind smaller antagonists. The big pirates are thus free to experiment with new weapons and to battle ideologically without using the big guns.

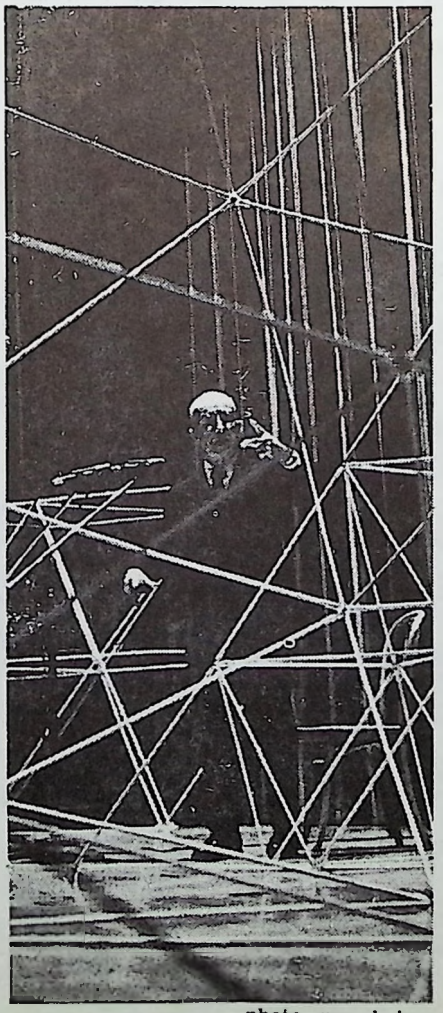


photo: greg heins

"I HAVE AN ANNOUNCEMENT TO MAKE. WORLD WAR III IS OVER. THE UNITED STATES LOST IT."

Everyone hates the United States, including much of its own youth. The fact that America is negotiating in Paris with North Vietnam is an ideological victory for the other side: the world accepts these two countries as the real antagonists, when, in fact, Fuller says, they are America and Russia. Thus, in terms of modern warfare, "World War III is over. The United States lost it."

"THE WORKING BASIS OF ALL OUR GREAT NATIONS IS NOW INVALID." There IS enough to go around. We must only begin to use it. Instead of fearing automation, we should automate the entire economy, thus freeing workers for more human tasks such as thinking. They should be able to say: "What was it I was thinking about, before I was told I had to make a living, that fascinated me so?"

The whole concept of "earning a living" has to be broken down. The whole concept of "free enterprise," competition for a limited amount of wealth. The planned obsolescence and low mechanical efficiency of our economy are based on outdated assumptions. When Fuller speaks of a "Design Revolution," he is speaking more radically than many self-proclaimed revolutionaries. He is speaking about patterns of thought. "The most formidable of our conditions is bureaucratic inertia, people just depending on society for a job, and not doing their own thinking." There is something patently insane about "all the typewriters sleeping with the beautiful plumbing and all the people sleeping in the slums."

Fuller is not just a critic or analyst. He does not primarily deny. He affirms. He is an inventor. His mind is creative as well as analytic. Integrity is a key word for him. "There is an entirely new way of dealing with one another. The great esthetic of tomorrow will be integrity." By integrity he means people thinking for themselves. Being alive to the information that is available, learning how to use it. Or: being in rhythm with the designs of nature, using what the earth has to offer. Fuller is deeply religious about the way nature and people and the universe were designed, the way they were meant to work.

"The faster we go, the more integrity is demonstrated." Fuller does not criticize our technology but only the way it is used. In a way, he is a technological imperialist. There's nothing wrong with bringing technology to Vietnam, as we are doing, Fuller says: we're just doing it for the wrong reasons. He is very impatient for everyone to have enough: he knows there IS enough.

You can't blame him for being impatient. At 74, he's been studying physics, inventing machines and designing structures all his life. Audiences all over the world clap thunderously after he finishes his mammouth 4-hour speech. "I'm taking a lot of your time," Fuller says sometime during the third hour. "But I don't think that man has much time."

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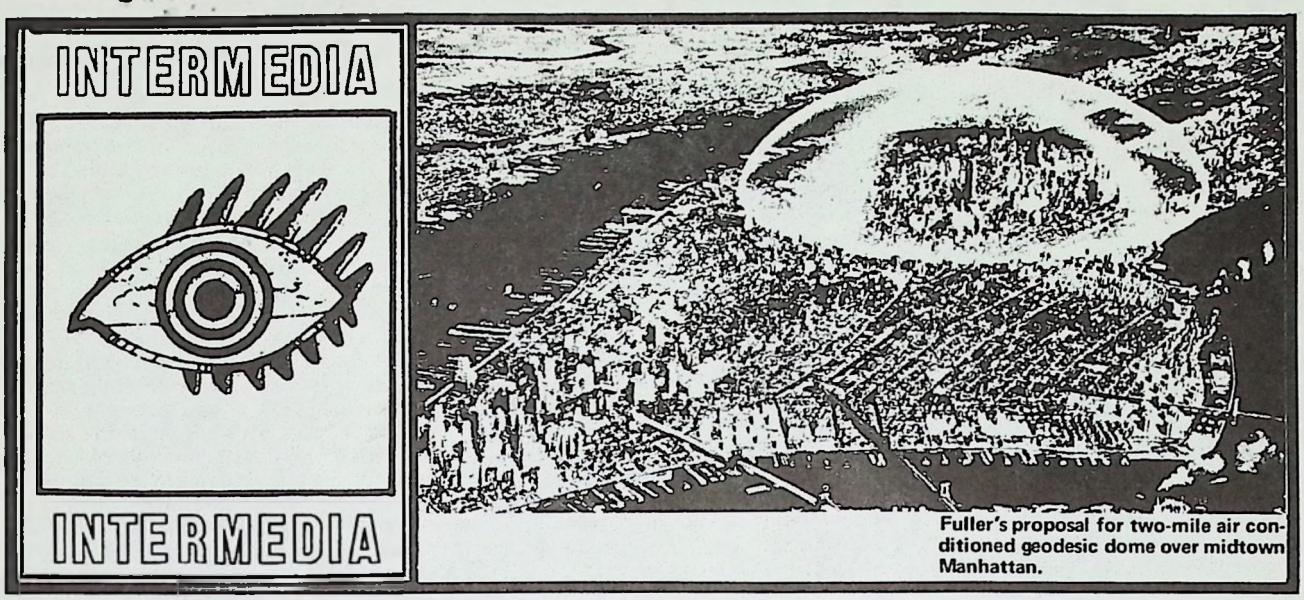
December 19, 1969



Fuller's proposal for two-mile air conditioned geodesic dome over midtown Manhattan.

I travel around the world a great deal, and everywhere I hear humanity saying, "We are not against any other human beings; we feel the world ought to work properly." Everywhere they say it's our politicians that get us into trouble. This is the majority viewpoint all around the earth today. — R. Buckminster Fuller

GENE YOUNGBLOOD

A concrete scientific alternative to politics now exists. For the first time in history it is now possible for society to shape its destiny completely outside the realm of political activity as we know it. Even the remotest possibility of a true alternative to politics should be sufficient motivation for each man to discover for himself whether or not it exists. But Buckminster Fuller's World Game is far beyond the planning stage. It is presently under way at Southern Illinois University, where a $16 million computer complex is being constructed to serve as World Game headquarters.

There, at the site of Fuller's World Resources Inventory, a football field sized map of the world will be stretched out horizontally in the center of a huge arena some 600 feet long and 400 feet wide. From two levels of balconies approximately eight to ten floors above the map, viewers will be able to see the entire earth's surface simultaneously without any visible distortion of the relative size and shape of the land and sea masses. This huge cartographic Dymaxion projection of the earth will display the continents arrayed as one world-island in one world-ocean with no breaks in the continental contours.

The great map will be wired to serve as a giant visual display surface for information from a battery of high-velocity digital computers with megabit capacities approaching four million bits each. The computers will be located beneath the map in subterranean chambers, or in special structures adjacent to the display arena. The map's surface will be activated by the computers to show proportional data regarding the planet's raw and organized resources, world conditions and events, together with the history and trending patterns of world people's movements and needs. Remote viewing and operating consoles will be situated throughout the double balconies for personal interaction with the computers and their visual displays.

While the Illinois complex will serve as the central brain, World Game extension groups are being established at universities, colleges and centers all around the world. They'll be equipped with remote-control viewing and input/output subsystems linked with the central World Game Inventory. (I'll be conducting one such group next year as a faculty member of the California Institute of the Arts.) With this network of ultra-sophisticated technology, a giant world logistics game will be played by individuals or groups all around the world, using a series of computer programs based on principles of Game Theory, General Systems Theory, input/output theory, etc. Called "The World Game," it is basically a reversal of Dr. John Von Neuman's widely-used Game Theory of military strategy, such as practiced in the computerized brain trusts of the Rand Corporation and the Pentagon.

Militarists attempt to pre-experience the probabilities and consequences of world war by using Von Neuman's Game Theory in terms of optimum logistics and ballistics presently available. Game Theory is always played on the axiomatic assumption that it's either "them" or us, that there's not enough world resources to support humanity, and therefore only the fittest survive, armageddon is inevitable. (This is the only reason sovereign nation-states exist in the first place.) According to Game Theory, someone must lose. The name of the game is Divide and Conquer.

According to World Game, no one loses. The name of this game is United We Stand. The World Game is mankind's first historical attempt to solve whole-earth problems, not just local ones (because no problem is exclusively local), and on a scale previously available only for war gaming. The object of the World Game is to make the world work successfully for all human beings. "The objective," Fuller explains, " is to explore for ways to make it possible for anybody and everybody in the human family to enjoy the total earth without any human interfering with any other human and without any human gaining advantage at the expense of another. The programs that the computers will select as being most favorable for all humanity will go far beyond man's ignorant ways of assessing what he 'can afford.' The computers will demonstrate that he can afford nothing short of the best, which is to make spaceship earth a successful environment for man. If anyone playing the game employs ideological biases and attempts to enforce the dominance of one by another, that player will be disqualified. The game must be won by peaceful means, by the use of intelligence and proper use of our resources. The players will not compete. They will engage in cooperative exploration to see how all humanity can win a successful, pollution free life."

Fuller asserts, after fifty years of study, that science has proven this possible. He asserts also that world history during these seventy years of the 20th century has proven that mankind increasingly accomplished more with less, thus nullifying the universally-accepted Malthusian dictum that there's not enough to go around, that we must survive by a system of economics of scarcity. Fuller points to the fact that humanity has progressed from one per cent living in appreciable health and comfort in 1900 to forty-four per cent currently living at a higher standard than ever before—while at the same time the earth's physical resources have been steadily decreasing. Since this was not the objective of any na-

tion, it is obviously the result of science and industry doing ever more with ever less.

For fifty years Fuller has been compiling an inventory of world resources, both physical and metaphysical. For the past two decades he's had a large staff and computer facilities, and the World Resources Inventory has become the world's most comprehensive collection of information about the status of planet earth. (A partial cross-section of this information is available in the six-volume set of "World Design Science Documents," published at Southern Illinois University.) It includes all the known amounts and locations of the physical resources of earth, their rates of consumption and regeneration, as well as all the metaphysical resources as represented by mankind's ideas, concepts and theories throughout history. It contains trends, known human needs, fundamental behavior characteristics as determined psychologically, anthropologically, ecologically and sociologically. It includes trends in population growth, population migration, birth and death rates globally, all political events, trends and consequences, all socio-economic developments around the whole earth.

In addition, the World Game now has access to all information from NASA's meteorological planet analysis and earth resources satellites. Equipped with special high-resolution 5000-scanline TV cameras in relatively low orbits, the satellites yield pictures equivalent to 100 feet above ground. (Higher resolution is possible but some countries complain of "invasion of privacy.") Sensors aboard the satellites are able to pick up unique electromagnetic and thermodynamic frequencies, and thus can recognize the specific temperature of different types of woods, flesh, furs, metals, etc. The satellites have been identifying, locating and counting the number of beef cattle grazing around the earth. Other sensors have been able to tell exactly what and where the living grain crop is. For the first time in history, world man can learn exactly where both his shifting and fixed resources are, and in the digital computer he has a brain capable of storing and retrieving this information on a scale impossible for all of humanity to match.

Not only does the World Resources Inventory show where all the people on earth are located and how they're moving about, but the total weather pattern as well. The total weather pattern will be correlated with the total crop pattern. We will know where the rains are, where the cattle and crops are, and how the weather may eventually be guided to insure the crops. The inventory includes world food production per year in metric tons, locally, nationally and globally. It shows the entire coal and iron resources of the earth and their rates of consumption. (A typical finding of the World Game is that there's more tin above ground in the United States than there is underground in the rest of the world.) You can learn the total tonnage of fibers produced per year, globally or locally, broken down into kinds of fibers. The inventory shows how many persons in Africa and Asia own radios, television sets and appliances. Trends show total energy consumption, electrical and thermal, around the whole globe.

Armed with this arsenal of constantly-updated information about the world's wealth, dedicated revolutionaries around the globe will set out to render politics obsolete as they disclose methods to make the whole earth successful by playing the World Game. Humans everywhere, from students to scientists—disenchanted with politics yet finding no solution in violent revolution—will discover a direct and constructive mode of activism in the World Game. Global information is the natural enemy of local government, for it reveals the true context in which that government is operating. Global television is directly responsible for the political turmoil which is increasing around the world today. The Nixon administration senses this and is beginning to react, but it's too late. Television makes it impossible for governments to maintain the illusion of sovereignty and separatism which are essential for their existence. Television is one of the most revolutionary tools in the entire spectrum of technoanarchy. World Game players will make dramatic use of television all around the earth.

The Game will proceed in the following manner: with the hardware and software described above, coded displays of world problems will be viewed singly or in relation to one another, and will permit retrospective viewing of past historical and present trending patterns. Various trends will be extrapolated and compared in future time increments. On the basis of this totally comprehensive time/energy continuum, players will formulate World Game "moves" in terms of variable solutions to the problems based on availability and development of resources at present and in the future, always doing more with less. A move which does not accomplish more with less will be considered invalid. These solutions will constitute individual " sessions" or playings of the game, but they'll never be added up or offered as " answers." Instead they'll be reinserted into the computers where they'll be evaluated against the many other incoming solutions. The game will never end. The overall program simply will be continually modified to accomodate mankind's increasing metaphysical wealth as represented by World Game solutions, which in turn will mean greater control over our physical destiny without resorting to ideological premises.

A branch of the World Game effort will be devoted exclusively to disseminating its findings to the communication channels of the world—the intermedia network of television, radio, newspapers and magazines—in ways which will dramatically relate World Game discoveries to political and social events occurring simultaneously. For example, it will be possible to prove with undeniable scientific accuracy that a food shortage in a particular section of India was the result of this or that political maneuver. It is expected that within five to ten years the World Game will have attained such a high degree of analysis and evaluation that the entire physical and metaphysical events of the day may be explained and solutions offered on a daily basis concurrent with the evening news.

Fuller: "Politicians are going to confess the obvious —that no human beings can keep in mind all the special interests of all people and all the whereabouts and unique behaviors of all the resources of earth. No human beings can persuade other people to behave in unfamiliar, untried ways, but the computer can integrate and disclose the critical information and be completely convincing... As the World Game is played progressively it will disclose a myriad of politically untried, unprecedented yet effective ways of solving hitherto unsurmountable problems. These will become big news items of the world's press and international wire services. As man gets into more critical proximity to a full-scale World War Three, the people of the world will begin to say in increasing numbers, 'Now that we can see a way in which this and that can be done, we must obviously adopt the policies indicated by the World Game.' Popular pressures will gradually force world politics to yield to these mutually-beneficial World Game programs."

Fuller admits that mankind may already have violated its occupancy of spaceship earth beyond the point of tolerance. Of all the trends and patterns which his work has revealed, none stands out so clearly as that of man's inherent blindness, ignorance and indiscretion. Never in history has mankind consciously behaved in its own interest, but rather has stumbled blindly and accidentally into success, leaving a trail of waste and pollution. But time has run out. This wheel's on fire, and it's rolling down the road. "Our greatest problem," he says, "is the educational problem of getting man to realize in time what his problems are, and what the most effective priorities may be for saving them."

THE FUTURIST

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Vol. III, No. 1 February 1969

Buckminster Fuller shows his floating city to U.S. housing officials (See inside).

What Business Should Do NOW About the Future

The Rocky Road to Utopia

The Horsepower Explosion

Buckminster Fuller's Floating City

The partner of comprehensive designer Buckminster Fuller describes a floating community that could be built in a shipyard and towed by tug boats to moorings beside large cities. Bucky Fuller and the author, together with Triton Foundation staff, developed the concept under a grant from the United States Department of Housing and Urban Development.

by Shoji Sadao

It all began early in 1966 with the very unusual request by a Japanese businessman asking Bucky to investigate the technical and economic feasibility of building a tower taller than Mount Fuji.

We—Fuller and Sadao, Inc., and Geometrics, Inc. [two Cambridge, Massachusetts, architectural firms that work on Fuller's concepts]—commenced work on the project in the summer of 1966 with what we understood to be a fairly clear and definite scope of work. A month or so later, however, our client asked if the scope could be enlarged to include a study of a super vertical city for a million inhabitants.

We could not accommodate the request at that time and proposed instead that we look into the matter after completion of the tower study. However, Bucky was in Japan at this time discussing the tower study and responded to the request by proposing the idea of a floating tetrahedron city for Tokyo Bay. A tetrahedron is a pyramid with four faces including the base.

This was accepted by the client. Bucky then began to develop the general case study of an autonomous, sea-going tetrahedron city for a million inhabitants, while we (Fuller-Sadao and Geometrics) continued work on the tower study, completing it in December, 1966.

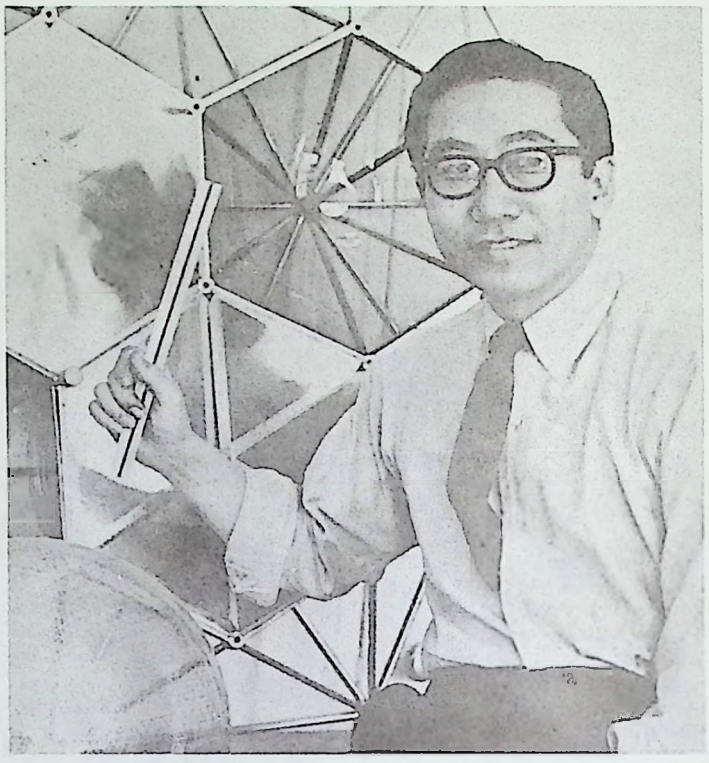
There followed several months of correspondence with Japan attempting to clarify the scope of the project; finally a meeting in Tokyo in May 1967, which I attended, made evident the fact that there were several grave misunderstandings which proved fatal to the whole study. Several months later, our Japanese client informed us of his intention to abandon the project. However, articles by Bucky describing the floating tetrahedron city appeared in *Saturday Review, The New York Times Magazine,* and *Playboy,* and during the summer of 1967 officials of the U.S. Department of Housing and Urban Development discussed the possibility of Bucky continuing his work on the floating city under a HUD grant. A grant was issued to the Triton Foundation, Inc., of which Bucky is president and I am treasurer, in October, 1967, and the study was submitted in 1968.

The study was a broad investigation of the technical and economic feasibility of developing water areas immediately adjacent to the cores of major cities by floating entirely new communities. The study was directed by Peter Floyd of Geometrics and myself. Consultants in city planning, transportation, and economics contributed to the study as well as consulting structural, mechanical, electrical and marine engineers.

Over 80% of U.S. metropolitan areas with a population of 1,000,000 or more are near bodies of water sufficiently deep to accommodate such floating communities. Most have a depth adequate for shipping (25 to 30 feet) and relatively sheltered harbors. At these depths, a maximum average height of 20 stories can be floated. This means that if some sections of the floating structures were lower than 20 stories, others could be still higher.

Technology for Floating Cities Already Exists

The technology necessary to build floating cities is already in existence. We have been building super liners for many years that carry populations the size of entire towns. (The S.S. *United States,* for example, holds 3,000 persons, including crew and passengers.) Super tankers now are being constructed which weigh



Architect Shoji Sadao is a principal in the architectural firm of Fuller and Sadao, Inc., of Cambridge, Massachusetts. The firm has developed many of Buckminster Fuller's concepts including the design of the U.S. Pavilion at the 1967 World's Fair at Montreal.

30,000 tons dead weight. (The 5,000-person neighborhoods we studied would weigh 150,000 tons.) Floating platforms for oil derricks and oceanographic experiments have long been in successful operation, some in conditions of unprotected water—a condition that would not trouble city sites.

The basic unit of the "Triton City" plan is a neighborhood-sized floating community that would accommodate 3,500 to 6,500 people. This unit, averaging 5,000 residents, is the size required to support an elementary school, a small supermarket, and local convenience stores and services. There are two kinds of neighborhood modules designed for the city. One is composed of a string of four to six small platforms, each holding about 1,000 people; the other is a larger, triangular platform which would be of high density and have capacity for as many as 6,500. Three to six of these neighborhoods, with a total population of 15,000 to 30,000, would form a town. At this point, a new town platform including a high school, more commercial, recreational and civic facilities, and possibly some light industry, could be added. When the community has reached the level of three to seven towns (90,000 to 125,000 population), it would become a full-scale city and would then add a city center module containing governmental offices, medical facilities, a shopping center, and possibly some form of special city-based activity like a community college or specialized industry.

Because the system of development is based on aggregation of separate modules, flexible arrangements of total communities up to 100,000 persons could either grow gradually, starting with a cluster of two to three neighborhoods, or be built up very rapidly. If needs should change after the city has been established, units can be added or subtracted in keeping with community growth, and not cause disruption of the entire

Buckminster Fuller, Architect of the U.S. Pavilion at the 1967 World's Fair at Montreal, shows a model of the Triton floating city to Charles M. Haar, then Assistant Secretary for Metropolitan Development at the Department of Housing and Urban Development. The floating megastructure shown here might house 5,000 people. The whole community can be treated as a single building, allowing big economies in the water, sewerage, power, heating, and air conditioning systems. The front doors of the dwelling units open on "streets in the air" that resemble the promenade decks of ocean liners.

The triton floating city might be located in a river or harbor next to a metropolis. With the sea as a highway, an entire neighborhood can be built in one location and towed in one piece to another site. Examining the scale model are (from left) Fuller, Haar, and Leonard J. Duhl, then Special Assistant to former HUD Secretary Robert C. Weaver.

fabric. Cities can develop their facilities incrementally, without having to make a greater expenditure than is actually justified at any given point in time.

Water Site Permits more Modern Technology

Siting of the city on water is an opportunity to overcome some of the expense and delay of ordinary "on ground" construction by taking advantage of more modern production technology. With the sea as highway, an entire neighborhood, town, or city center unit can be built in another location—such as a shipyard or dry dock—and then towed to its site in one piece. By using a large, existing construction facility of this kind, the economy and efficiency of shop fabrication can be applied to construction problems which have traditionally been solvable only at the final site location.

In terms of both structure and organization, it is most sensible to provide relatively small (in terms of city sizes), individual neighborhood platforms—roughly the size, though not necessarily the same proportions, of large liners and tankers. The platforms would be up to four acres in area and house as many as 5,000 people. In this way, the structural elements are kept to sizes which can be reasonably handled by existing shipyard facilities, and movement of the platforms into place is easily accomplished. Larger town and city complexes could then be made by linking these platforms at the final location.

For maximum structural efficiency, the platform (which would be of steel or concrete) and the portions of the buildings rising above the platform are considered as a "megastructure," that is, a single complete framework. This also allows the most flexible distribution of spaces: requirements for large, open spaces are met, and needs for smaller spaces can be readily satisfied by lightweight structural components filling in the larger ones. The infilling components (apartments, classrooms, stores, offices, etc.) are factory produced as complete, finished units before they are fitted within the frame. This prefabrication of elements is a way of approaching the efficiency of the automobile industry in assembly line production and of achieving similar economics. Additionally, it would be possible to make subsequent changes by removing outmoded units and replacing them with new ones without disturbing the overall disposition of the city.

Functionally, a whole neighborhood can be treated as a single building and all mechanical services (including water, sewerage and waste, power, and heating and air conditioning) centrally provided. This has two advantages; (1) No duplication of costly central plant equipment is required for individual dwellings; (2) Distribution of services on a large scale is much more efficient.

The prototype density used for the Triton City communities is 300 dwelling units per acre. This high density of population would economically support some form of transportation between the community and the city core. While there would be automobile access to and from the floating platforms and parking for residents' cars, it is anticipated that movement from platform to platform (that is, from one neighborhood to another) would be a walkable distance or accomplished by public transit. To discourage automobile congestion in the floating city, there is little provision for transient parking. All wheeled vehicles are restricted to a single level in the city complex, which is segregated from pedestrian areas. At this level are truck loading and unloading facilities, transit stations, and ramp access to parking garages. It is probable that the transit system would be rubber tired and would circulate on the same roadbed as automobiles, buses, and trucks. However, possible use of a system such as the Westinghouse sky bus is being considered.

Parking Lots Would Be Hidden; Streets Would Have Safety Features

Because the megastructure is a whole neighborhood, some new departures in aesthetics and safety are possible. All parking is within the flotation, removing from view one major contemporary eyesore, the parking lot. Since wheeled vehicles are not permitted above the entrance level, the streets would be safe for pedestrians. Every neighborhood child could walk to school—and in no danger of being run over. As another precaution, the elevators and stairs, which are housed in vertical towers, would have glazed sides; everyone inside would be visible at all times. The installation of vertical circulation facilities in three centrally located towers also means that they could be surveyed from one vantage point and that they would be intensively used, thus dually insuring the safety of residents. Moreover, there are no dangerous alleyways and no hidden access to any dwelling, as all doors are directly on the streets, which are wide, straight and easily patrolled.

All dwelling units face directly on the water, and the exterior of the megastructure slopes slightly backward. Apartments on

higher levels look on the garden terraces of those below, rather than, clifflike, straight down to the water. Apartments on the upper levels give magnificent views while those on the lower levels offer closeness to the water.

The front doors of the dwelling units open onto broad (about 18-feet wide) "streets in the air" that are solely for pedestrian use and very much resemble the promenade decks of ocean liners. These streets are connected by bridges to the schools, shops and other community facilities, which are in the interior portion of the megastructure. At the higher levels, the apartment units surround and enclose the village square, a public space open to the sky. The many roof levels of the structure are terraced and landscaped for various kinds of recreation.

By designing a megastructure (that is, an entire framework of structure and services) for high density residence, great economies in transportation, services and utilities can be realized. The economy is not only financial, but also in conservation of open space for recreation and in easy access to the core city by highways and rapid transit. Preliminary cost estimates indicate that the whole fabric (including housing, schools, and other community facilities, all services, roads and utilities) can be provided at an expense of $8,000 per person (at a density of 300 dwelling units per acre).

The project is preliminary and exploratory in character and it is not expected that HUD will take any immediate action. However, the response of those who have looked at the project has been good. For instance, Charles M. Haar, HUD's Assistant Secretary for Metropolitan Development, has described the floating city as "one of the most unusual new concepts we have seen."

"A community on water, with highway and mass rapid transit to the central city, offers an interesting possibility for relocating people, facilities and services when core area renewal is in progress," Haar said.

I myself am convinced that the floating city offers one of the best means of achieving economically feasible and attractive communities. I believe that such cities will be built within the next few years.

(Copies of the 131-page Triton Foundation report may be obtained from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151, for 65 cents in microfiche or $3 in paperback. Ask for PB-180 051—*Triton City-A Prototype Floating Community*. The address of the Triton Foundation is 96 Mount Auburn Street, Cambridge, Massachusetts 02138.)

4 Astronauts to Headline National Meet in Denver

Four U.S. Astronauts, two Russian scientists, Air Force Sec. Robert Seamens and inventor-architect-designer R. Buckminster Fuller will headline the joint national meeting of the American Astronautical Society and Operations Research Society in Denver beginning Tuesday.

The astronauts appearing at the four-day meeting in the Brown Palace and Cosmopolitan hotels are Walter Schirra, Frank Borman, Walter Cunningham and Donn Eisele.

Schirra will deliver the meeting's keynote speech Tuesday morning and Borman will speak at a Tuesday luncheon.

Seamens will be featured speaker at an awards dinner Tuesday night in the Cosmopolitan Hotel.

The Soviet scientists, Yull C. Hodarev and Yuri N. Ivanov, will speak Thursday at "Soviet Space Night."

Fuller to Speak

Fuller, a professor at Southern Illinois University and frequent speaker in Colorado, will give a formal presentation of his "World Game Strategy" at a luncheon panel discussion Wednesday.

A seven-member panel will discuss Fuller's presentation. Panel members will include Dr. Jonas Salk, director of the Salk Institute for Biological Studies; Norman Cousins, president of Saturday Review Inc., and William Lear, president of Lear Industries.

In addition to speeches and presentations of papers, there will be the first national space art show, a world systems center workshop for development of communications and technology exhibits.

The art show, open to the public from 9 a.m. to 9 p.m., will be held in the Central City Room of the Brown Palace Hotel.

Art Exhibits

In addition to works by some 30 artists invited to submit to the show, there will be special exhibits by Peter Hurd, NASA artist Yeffe Kimball and a series of nine paintings by Chesley Bonestell depicting a manned mission to Mars.

Participating societies at the joint meeting are the American Institute of Aeronautics and Astronautics, Rocky Mountain Section; Institute of Management Sciences; Working Group of Extraterrestrial Resources; Society of Logistics Engineers; the American Water Resources Association, and the American Institute of Biological Sciences.

The joint meeting will be the 15th annual meeting of AAS and the 35th national meeting of ORSA.

The conference title is "Planning Challenges of the 70s in Space and the Public Domain."

George W. Morgenthaler of Denver's Martin-Marietta Corp. is general program chairman.

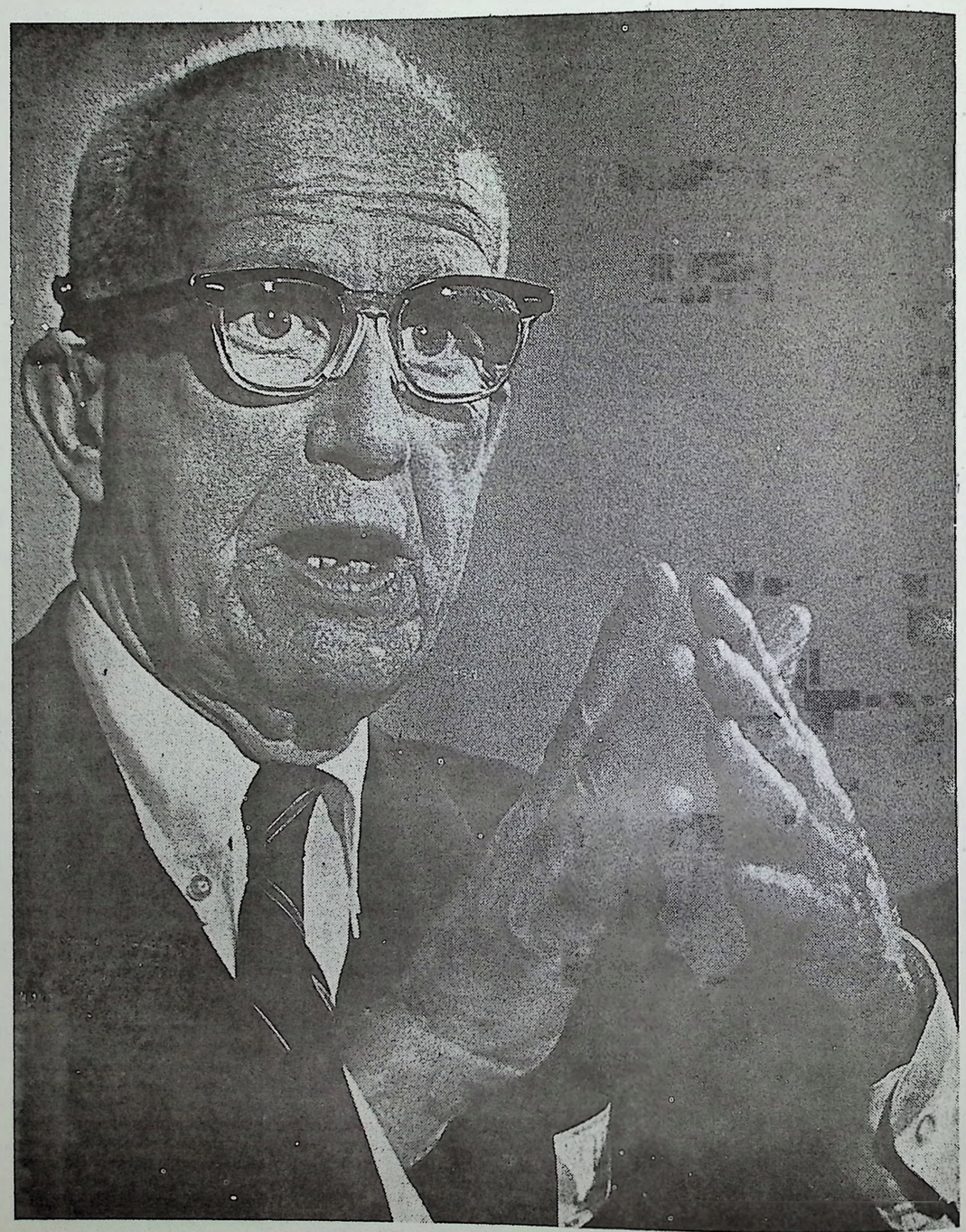
R. Buckminster Fuller, who will speak in Denver Wednesday, stands in front of an aluminum geodesic dome in Moscow. Fuller invented the geodesic dome concept. The Moscow dome was built as a pavilion in 1959 by the U.S. which sold the structure to Russia for a permanent exhibition hall. Fuller will speak at the joint meeting of the American Astronautical Society and Operations Research Society.

Rocky Mountain News

DENVER, COLORADO
June 16, 1969

'WORLD GAME' STRATEGY EXPLAINED

'Thou-Shalt-Not' Tactics Can't Reform Mankind, Fuller Insists



Denver Post Photos by Steve Larson

R. BUCKMINSTER FULLER, INVENTOR-ARCHITECT-PHILOSOPHER, DESCRIBES EARTH AS A SPACE SHIP
In discussing his World Game strategy, he said we can't waste the ship's supplies and pollute the environment.

By GENE LINDBERG
Denver Post Staff Writer

We're all astronauts aboard a spaceship, R. Buckminster (Bucky) Fuller told a capacity audience here Wednesday noon.

"All of us—all mankind—are passengers aboard an 8,000-mile spherical spaceship called earth," the inventor-architect-philosopher said, opening a panel discussion of his "World Game" strategy which followed a luncheon in the Cosmopolitan Hotel.

Fuller and members of the panel were featured guests at the second day's luncheon session of the American Astronautical Society-Operations Research Society joint national meeting here, ending Friday.

Stripped of technicalities, Fuller's "World Game" strategy is to:

Quit trying to reform man by "thou-shalt-not" tactics. Instead, commit mankind to reforming man's environment here aboard this crowded spaceship.

Fuller's fiery genius for explanation and persuasion left no doubt of his earnest belief in what he said. There are too many aboard "Spaceship Earth" for the passengers to continue fighting among themselves, wasting ship's supplies and polluting their environment.

The same common-sense rules that apply aboard a three-man Apollo craft hold good for the whole planet, now carrying more than 3½ billion passengers.

"Make the most of everything; get more done with less energy, less waste," urged Fuller.

On the panel to assess and evaluate the Fuller "design" were Dr. Jonas Salk, discoverer of polio vaccine; Norman Cousins, president of Saturday Review, Inc., New York; Charles Haar of Harvard Law School; William Lear, Reno, Nev.; William Wolf of West Concord, Mass.; Francois de Chadenes, petroleum geologist, Boulder.

All except Salk and Cousins also appeared with Fuller later, at a press conference on Fuller's "World Game."

Fuller, professor of design and director of world resources inventory at Southern Illinois University, Carbondale, Ill., kicked off with an analogy, comparing present world turmoil to the early day traffic mess that resulted, soon after the turn of the century, when automobiles first took over streets and highways in populous areas.

"To stop the carnage and mayhem of automobile accidents, the cry then was to reform the drivers," said Fuller. "Make 'em slow down. Make 'em stop, look and listen. But the deaths and injuries kept mounting.

"I noticed that a large majority of the accidents happened at street corners and highway intersections.

"Narrow, rough roads made for collisions. Unbanked turns put cars into the ditch. So it made sense to me to reform the roads, not just the drivers. Bank the turns, widen and smooth the roads."

That, said Fuller, is what he means now by reforming our world environment to make human travel aboard "Spaceship Earth" safer and happier for everybody.

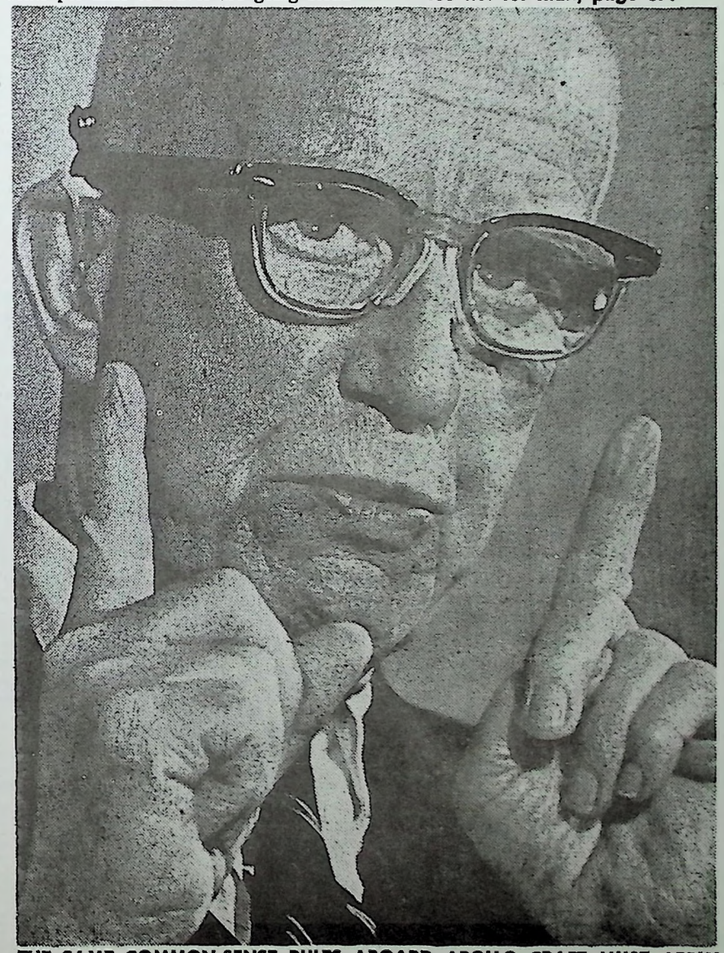
Certainly, he said, the accidents, deaths and injuries continue to mount on highways. But roads are better, drivers are more capable, vehicles are better designed, and the significant thing is, accidents per mile of travel are going steadily downward.

Population explosion? The statistics prove, says Fuller, that the children per family decrease in nations that become more highly industrialized, more capable of changing their environment to meet human needs.

One modern wheat farmer can grow bread for hundreds, Fuller points out, where it used to take a big family of boys to run one farm and feed the family.

Pollution, waste, human misery, hunger, ignorance are all parts of the same world problem, says Fuller. We've got to stop playing the war game and start playing the world game, conquering hostile environment, making the most of favorable environment, he contends.

Russians report Venus too hot for man, page 37.



THE SAME COMMON-SENSE RULES ABOARD APOLLO CRAFT MUST APPLY
"Make the most of everything; get more done with less energy, less waste."

THE DENVER POST
10 Cents, 76 Pages
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The Voice of the Rocky Mountain Empire® Denver, Colo.—Climate Capital of the World—Friday, June 20, 1969

Science Shows its Relevancy

Issue: Science's goals are very much part of national planning.

LEADERS of the American Astronautical Society and the Operations Research Society, both leading U.S. scientific organizations, deserve honors for the splendid national joint meeting they staged this week in Denver.

It was science at its best. The two organizations were looking for relevancy, whether from inside science or without, and in our opinion they found it.

They brought in Norman Cousins, distinguished editor, to declare that while thousands of people worked as a team to guide the astronauts to the moon "not one man" is working full-time to make sure our mother ship, Earth, stays on course.

Buckminster Fuller, designer and philosopher, called for reforming man's earthly environment so that he need not keep on fighting over it and polluting it. It is better, he said, to straighten out a dangerous highway curve than to reform drivers; the same approach should be applied to Earth.

Jonas Salk, discoverer of polio vaccine, called for an ultimate closed system in human numbers, with births maintained at a level equal to deaths.

These were among the men brought in as keynoters. But there were hundreds of papers given and thousands of ideas expressed. The subjects ranged from elaborate computer philosophies to simple statements of fact about recreation and wildlife (Harry Woodward, Colorado Game, Fish and Parks director, gave a paper).

And if the public is sometimes led to believe that some phases of science are overfunded the best place to look for verification is among scientists, themselves.

There was brutal honesty, for example, on the subject of space planning in the 1970s. Scientists want a better economic base for manned flight; they concede that many things can be done best by automation. Therefore, apply economic tests to what we do in the future, they argued.

The four-day convention at the Brown Palace and Cosmopolitan Hotels did not center on deeply philosophical issues to the extent that this editorial may imply. Much building has been done on the base established by space research of the past two decades. Such accomplishments were discussed.

ORBITING equipment has now brought weather prediction to the level of a nearly-exact science. Other orbiters can be used to detect diseases and mineral deficiencies among trees and other crops. The compression of information into ever-smaller packages received much attention, as did the need for a "language" for unifying science.

All in all, the AAS and ORSA leadership deserves a "well done." As laymen, we cannot follow all the abstruse points of a mathematically-precise paper but we can grasp the validity of a national meeting which tackles the human condition with as much variety and imagination as did these two groups. We think the credibility gap between science and the public was narrowed by this meeting.

Saturday Review

November 12, 1966 35¢

CHILDREN'S BOOKS FOR FALL

BUCKMINSTER FULLER
"What I Have Learned"

Saturday Review

380 Madison Avenue, New York, N. Y. 10017

Norman Cousins, Editor

March 17, 1965

Mr. F. Buckminster Fuller
University of Southern Illinois
Carbondale, Illinois

Dear Bucky:

There are perhaps ten or twelve men in the world who, like you, have become citizens-at-large in the world community and whose influence transcends geography and language. Among these men are Albert Schweitzer, Bertrand Russell, E.M. Forster, Paul Tillich, and yourself. My hope is to persuade each of them to write an article for Saturday Review that would later be incorporated in a book. The articles would be in the nature of a personal summing-up, telling the principal lessons you have learned from life.

I realize that we are asking you to do a great deal in a short space, but the pieces would be in the nature of a distillation. Each article or chapter would run between 3000 and 5000 words.

I should, of course, be pleased to send you further details.

With all good wishes,

NC:b

Saturday Review
November 12, 1966

WHAT I HAVE LEARNED—VIII

How Little I Know

The confessions of a designer-architect-scientist-philosopher who, in reflecting on his varied expertise, finds that he is "unlearned," but not without knowledge or significance.

By BUCKMINSTER FULLER

"TELL US, in 5,000 written words (equivalent, at my oral rate, to three-quarters of an hour's discourse), what you have learned in your lifetime," said the editors of *Saturday Review*. "That ought to be easy," I said. Three weeks have gone by.

What have I learned in my lifetime?

I have not learned that it is true, but I assume it to be probable that: *The combined metaphysical and physical universe is the aggregate of all humans' consciously apprehended and communicated (to self or others) experiences.*

Eddington said, "Science is the conscientious attempt to set in order the facts of experience." Ernst Mach said, "Physics is experience arranged in most economical order." All the words in all dictionaries are the consequent tools of all men's attempts to communicate all of their experiences—that is, to communicate Universe.

There are 32,000 current words in *The Concise Oxford Dictionary*. We don't know who invented them. What an enormous inheritance! Shakespeare used 10,000 of them. It would take many more volumes than Shakespeare's to employ the 32,000 logically and cogently. In a 5,000-word article I may use only 1,000. Are 31,000 of these words superficial and extraneous to the reporting of what I have learned? I have learned that you would think so if you ever saw a magazine's editor at work on my work!

Womb days—
Womb days—
Dear old tummy tomb days . . .

I can't consciously recall those busy elementary assembly days. But post-graduate activity in experimental biology by me and you (one and two) which surprisingly produced wee thee (we three) and more (four) suggests to us that our subconscious reflexing can never forget the satisfactory routines of our 273 undergraduate days. Probably no billionaire out here in the air "ever had it so good." It is understood that if you know that I know how to say it "correctly" (the exact meaning of which I have not yet learned), then I am entitled to say it all incorrectly—which once in a rare while will make you laugh. And I love you so much whenever you laugh. But I haven't learned yet what love may be. But I love to love, and love being loved, and that is a whole lot of unlearnedness.

I HAVEN'T learned how or why the universe contrived to implode and intellectually code the myriadly unique, chromosomically orchestrated DNA-RNA, quadripartite moleculed, binary-paired, helically extended, and unzippingly dichotomied, regenerative symphonic jazz, as . . .

A one and two,
Three and four,
Me . . . you,
Thee . . . they
And more . . .

As yet dancing to the DNA Waltz, I am now seventy years, or approximately 600,000 hours, old. I have slept away 200,000 of those hours. Another 200,000—half of my 400,000 awake hours—have gone into routine work prescribed, imposed, or induced by other men, such as being "educated," earning a living, paying taxes, obtaining licenses, answering telephones and questionnaires. Another 100,000—half the remaining 200,000 awake hours—have gone also into routine work, but this time prescribed as the by-laws of membership in the non-simultaneous-invention universe, as one of its impressively independent, variable functions, Man—a metabolically regenerative, 99 per cent automated, individually unique, abstract-pattern integrity system whose input-output energy involvement and control capability must continually expand, extend, relay, rebuild, and maintain as "operative" an interior-exterior, bipartite tool complex, beginning with an integrally centralized organic set and subsequently extending into an extracorporeally decentralized organic set, both of which interior and exterior sets consist of progressively interchangeable and intertransformable chemical, hydraulic, pneumatic, electromagnetic, thermodynamic, molecular, and anatomical, structural patterning processes. All of which complex regenerative process, such as me, is compounded as an invisibly minute, abstract-pattern marriage operation, inaugurating a new individual life which, like a telephone message, weighs nothing in itself but makes itself "known" by a complex pattern of orderly local physical environment displacements, which—as the circular wave emanating in any liquid such as water, milk, or kerosene, from the impact of an object dropped into the liquid—grows or expands regeneratively.

So, too, does the complex wave package of human being begin to expand regeneratively the local environment's chemical association and disassociation events, continually shunting more and more chemical events into its local disturbance—like a tornado gaining twist—until the new human being nine months later emerges from its mother's womb as a seven-pound, placid, pink tornado,

which each day takes in and processes, approximately three pounds of foods, eight pounds of water and eighty-four pounds of air—amounting at my seventy years to a cumulative total of approximately 1,000 tons, or 300,000 times my arrival weight, while I have gained only twenty-four-fold, integrally. All of which internal and external regenerative man package arrives without any instruction manual covering either its own operation or that of the non-simultaneous universe of which Man is an independent function, having fortunately the built-in subconscious capability of self-discovery, which, in turn, has discovered its conscious ability to discover experimentally and progressively the ability to formulate concepts and words, and thereby to relay to other contemporaries and to subsequent generations of Man the apprehended data and comprehended principles apparently governing some of the operations of Universe and of Man. Of the remaining 100,000 hours, 60,000 have been used in getting from here to there; and that has left me a bonus of 40,000 hours, or 6⅔ per cent of my life, to invest at compound interest in whatever way I have wished.

I'M not inclined to use the word *creativity* in respect to human beings. What is usually spoken of as creativity is really a unique and unprecedented combination in the use of principles which exist *a priori* in the universe. I think Man is a very extraordinary part of the universe, for he demonstrates unique capability in the discovery and intellectual identification of the operative principles of Universe, which, though unconsciously employed, have not been hitherto differentiated, isolated, and understood as being principles by other biological species. But I reject the word *creativity* for use by any other than the great intellectual integrity progressively disclosed as conceiving both comprehensively and anticipatorily the complex interpatternings of reciprocal and transformative freedoms in pure principle which apparently govern Universe—which altogether are the verb *god*. I go along with the 5,000-year-old-philosophy of the Bhagavad-Gita which says, "Action is the product of the qualities inherent in nature." "It is only the ignorant man who, misled by personal egotism, says: "I am the doer."

I am most impressed with the earliest recorded philosophic statements by unknown individuals of India and China. Through millenniums the philosophies have become progressively compromised and complicated. I am an explorer, however, of the generalized design science principles which seemingly differentiate Man from animal and mind from brain.

The word *generalization* as used in the literary sense, means "a very broad statement." It suggests covering too much territory, too thinly to be sound. The literary men say, "This is too general." In the mathematical sense, the meaning of generalization is quite different. The mathematician or the physicist looks for principles which are persistently operative in nature, which will hold true in every special case. If you can find principles that hold true in every case then you have discovered what the scientist calls a *generalized principle*. The conscious detection of generalized principles which hold true under all conditions, and their abstraction from any and all special-case experiences of the principles, is probably unique to humans.

By abstraction, I mean an idealized, "empty set" statement such as one of my own: "Tension and compression are only coexistent" (e.g., when you tense a rope its girth contracts—*ergo*, compresses; when you compress a sphere's polar axis, its equatorial girth expands and tenses). It is inconceivable that a dog, tugging at its leash at one time and compressing its teeth on a bone at another time, should formulate consciously the generalized "*only coexistence of tension and compression,*" though the dog is subconsciously coordinate in tension-compression tactics. To generalize further than "tension and compression are only coexistent," we may say that "plus and minus only coexist," and generalize even further by saying, "Functions only coexist."

Then there is an even more powerful and intellectually more exalted stage of generalization of principles, and that is the generalization of a complex of generalizations, such as "unity is plural and at minimum two"—which combines the generalized law of the coexistence only of functions with the theory of number. In turn, we discover the generalizations governing the associative powers of the nucleus and of the weak interactions for the unity is two of the congruent, convex, and concave spheres, evidenceable in the generalized laws disclosed conceptually, arithmetically, and geometrically in synergetics. I am certain that what we speak of as human morality is a form of tentative generalization of principles underlying special case experiences of human potentials, behaviors, actions, reactions, and resultants. Man has also the unique ability to *employ* generalized principles—once recognized—in a consciously selective variety of special case interrelationships.

The whole regenerative process of intellectual discovery and specialized use of generalized principles is known as teleology. Teleology embraces the theory of communication. Though as yet having special-case limitations, it is a hypothetical approach to a pure, abstract generalization to say that teleology is only intuitively initiated by humans. Intuition alerts brain to first apprehend and then recognize each special-case experience within some minimum number of special case recognitions. Intuition alerts mind to comprehend and formulate conceptually the abstract generalization of a principle recognized as operative in all the special cases. Intuition alerts brain to the objectively employable generalized principle in a hitherto unexperienced special case.

Teleology, as part of communications theory, relates to the pursuit of truth as entropy and anti-entropy. It may be that communications theory may be mathematically equated with electrical transmission theory, whereby the higher the meaning or voltage the more efficient and longer-distance the communication attainable. Some notions:

Song of the Dead And the Quick

Newton was a noun
And Einstein is a verb
Einstein's norm makes Newton's norm,
Instant Universe,
Absurd.
"A body persists
In a state of rest
Or———
Except as affected———"
Thus gravestones are erected!

"Non-simultaneous, physical universe
Is Energy; and
Energy equals mass
Times the second power
Of the speed of light"
No exceptions!
Fission verified Einstein's hypothesis
Change is normal
Thank you, Albert!

Law of Conservation of Energy

Energy can be
Neither created nor lost.
Ever intertransforming at
Non-simultaneous varieties of rates,
Physical Universe is finite,
All experiences are individually finite.
The aggregate of all experiences is finite.
Universe is finite.

Irreversible Verse Einstein's Intellect

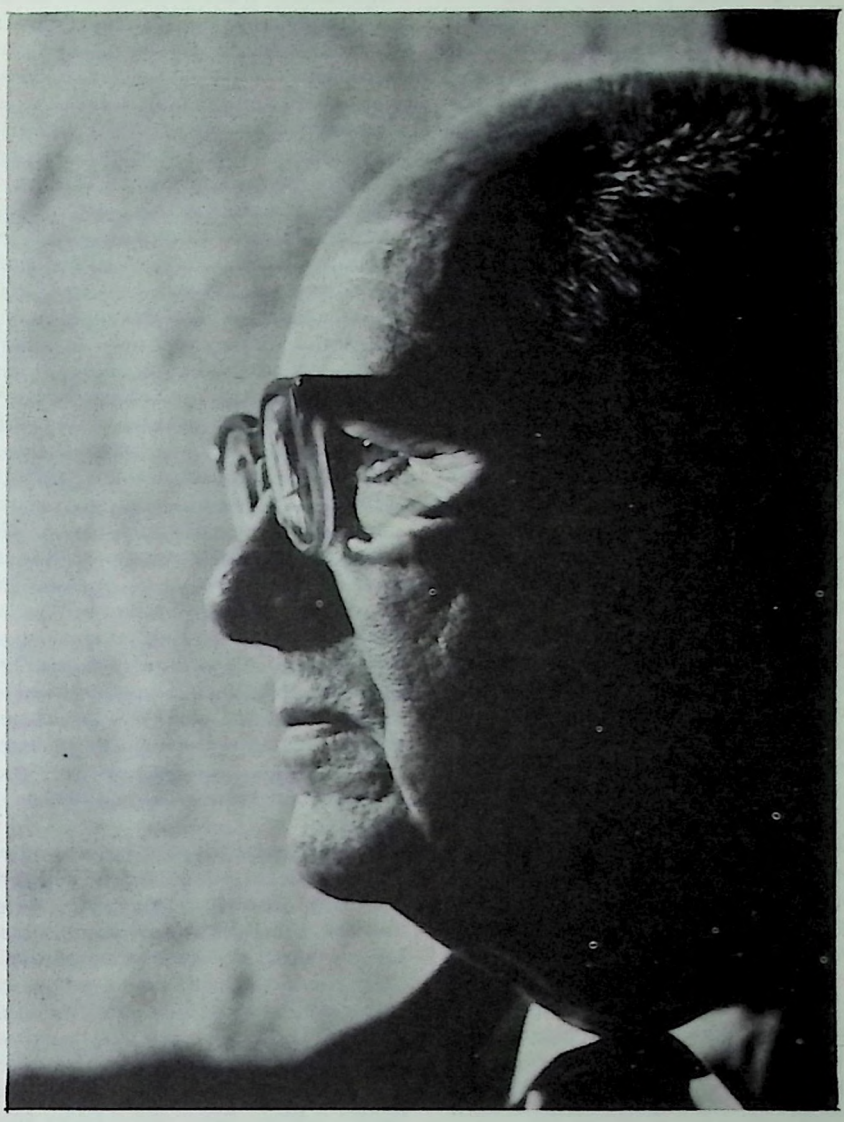
Defined *energy* $E = MC^2$
Energy cannot define *intellect*
Intellect the *metaphysical*
Is comprehensive to
Energy the *physical*
While Universe is *finite*
Energy is *definite*
Because definable
Energy is XY
Intellect is O

The wealth of Earthians
Is irreversible
Wealth cannot alter yesterday's
experiences.
It can only alter today's and
tomorrow's experiences.
It can buy
Forward time in which intellect
May scientifically explore for
The orderly interrelationships
Disclosed in yesterday's experiences
Which can be employed by intellect
To forecast
Anticipatory and orderly rearrange-
ments of tomorrow
By technological transformations
Of the physical energy environments
Events and circumstances.

The second law of thermodynamics predicts the inexorable energy loss, known as entropy, from all local systems of Universe. Entropy is also known mathematically as "the Law of Increase of the Random Element." But energy is shown experimentally as accomplishing disassociation here only through regrouping or association there. Energy transactions are 100 per cent accountable. Though entropically irreversible every action has its reaction and resultant, and every nuclear component has its positive or negative behavioral opposite.

Wealth is the organized and operative tool and energy capability to sustain Man's forward metabolic regeneration; to physically protect him; to increase his knowledge and degrees of freedom while decreasing his interfrustrations. Solo wealth is to common wealth as x is to x^4. Wealth is energy compounded with intellect's know-how. Every time Man uses his know-how his experience increases and his intellectual advantage automatically increases. Because of its conservation energy cannot decrease. Know-how can only increase. It is therefore scientifically clear that wealth which combines energy and intellect can only increase, and that wealth can increase only with use, and that wealth increases as fast as it is used. The faster the more!

HAS Man a function in Universe? In dynamic balance with the inside-outing, expanding universe of radiant stars, Man witnesses radiantly dormant earth as a collecting or outside-inning, contracting phase of Universe. Earth receives and stores a continually increasing inventory of sun and star-emanating radiation in its lethal-energy-concentrates, sifting, sorting, and accumulating spherical Van Allen Belts. In addition to the Van Allen Belts, the succession of earth's concentric spherical mantles—e.g., the ionosphere, troposphere, *et al.*—constitute an extraordinary series of discrete filters for the random-to-orderly sorting, shunting, partially accumulating, and final inwardly forwarding of the benign radiation residues to the biosphere stage of earth's continual and orderly processing of its discrete share of the expanding-universe-propagated energy-income receipts. Earth also receives daily additional thousands of tons of expanding-universe dispatched stardust. This concentration around earth's surface of the universe-deposited dust apparently consists of all the ninety-two regeneratively patterning chemical elements in approximately the same order of relative abundance as found to occur in the thus-far inventoried reaches of Universe. The biological



The author: One of the most extraordinary Americans of our era, R. Buckminster Fuller first gained prominence in 1927 with the invention of the Dymaxion House, a spacious, low-cost, high-strength dwelling uniquely suspended from a central mast. In the early 1930s he also introduced the three-wheeled Dymaxion car, which had a top speed of 120 miles an hour, went forty miles on a gallon of gasoline, and could turn in its own length. Of his many other inventions perhaps the most famous is his geodesic dome, whose design is based on a mathematical formula he himself developed and named "energetic synergetic geometry."

He also has founded several design and manufacturing firms and served as a consultant to industry, the U.S. Government, the Ford Foundation, and other agencies. In 1961-62 he was Charles Eliot Norton professor at Harvard, and he has been a visiting professor, lecturer, and critic abroad and on many American campuses, including Yale, Cornell, Princeton, the Massachusetts Institute of Technology, and the University of California at Berkeley. In 1959, he was appointed to a professorship with life tenure at Southern Illinois University. His books include *No More Second Hand God*, *Education Automation*, and *The Unfinished Epic of Industrialization*.

life on earth is inherently anti-entropic, for it negotiates the chemical sorting out of the earth's crust's chemical-element inventory and rearranges the atoms in elegantly ordered molecular compound patternings.

Of all the biological anti-entropics—*i.e.*, random-to-orderly arrangers—Man's intellect is by far the most active, exquisite, and effective agent thus far in evidence in the universe. Through intellect, Man constantly succeeds in inventing technological means of doing ever more orderly—*i.e.*, more efficient, "better sorted-out"—local universe, energy tasks with ever less units of investments. To guarantee his and their anti-entropic functioning, the intellectual-integrity universe that has designedly arranged Mankind and all the other living species, has its ultra-shortsighted, built-in "desire" drives, its romantic-conception ambitions and protectively colored self-deceits, as well as its longer distance "needs," all of which cause each specie to pursue its particular "honey" with its particular rose-colored glasses as does the bumblebee, which at the same time inadvertently and unconsciously performs myriads of other tasks, designed with fabulous scientific capability by Nature—which inadvertent intercoordinate tasks are all essential to realization of the regenerative continuance of the much larger survival-support conditions for the generalized ecological system of all life. It is part of the comprehensively anticipating design science of life that the bumblebee's self-unviewed, unwitting, bumbling tail bumps into and knocks off male pollen, which it later and, again, inadvertently, knocks off upon the female botanical organs, thus unconsciously participating in a vastly complex ecological interaction of the many energy-processing biochemical "gears" of the total life system, dynamically constituted by all living species.

THE myriad inadvertencies of all the living species have sum-totally provided a metabolically sustaining and regenerative topsoil process which, it is realized now—but only by our retrospectively gained knowledge—has kept Man regeneratively alive on earth for at least 2,000,000 years, while ever improving his physical survival advantages and increasing his longevity. This vast "game-playing" of life has also indirectly occasioned not only the regenerative multiplication of human beings but also a progressively increasing percentage who survive in conditions of ever improving physical advantage.

I think Man is very properly concerned about that which he does not understand. I don't think that it is the machine *per se* that bothers Man; it is just not understanding anything that disturbs him. When an accident bares portions of human organs familiar only to doctors, those organs look foreign and frightening to people. Stick your tongue way out before a mirror. It is a strange-looking device. If, existing originally and transcendentally as psyches only, individuals had to choose and assemble their own sets of organic parts, having been assured of mortal incarnation and of mortal "honey-chasing" experiences after successful selection and completion of the assembly, and these individuals were endowed as psyches only with an esthetic sense of selectivity—being devoid of any understanding of either the separate or integrated functions of those parts—no humans would merge those cooperatively functioning parts into mortal beings, for no part of the "guts" would be chosen. Nature had to skin over the regenerative chemistry and physics controls with an esthetically intriguing, pseudo-static, sculptural baby-doll unity in order to trick the immortal psyches into the problem-beset, temporary occupation of such humid-process regenerative machines as those of the humans.

I have learned that Man knows little and thinks he knows a lot. When any man can tell us just how and why he is handling and disposing the energies of his breakfast; or when any man can tell us that he is deliberately pushing each of his million head-hairs out through his scalp at specifically preferred rates and in specifically controlled shapes for specific purposes, we may say that this man knows a little. But I don't know of any man who can tell me so little, even, as why we have hair.

I am the most unlearned man I know. I don't know anyone who has learned how little one knows as have I. But that does not belittle the little I seem to know, and I have confidence in the importance of remembering how little we know and of the possible significance of the fact that we prosper, and at some times even enjoy life in Universe despite the designed-in littleness that we have to "get by with." Despite their billionfold numbers, babies and very young children soon after their arrival on earth have uttered and continue to utter spontaneous comments and questions concerning life on earth and in Universe which are so economical and uniquely fresh in viewpoint and formulation as to be pure poetry, proving, apparently, that poetry is inexhaustible; to which their sophisticated and surprised, off-guard adult audience cliché unpoetically, "Oh, how cute."

I have learned that truth is an omnipresent, omnidirectional, evolutionary awareness, one of whose myriadly multiplying facets discloses that there are no "absolutes"—no "ends" in themselves, no "things"—only transitionally transformative verbing. It seems possible to me that God may be recognizable in Man's limited intellection only as the weightless passion-drive which inspires our progressive searching for the momentarily only, and only most-truthful-thus-far-possible comprehension of all the interconnections of all experiences. It seems, then, to me, that the nearer we come to understanding, the nearer we come to the orderly, omni-interrelationships of all the weightless complex of all generalized principles which seem to be disclosed to us as so important as to be tentatively identified as God. For it is the integrable interrelationships of all the generalized laws which apparently govern the great verb "universe," of the vastly greater—because comprehensively anticipatory—verb-intellecting which verb of optimum understanding may be "God."

IT seems that truth is progressive approximation in which the relative fraction of our spontaneously tolerated residual error constantly diminishes. This is a typical anti-entropy proclivity of Man—entropy being the law of increase of the random element. Heisenberg's indeterminism, in which the act of measuring always alters the measured, would seem entropic were it not for the experimentally realized knowledge that the successive alterations of the observed diminish as both our tooling and instrumentation continually improve; *ergo*, intellection's effect upon measurement and the measured is a gap closing, and the pursuit of more truthful comprehension is successfully anti-entropic. Before Heisenberg, T. S. Eliot said, "Examination of history alters history." And Ezra Pound and earlier poets reported their discoveries that in one way or another the act of thinking alters thought itself.

When we ask ourself, "What have we learned?" we feel at first that the answer is, "Nothing." As soon as we say so we recall exceptions. For instance, we have learned to test experimentally the axioms given to us as "educational" springboards, and we have found that most of the "springboards" do not spring and some never existed. As, for instance, points, holes, solids, surfaces, straight lines, planes, "instantaneous," "simultaneous," things, nouns, "congruence," "at rest." The words "artificial" and "failure" are meaningless, for what they aver is experimentally "nonexistent." If Nature permits a formulation it is natural. If Nature's laws of behavior do not permit the formulation, the latter does not occur. Whatever can be done or occurs is natural, no matter how grotesque, boring, unfamiliar, or unprecedented. In the same way, Nature never "fails." Nature complies with its own laws. *Nature is the*

law. When Man lacks understanding of Nature's laws and a Man-contrived structure buckles unexpectedly, it does not fail. It only demonstrates that Man did not understand Nature's laws and behaviors. Nothing failed. Man's knowledge or estimating was inadequate.

STEP to the blackboard. Write out a number so lengthy it has never been written before. The pattern of numbers constitutes a new form. The number is a doodle, and I cannot accredit novel form as creativity of Man. The number of relationships between items is always $\frac{N^2 - N}{2}$. The relationships between four or more items are always greater in number than the number of items. *Ergo*, there are always more chords than notes. And chords by themselves are not music. It takes two to make a baby. But it takes God to make two.

I assume that the *physical universe* is *definite*, and the *metaphysical universe* is *finite*. What men have called infinite I call finite. And what men called finite I call definite—*i.e.*, definitive. By my philosophy the finite, but imponderable, metaphysical universe embraces the definite, ponderable, physical universe. *Finite* is not conceptual. *Definite* is conceptual. I have mathematical proof that the difference between the sums of all the angles around all the surface vertices of any conceptual, definitive physical system and the finite but nonconceptual metaphysical universe is always 720 degrees. Or a difference of only one *definitive tetrahedron*. Therefore, the combined physical and metaphysical universe is finite.

You can't buy anything worthwhile, like spontaneous *love* or *understanding*. Though metaphysically finite, these are imponderables. The absolute would be non-transformable, static, and weighable. *Ergo*, experimentally meaningless. Infinity is only local, and occurs within definite systems, as for instance, a circle around the sphere, which may be followed experimentally only as long as intellect follows.

Not being simultaneous, Universe cannot consist of one function. Functions only coexist. Universe, while finite, is not *de*finable. I can define many of its parts, but I cannot *de*fine the non-simultaneously occurring aggregate of experiences whose total set of relationships constitutes the whole universe, though the latter, as an aggregate of finites, is finite.

There is strong awareness that we have been overproducing the army of rigorously disciplined, scientific, game-playing, academic specialists who, through hard work and suppressed imagination, earn their Ph.D.'s, only to have their specialized field become obsolete or by-passed in five years by evolutionary events of altered techniques and exploratory strategies. Despite their honor grades, they prove not to be Natural Philosopher Scientist-Artists, but just deluxe quality technicians or mechanics. And what they lack to adapt themselves to change has now been pronounced in Washington as "creativity."

Philip Morrison, head of Cornell University's Department of Nuclear Physics, talks about what he calls "left-hand" and "right-hand" sciences. Right-hand science deals in all the proven scientific formulas and experiments. Left-hand science deals in all of the as yet *unknown* or *unproven*—that is, with all it is going to take intellectually, intuitively, speculatively, imaginatively, and even mystically, by inspired persistence, to open up the as-yet unknown.

The great scientists were great because they dealt successfully with the unknown. All the "greats" were left-hand scientists. We have been governmentally underwriting only the right-hand science, making it bigger and sharper. How could Congress justify appropriations of billions for dreams? So the billions went only for the swiftly obsoleting, bigger, faster, and more incisive modifications of yesterday's certainties by Ph.D. specialists. Everything that constitutes science is unteachable. Scientific routines for specialized technicians, and scientific formulas for their reference, alone are teachable.

The American Academy of Sciences, studying the few American scientists who have made historical breakthroughs, hoping thereby to develop more of the same, found out in the early 1950s that the first thing to be looked for is the university attended. It is interesting, therefore, that the California Institute of Technology and the Massachusetts Institute of Technology did not make the first twenty; Reed College is the top U.S. source of first-rank capability scientists. The outstanding observation is that "great scientists" are all graduates of small, liberal arts colleges rather than of powerful scientific establishments. The National Science Foundation asked the great "breakthrough" scientists what they felt to be the most dominantly favorable factor in their educational experience. The answer was almost uniformly, "Intimate association with a great, inspiring teacher."

TEACHING is not done with a needle or a pump. It can best be accomplished through the informed leadership of meticulously self-disciplined individuals who have invincibly loving faith in the integrity of universal evolution and of the indispensability of Man's functioning, unknown though it may be, in the realization of totality. To be with a great scientist at his research work can give the highest inspiration to an unimpaired student who must take the initiative in disciplining *himself*. Look for opportunities for the young to work with the loving pioneers—when they are as yet pioneering; to see the whole world picture of science as a part of a complete creative need—as an artist's need to articulate.

Kepes, at the Massachusetts Institute of Technology, made a beautiful demonstration. He took hundreds of 8 x 10-inch, black-and-white photographs of modern paintings and mixed them thoroughly, like shuffled cards, with photographs taken by scientists through microscopes or telescopes of all manner of natural phenomena—sound waves, chromosomes, and such. The only way you can classify photographs with nothing recognizable in them is by your own spontaneous pattern classifications: Group the mealy, the blotchy, the striped, the swirly, the polka-dotted, and their subcombinations. The pattern-classified groups of photographs were displayed. The artists' work and the scientists' were indistinguishable. Checking the "back-mounted" data, it was found that the artist had frequently conceived his imagined pattern before the scientist had found it in nature. Science began to take a new view of artists.

Loving mothers prohibit here and promote there—often in ways irrelevant or frustrating to brain-coordinated, genetic evolution, often suppressing a child's profound contribution trying to emerge. We have to look on our society as we look on the biological world in general, recognizing, for instance, the extraordinary contributions of the fungi, the manures, the worms, *et al.*, in the chemical reprocessing and fertility upgrading of the earth. We must learn to think of the functions of the trees' roots as being of equal importance to the leaves' functions. We tend to applaud only the flower and the fruit, just as we applaud only the football player who makes the touchdown, and not the lineman who opened the way. What society applauds as "creative" is often isolated out of an extraordinary set of co-equal evolutionary events, most of which are invisible. Evolutionary "touchdowns" are unpredictable—sometimes centuries apart. Who knows which child is to make the next breakthrough?

In the next decade society is going to be preoccupied with the child because through the behavioral sciences and electrical exploration of the brain we find that, given the right environment and thoughtful answers to his questions, *the child has everything he needs educationally right from birth*. We have thought erroneously of education as the mature wisdom and over-brimming knowledge of the grownups injected by the discipline pump into the otherwise "empty" child's head. Sometimes parents

say "don't" because they want to protect the child from getting into trouble. At other times when they fail to say "no" the child gets into trouble. The child, frustrated, stops exploring. It is possible to design environments within which the child will be neither frustrated nor hurt, yet free to develop spontaneously and fully without trespassing on others. I have learned to undertake reform of the environment and not to try to reform Man. *If we design the environment properly,* it will permit child and man to develop safely and to behave logically.

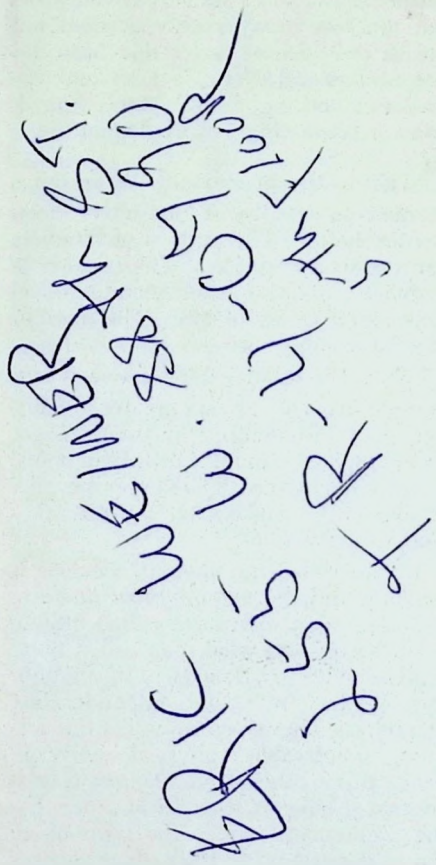
Order is achieved through positive and negative magnitude and frequency-controlled alteration of the successive steering angles. We move by zigzagging control from one phase of physical universe evolution to another. The rudder concept of social law is most apt. The late Norbert Wiener chose the word *cybernetics,* derived from Greek roots of "rudder," because Wiener, Shannon, and others in communication theory were exploring human behaviors and their brain-controlled "feedback," etc., as a basis for the design of computers—and it became evident that the human brain steers Man through constant change.

No sharp cleavage is found which identifies the boundary between life and nonlife, between the heretofore so-called "animate" and "inanimate." Viruses—the smallest organized structures exhibiting "life"—may be classified as either crystalline or "cellular" forms. This is the level also at which the DNA/RNA genetic coding has elucidated the basic life design. The genetic code is essentially a structural pattern integrity. Such pattern integrities are strictly accountable only as mathematical principles. Pattern integrities are found at all levels of structural organization in Universe. The DNA/RNA, is a specialized case of the generalized principle of pattern integrity found throughout life and nonlife. *All pattern integrity design is controlled by angle and frequency modulation.* Life is not strictly "animate" at any point. Given that the "ordering" of life is accomplished through such codings as DNA/RNA which are essentially angle and frequency modulation, then we may go on to suggest that "life," as we customarily define it, could be effected at a distance—it may be radiated from a remote source. Life could be "sent on."

Within the order of evolution as usually drawn, life "occurred" as a series of fortuitous probabilities in the primeval sea. It could have been sent or "radiated" there. That is, the prime code or angle and frequency-modulated signal could have been transmitted from a remote stellar location. It seems more likely (in view of the continuous rediscovery of Man as a fully organized being back to ever more remote periods) that the inanimate structural pattern integrity which we call human being was a frequency modulation code message beamed at earth from a remote location. Man as a prime organizing "principle" construct was radiated here from the stars—not as primal cell, but as a fully articulated high-order being.

All that is weighable in respect to life is physical. All that is weightless in respect to life is metaphysical. I am not the 1,000 tons of physical elements which I have progressively processed cellularly in hair, skin, flesh, and bones and progressively discarded for reformulation and articulation by other lives of any species.

You and I are essential functions of Universe. We are exquisite anti-entropy. I'll be seeing you! Forever.



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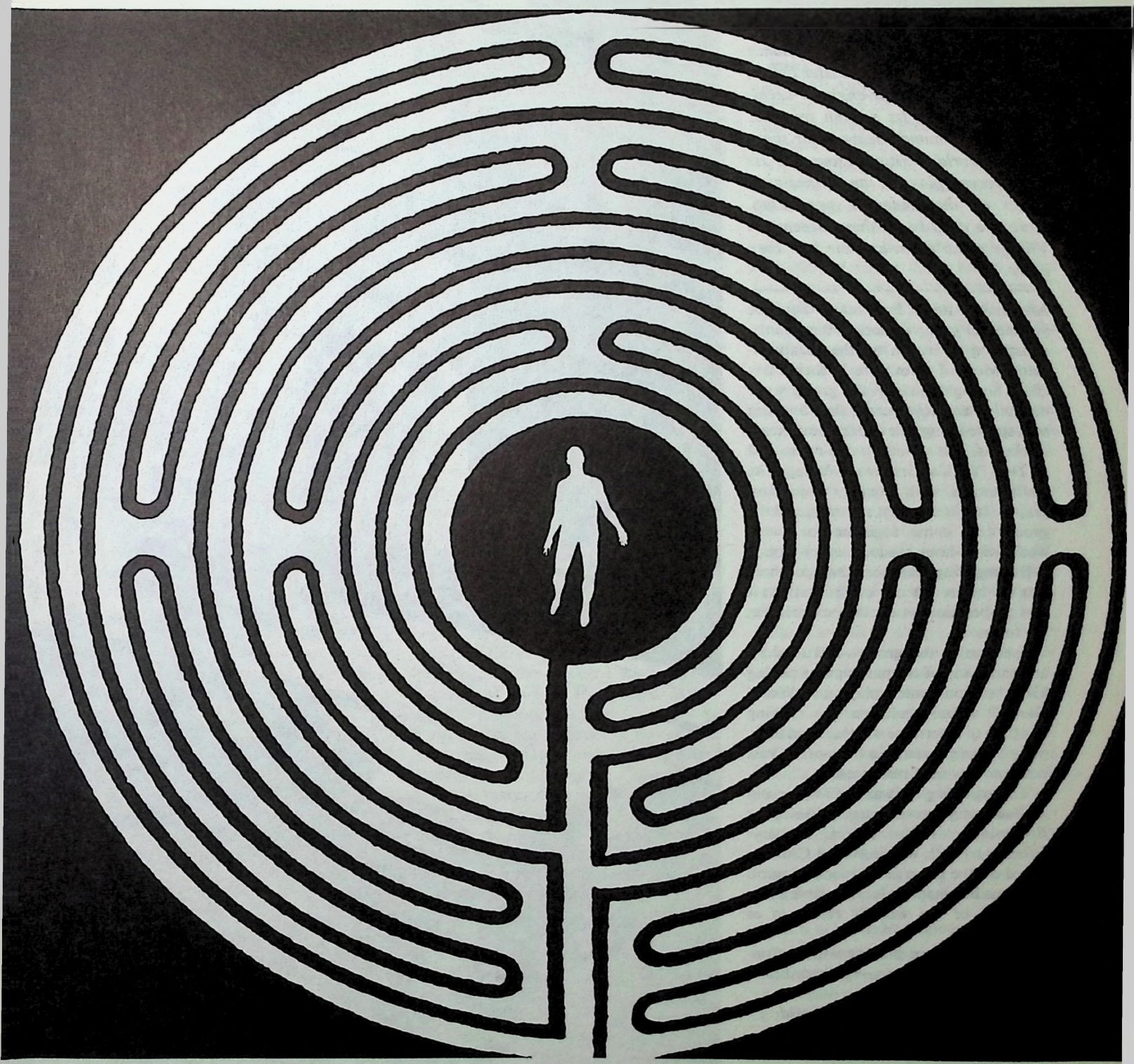


Habits: Tough to break out of . . .

Today Greenwich Village, Tomorrow the World

Called "World Game," it's the brainchild of a 20th century Renaissance man, the renowned Buckminster Fuller, 74-year-old inventor-engineer-architect-philosopher. Its solemn purpose: to give every human being a fair share of the world's vital resources. Its most recent players: an enthusiastic group of the under-30 generation. Here, we drop in on their Greenwich Village game room and see how they score.

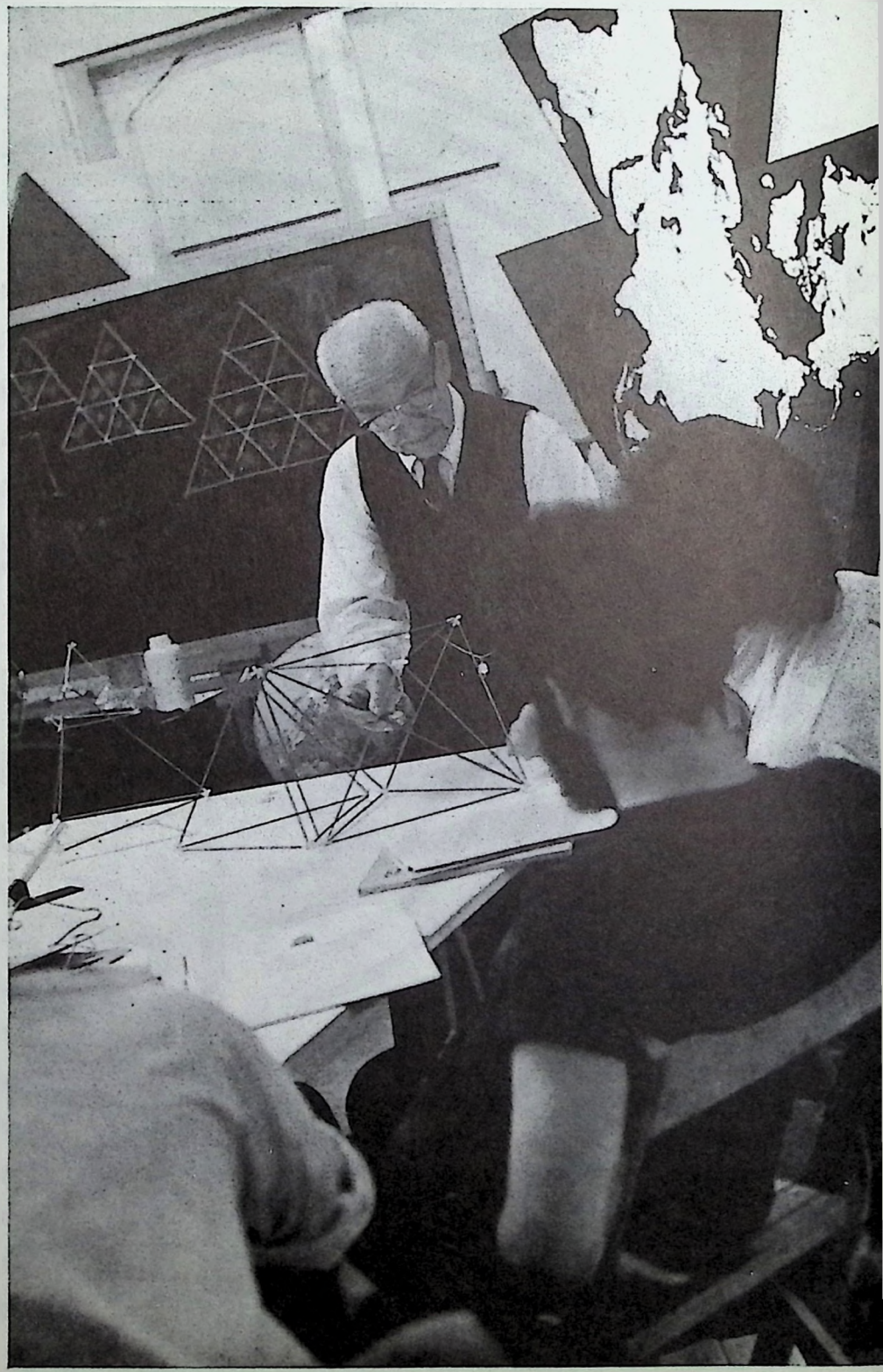
An outsider might have taken them for yet another group of under-30 militants, conspiring to march on the Establishment. Most of them were in their early 20s. The eight girls in the group wore miniskirts and love beads; the 16 young men sported long hair and/or beards and sideburns. The setting: a one-room pad in New York's Greenwich Village, its walls awash with charts, maps and graphs. It was this past summer, and the group had come together for seven weeks of 12-hour sessions, every day.

Belying all appearances, their goal here was neither revolt nor confrontation; it was cooperation on a scale the world has yet to know.

Specifically, the group—recruited by ads and many of the participants paying $300 tuition—was playing "World Game," whose challenge was nothing less than to determine whether, and how, everyone might share in the world's vast but unevenly used resources.

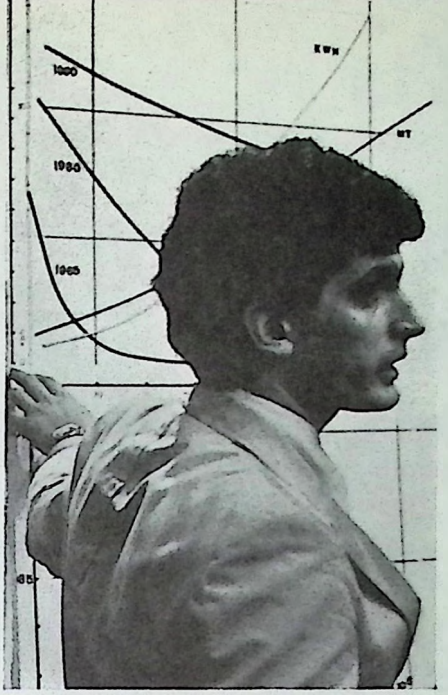
The group's guru was the 74-year-old architect-engineer-inventor-philosopher Buckminster Fuller (*Think*, January-February 1968), whose World Game is based on the premise that technological progress has made at least feasible a distribution of the world's resources as needed.

Fuller has been playing with the notion of World Game—he describes it



Fuller joins in a session of his World Game, played this past summer by a group in New York's Greenwich Village, and continuing now at Southern Illinois University.

Project coordinator, right, was Edwin Schlossberg, 24, a doctorate student in science and literature at Columbia. The game ended with an idyllic projection: the minimum survival needs of all the world's people can be met within 10 years.



Right: "This is not an exercise in politics," Fuller said to the under-30 group. "We want to have the answers ready when the politicians are in trouble and turn to us. . . ."

simply as "an organized way to deal with large problems"—since 1927, when he was a Navy officer. On land, men equated security with bigness. At sea, the trick was to "do more with less"—and Fuller has adapted this principle in his efforts to solve global problems.

In his Game, he explains, the world is viewed as one single entity or system ("synergy"). We are aboard Spaceship Earth, equipped with adequate facilities for giving all of its human passengers their physical needs. The physical-chemical elements and the metaphysical "know-how" are now in adequate supply; but they can be turned to comprehensive advantage only if we learn how to play World Game on a "you and me" basis, not a war game on a "you *or* me" basis. The aim of the game is to establish ways to use the world's resources "to take care of everybody at a high standard of living without anybody profiting off or impeding anybody."

A Look at the Plumbing

In this summer's session, funded by a Rockefeller Brothers grant, Fuller participated for the first three weeks, describing with near-missionary zeal his own vision of the coming age: men will recognize, for the first time in history, that their needs can be satisfied only by full cooperation with other inhabitants of the planet, however distant they may be—geographically, politically, intellectually and culturally.

He expressed bluntly his impatience with inefficiency. It irritates him to think that we must use 15 pounds of water to get rid of one pound of waste. ("Scientists have never looked at the plumbing.") He is exasperated by the vast amounts of energy frittered away each hour as car engines idle at red lights and in traffic jams. He is irked even by the millions of beds around the world left unslept in for most of the day. The consequence of this state of affairs—so much of humanity consigned to unrelieved want—utterly appalls him.

The immediate goal before this past summer's group was to learn to play the Game themselves as demonstrated to them by Fuller. Their interests ranged from physics to art, from mathematics to anthropology, but excluded technical specialization. It was up to them to gather their own information within scientific bounds and mathematical controls. They could then make a start toward the larger goal of determining whether mankind's needs can be met with the resources available on earth.

The young participants were at first skeptical that any game could solve what generations of men and modern technology have not. But as Fuller went on, they became as zealous as he. They set a rigorous daytime work schedule for themselves, many working at home, after hours, as well. They tracked down and posted on large graphic displays all the information they needed to play out "scenarios"—where the people of the globe live, where the food supplies and mineral ores and sources of power are, what each man needs in calories. Proteins and kilowatts to maximize his potential rather than merely survive.

Up on giant grids went future trends on such critical matters as: life expectancy, mortality rate, fuel supply, arable land, housing, illiteracy, pollution, hydropower, steel production. The group's pride in these displays was clear to see. "We're making visible patterns which up to now have been invisible," one boasted. Fuller returned as the Game neared an end and was delighted.

Project coordinator Edwin Schlossberg, 24, a doctorate student in science and literature at Columbia University, summed up the group's findings. None were revolutionary, yet all provided evidence that the Game might someday, somehow be won. Their findings:

Incalculable power resources in Africa and South America are as yet untapped.

Those areas of the world with the least food have the greatest potential for population growth.

Only 10 percent of the world's total vegetable crop is now made available for human consumption.

While more than half the world now receives an acceptable "bare minimum" of 2,400 calories a day, clear progress from earlier times, the "bare maximum" is 3,500 calories. This is high to desk workers battling a diet, but it reflects the needs of pregnant women, lumberjacks, athletes and others with high-energy requirements. It is a caloric level which, say the students, would release "mental and metaphysical energy" bound to accelerate further the ongoing improvement of the human condition.

In one exciting piece of work, the participants devised a master power network covering groups of nations. Because these networks would include different time zones, the wasteful peaks and valleys of power usage now common would be leveled out somewhat (e.g., while Canadians sleep and use little power, Russians at work could draw from the shared network, and the cost to both would come down dramatically).

The summer game ended with this idyllic projection:

The minimum survival needs of all the world's people can be met within 10 years. Within 30, they can enjoy a standard of living high enough so that they will be able to pursue, at least part of the time, culture and art and education—"the riches of life."

How feasible, really, is all of this?

Might it conceivably happen?

The sharing of resources will clearly require cooperation among countries whose main objective at present seems to be mutual annihilation. The warring of nations, the starving children of Biafra, the deep-lying hates, abiding selfishness, national prides, and the sheer indestructibility of human perversity—all of these

suggest the seeming hopelessness of ever turning the World Game into reality.

Yet Fuller, called by some a "technological transcendentalist," believes—and his disciples came to believe also—that "This is not an exercise in politics. We want to have the answers ready when the politicians are in trouble and turn to us. It can work when the politicians have to make it work."

The Game is not over. The summer version intended to test the game's "feasibility," is on the way to becoming a full-scale, $16-million computerized version at the Edwardsville campus of Southern Illinois University, where Fuller is a Distinguished University Professor. His operation there, known as "World Resources Inventory," has been proposed to NASA as a repository for data collected by its earth resources satellites. This Fullerian planting in the groves of academe will serve as a clearing house of information for other universities. MIT, McGill, Columbia, the State University of New York (Binghamton), Yale and the University of North Carolina have already plugged in. ■

Our Race for Resources: Can We Win It?

As the good life expands, so too does the fear of many that the world may one day exhaust its resources; that all of us, ultimately, may fail to survive. The statistics are certainly worrisome enough. By the year 2000, water withdrawals may increase 2–3 times; food consumption will be up 3 times; fuel consumption 3 times; iron and steel consumption 2⅓ times; wood and timber consumption 3⅓ times; synthetic fertilizers over 5 times.

Can we meet this expected demand? No one can really know. Each year we hope to prove new reserves of resources at least as great as our withdrawals. But the increasing population, level of education and standard of living—escially in the developing countries—make this harder and harder to do.

Better techniques lend great encouragement, however. So does history. Contrary to the dissipation of matter and energy, scientific and engineering skills grow from within and continually expand man's abilities, his intellectual and particularly his material resources.

My personal estimate, based on considerable research and analysis, is that we need not fear exhaustion of the world's physical resources—*if* we have the political courage and understanding to develop fully and share as broadly as possible our vast technical capabilities. Clearly, we now have neither. Mr. Fuller's World Game may therefore seem, to some, only an exercise today. Yet we should all hope as devoutly as he, for the benefit of our progeny, that the Game will be played in deadly earnest in the years ahead.

Donald F. Othmer
Distinguished Professor, Chemical Engineering
Polytechnic Institute of Brooklyn (New York)

Saturday Review

March 2, 1968

Buckminster Fuller, when asked by "Who's Who" last year to write a one-sentence statement of his life objectives on the model of de Tocqueville's 152-word "aphoristic declaration," in characteristic fashion wrote the following declaration about himself:

WHAT I AM TRYING TO DO

Acutely aware of our beings' limitations and acknowledging the infinite mystery of the a priori universe into which we are born but nevertheless searching for a conscious means of hopefully competent participation by humanity in its own evolutionary trending while employing only the unique advantages inhering exclusively to the individual who takes and maintains the economic initiative in the face of the formidable physical capital and credit advantages of the massive corporations and political states and deliberately avoiding political ties and tactics while endeavoring by experiments and explorations to excite individuals' awareness and realization of humanity's higher potentials I seek through comprehensive anticipatory design science and its reductions to physical practices to reform the environment instead of trying to reform men being intent thereby to accomplish prototyped capabilities of doing more with less whereby in turn the wealth augmenting prospects of such design science regenerations will induce their spontaneous and economically successful industrial proliferation by world around services' managements all of which chain reaction provoking events will both permit and induce all humanity to realize full lasting economic and physical success plus enjoyment of all the Earth without one individual interfering with or being advantaged at the expense of another.

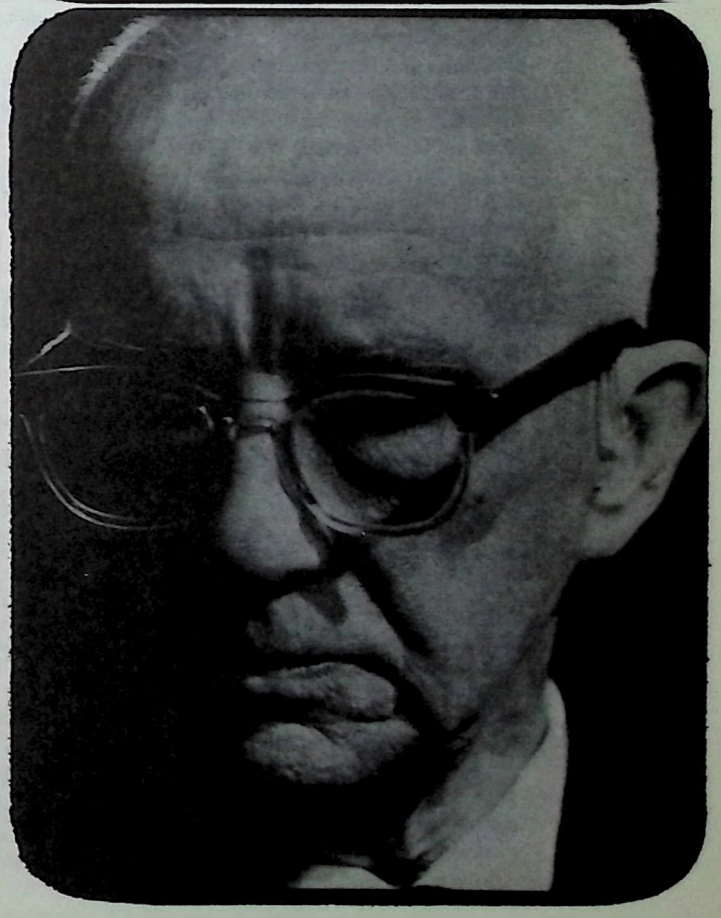
—BUCKMINSTER FULLER,
Aboard our 1,000-miles-per-minute speeding
spaceship Earth within the outer reaches of the cosmically
spiraling and expanding Milky Way,
the Galactic Nebula.

Modified from 152 to 200 words at the
location on spaceship Earth where the first man-made
atomic explosion occurred: Alamogordo.

THE REVIEW reprint
OCT. 3, 1969

THE WORLD GAME: how to make the world work

by R. Buckminster Fuller
edited by max ackerman



To some large extent most "innovations" are variations on a previous theme. Once in a lifetime, though there is an Archimedes, an Aquinas, a da Vinci, a Newton, a Darwin, or an Einstein whose thought is so startlingly fresh that its insights become an enthusiastic start for a new age of endeavour. One such man is R. Buckminster Fuller.

The "World Game" represents Fuller's ultimate faith in man's ability to discover and design objectives for realizing true concord among his fellows. The technology and resources are available to make every man on earth a success. The "World Game" as presented in the following article illustrates a computerized gaming concept through which we can make 100% of humanity a success on our Spaceship Earth.

- Thomas B. Turner, Director
Spaceship Earth Design
Science Exploration
(The World Game)

The World Game idea forsakes the political expedient of attempting to reform man and commits man to reforming his environment. This is to be achieved in such a manner as to "up" the performance per each unit of invested world resources until so much more is accomplished with so much less that an even higher standard of living will be effected for 100% of humanity than is now realized by the 40% of humanity who may now be classified as economically and physically successful. "Peace" will then be not just a catch-word, but an experienced reality, which has been assimilated and chosen as the best of all possible alternatives open to human design experience.

Society has established fundamental confidence in the reliability of properly maintained and programmed computers. The fact is that in going from here to there by some kind of transport in 1969 the most dangerous way is by automobile. Next most dangerous is by railroad, and it is safest to go by airplane. That is a new era condition brought about by the extraordinary degree of reliability of computerized controls. As a consequence much more automation is about to take place and the computers, to do the myriad tasks, are proliferating at an amazing and popularly unrecognized rate.

I propose that a great world logistics game be played by introducing into the computers all the known inventory and whereabouts of the various metaphysical and physical resources of our Spaceship Earth as most accurately represented by my cartographic projection. We would enter into the computer all the inventory of human trends.

known needs and fundamental behaviour characteristics.

Individuals and teams would undertake to play the "World Game" by developing their own theory of how to make the total world work successfully for all of humanity. Each individual or team would play his theory through to the end of his predeclared program. The objective of the game would be to explore for ways to make it possible for anybody and everybody in the human family to enjoy the total earth without any human gaining advantage at the expense of another. To win the World Game everybody must win.

If Dr. Von Neuman's "theory of games", predicated upon one side losing 100%, can be called "Drop Dead", we can call our game "Let Live".

How can we explain that during the two-thirds of a century in which we rose from less than 1 to 40% of all humanity enjoying a higher standard of living (than had been realized by any pre-twentieth century monarch), that this realization occurred despite a continually diminishing percentage of metals per each world man-a ratio occasioned by human population increasing faster than humanity's discovery of new metallic ores.

We can explain the escalated physical success only by the fact that we have produced vastly higher products, services, and performances with ever less time, energy and weights of resource invested per each accomplished unit of end functioning, within our comprehensively evoluting world-around technological complex.

All the historical concepts of economic security of dry land man are predicated on doing more with more, that is, with wider, heavier and higher walls to protect him, more and more food in ever bigger grain bins and ice-boxes, more and more money in ever bigger and more numerous banks – "secure as the Rock of Gibraltar."

"The whole is not the sum of its parts. The word synergy is unknown popularly and it is the only word that means "behaviours of wholes unpredicted by behaviour of their parts."

The doing-more-with-less technology which has now eightyfolded the numbers of economically successful humans came into being entirely within the "top secret" weapons-carrying technology of the sea, sky and space.

So the great economic change that has come about in the last two-thirds of a century has not come as a consequence of the declared policy of any of the political ideologies. To prove that statement we will employ the mathematical strategy of "Reductio ad absurdum." Let us take (hypothetically) all the machinery, engines, motors, pipes and wires away from all the countries around the world; from the Europeans, Asians, North and South Americans, Africans and Australians, and dump all that machinery in the ocean. We find that without the industrial network of machinery, within six months two billion people – (not two million) i.e. half of humanity – would die of starvation. That is how intimately the world's machinery is tied into the regeneration of human life. Since that proved to be a disastrous idea we will leave all the machinery where it now is, and instead we will (hypothetically) take away from all the world's countries, all the politicians of all and every kind of ideology and we will send them on a perpetual trip around the Sun accompanied by all their militarists. We will melt up all the guns and other weapons and stock pile the metals for manufacturing more machinery to produce goods and services for humans.

As a consequence of the politicians' removal (computations quickly indicates) that as many people as had been eating would keep right on eating but that with the international political boundaries removed – the politicians being no longer present to enforce their barrier schemes and laws – man would stop "plowing under" and instead begin shipping more food and goods freely across the borders.

Since human babies and children demonstrate an intense interest in all things in all directions from the stars to the atoms, from whales to butterflies, and from wintry indoors to summery outdoors, it is obvious that they are not designed to be specialists. If nature intended humans to be specialists, she would have delivered them at birth with a vast variety of integral equipment, for instance with one eye and a microscope attached. Nature designs all kinds of specialist

"I think we are at that critical historical moment in which we have just broken our shell of permitted ignorance and henceforth we can survive only by learning to operate in our universe in a very different way."

birds with integrally attached wings which greatly hamper the birds bobbled walking.

Humans are unique amongst all living creatures in their degree of general adaptability to all the extremes of environmental changes, which include the capability of the human to extract generalized principles from his special case experiences and his teleogical capability developed thereby to rearrange the environment, as by the generalized principal of leverage. Man is teleologically equipped to cope with and survive within extreme variations of the environment that would be lethal to any naked human or other living species. Man can put on and take off his wings and telescopic eyes.

We may conclude that human society's deliberately cultivated speclalization is unnatural and debilitating to both its group and individual welfaring and evolutionary development. We may well ask how it happened that the entire scheme of advance education is devoted exclusively to even narrower specialization.

We find that the historical beginnings of school and tutoring were established, and economically supported by the illiterate and vastly ambitious war lords who required a wide variety of highly specialized brain slaves with which to logistically and ballistically overwhelm those who opposed their expansion of physical conquest. They also simultaneously DIVIDED and CONQUERED any all "bright ones" who might otherwise rise within their realms to threaten their supremacy. The war lord vitiated their threat by making them all specialists and reserving to himself exclusively the right to think about and act comprehensively. The war lord made all those about him differentiators and reserved the function of integration to himself.

So important were the brain slaves' developing schools, as assets of the physically mighty, that they had their own sons and their henchmen's (noble's) sons attend the brain developing schools as liberal arts bachelors in order to familiarize themselves with the ramifications of this most important resource for effectively detailing the realm's capabilities, which they, the top men, would secretly integrate into the grand strategy of their realms' conquests and the guarding and maintaining of this ruling might, over the commonwealth productivity of the realms' peasantry and the latter's support of the non-productive soldiers. Then they schooled their "noble birth" sons, equally diligently, in the mastery of arms, horses and fighting men. So old and dignified by time have such brain slaves developing schools become, that their origins have been forgotten and remain as yet undiscovered by an ever more widely literate society whose often illiterate political leaders always have been assured of election through their promises to get the rich man's schooling facilities for their low-or-no income constituents.

Now, biological and anthropological scientists have discovered and verified that extinction of past biological species and human tribes always has been the consequence of overspecialization.

The extinctions are consequences of the following set of scientific facts.

"As" Nature's high energy devastations are far less frequent than her low energy disturbances of the regenerative biological life patterns. In the physical interchangings and local transformations of universe the numbers of occasions on which nature will have large amounts of energy concentrated at any one locality to effect great changes is far less frequent than the number of times she will have small amounts of energy at any one locality to effect small changes. Insects and microbes are far more frequent and numerous than are tornadoes and earthquakes.

"If we do not comprehend and behave spontaneously with the highest, most unselfish integrity, I think man may readily not make it on this particular planet."

"If humans had to purchase their many separate organs and assemble those parts into logical interfunctioning, they would never do so. All those parts had to be preassembled and unitarily skinned in and coordinately operated by multi-quadrillions of atoms in the brain which after sixteen years of practical spontaneous coordination becomes so aesthetically acceptable one to the other that as it sings, dances and smiles one is inclined to procreate with the other."

"B" When inbreeding toward greater biological specialization occurs, the concentration of dimilar genes tends to dominate at the expense of general adaptability. Specialized, ergo, generally vulnerable species may survive during long periods of low energy environmental confrontations, all the time increasing their special advantage while losing their unused general adaptability.

Inevitably however the infrequent high energy change imposing event occurs. Bereft of general adaptability, the specialist is unable to cope with the unfamiliar and overwhelming magnitude and velocity of events. Thus devastated they became extinct.

Humanity lost its physical world masters soon after World War One, when they too abandoning their comprehensive command to the world military, became extinct through their over-specialization in exclusively sensorial judgments and their brain slave scientists wandered off into the vast and utterly nonsensorial ranges of the electromagnetic spectrum's (invisible) reality.

With the old pirate masters extinct, society accepted unquestioningly the momentun of the utterly specialized educational trending. Specialization was never questioned as being other than logical, inevitable and desirable

Humans as super-specialists have now developed the atomic energy capability to blow themselves to eternity, with no integrating capability to turn the vast energies to the comprehensive advantaging and regeneration of all humanity, and thus avoid swift, self-imposed extinction.

But evolution, apparently intent to continue man's existence aboard SpaceshipEarth as its most effective metaphysical protagonist, has produced the antibody to his extinction. The anti-body to his extinction is man's invention and development (under exclusively cold warring auspices) of the electronic computers. The computers are about to make humans obsolete, as either intellectual specialists or as specialized muscle and conditioned reflex automations. The computers and automation can completely out – perform man as either specialized intellectual differentiators or as wealth producing tools which will be able to secure humanity's forward days of metabolic regeneration. The computers can work all night, at super human speeds, selecting the blues from the greens under environmental conditions intolerable to man.

So the computer will, as an enormously expanded and accelerated brain facility, enter into an omni-man-serving function altogether replacing the inadequate public policy formulations of politicians. Men will act as local managers of the computer-discovered ways and means of serving the best interests of all men for the longest forseeable ages.

The programs that the computers will select as being most favorable for all humanity will go far beyond man's ignorant ways of assessing what he "can afford". The computer will demonstrate that he can afford nothing short of the best, which is to make all the Spaceship Earth a successful developmental environment for universe-exploring man.

A study group is being formed at McGill to hold seminars and start projects to develop and promote the WORLD GAME strategy. Results of these activities will be published in the beginning series of World Game Studies in July, 1970.

Students and faculty members interested in participating can contact Max Ackerman through The Daily Office.

the Review

Published every Friday by the McGill Daily, The Review is a supplement of cultural, social and political comment.
Editor. . . . . Jack Kapica
Illustrations & Photography. . . .Charles Gurd

BUCKMINSTER FULLER

to the

AMERICAN INSTITUTE OF PLANNERS
St. Louis, Missouri, October 18, 1965

Astronauts, aviators, mariners, sub-mariners and people of all countries use and appreciate tiny transistors, because transistors do so much more, so much more reliably with so much less. So also do a myriad of invisible alloys, chemical and electro-magnetic devices accomplish much more with less. These globally interacting, invisibly operating inventions were not organized as a benevolent world revolution by anyone. But their comprehensively integrating and inter-accelerating, more-with-lessing altogether constitute:– the one revolution which is politically welcome the world around. Computers, T.V.'s and plastics are wanted everywhere.

The centuries-long subconscious more-with-lessing is now entering human consciousness as constituting a unified world revolution – as inexorable and transcendental to man's will as is an earthquake. Some speak of the revolution as "the impact of technology on society", others as "automation". Everywhere people are aware of its portentousness. Few think of it correctly as "invisible-more-with-lessing" – 99.9% of humanity look upon it only as more-with-more, and more again.

Better than 99% of all scientific discoveries, researching, inventions and their consequent industrial developments are being conducted in those ranges of the electro-magnetic spectrum which are utterly invisible to man—that is, are untunable by any of humanity's sensory mechanisms. This is also to say that better than 99% of all the environmental transformations, which are already altering, or are about to alter the lives of humanity around earth, are invisible.

The invisible 99% environmental changes affecting humanity are integral to a world embracing and universe permeating set of physical principles. Science wrought industrialization is inherently world embracing.

All the fundamental problems of today are world problems.

While the United Nations has "world housing" and other problem studying groups, there is no jointly authorized world planning with followthrough action powers.

Despite the ramifications of thought of individual planners, planning, whether it be city, state, regional or national, is essentially preoccupied only with the direct transformation of the sensorially apprehendible local environment. Furthermore, this sensorial, physical planning––even at its most comprehensive––is inherently limited to the scope of its political patrons' authority and to the scope of practical considerations familiar to or understood by the planners' respective bodies politic. This is debilitating because the fundamental problems involved relate to the accommodation of a swiftly emerging world man. While rarely advantaged by a political authority greater than a city or state, the planner (even in Federal Highway programs) may never have a patron with authority greater than that of a sovereign nation.

Planners have no mandate to realize their plans. They are only suggesters of local condition reforms which are rarely heeded. Every planner knows that "hardening of the vehicular arteries" is imminent. Manhattan Island heart of greater New York City––despite the levy of over $42,000 dollars a day parking fines (1963 figures latest available) and despite multi-thousands of parking lots and garages brimming over with a daily peak of 2 million cars and trucks and despite its comprehensive grid of one-way traffic in four-lane cross town streets and eight-lane north and south avenues––finds itself reduced often to single squiggle, trickle traffic or to long, motor heating halts. It doesn't take a professional planner to see what to do about that. Anthropologist Margaret Mead says "stop all private car traffic at highway terminals at cities edge. Institute twenty-five cent, slot operated, drive-yourself taxis for central city. Provide taxi repositioning and maintenance service with a fraction of the parking ticketers." The automobile industry, backed by national opinion of its essentiality to total prosperity, would never permit such logical planning.

Sum totally the invisibility of fundamental environmental evolution and the politically limited scope of planning consign the deliberations of professional planners, as now constituted and economically and socially accredited, to functional triviality in respect to the factors governing the volcanic eruption of the vital evolution of humanity and its omni-interacting relationships to earth and universe.

Despite the foregoing discouraging realizations, it is to be noted that the factors affecting man's environmental revolution are subject to important degrees of human control. It is discernible that the evolutionary events may be controlled in such a manner as to make them both comprehensible and satisfactory to humanity. But, controlled favorably or not, the forces of the overall trending are irresistible. We can prepare the invisible dams, catch basins, canals and distribution plumbing with which to advantage man by the invisible flood. Uncomprehended, unheeded, uncontrolled, however, the changes will occur in ways unnecessarily painful and destructive to vast numbers of humanity.

While city, state, regional and national planners have failed to cope with the prime, comprehensive problems and have been left to ameliorating local urban conditions, man's participation in fundamental evolutionary events has for long been demonstrated in the powerful but exclusively negative direction of weapons systems developments. The latter and their strategic operations are inherently world embracing. They assume breakdowns of national barriers at the time of their strategic realizations. They assume absolute emergency power to effect their ends in the swiftest and most effective manner.

There are also world-embracing peaceful undertakings such as the International Geophysical Years, but, this peaceful cooperating in high level undertakings was only subjective. It gained information for all but (with only a few minor exceptions) did not have a mandate to undertake comprehensive actions in respect to the potentially beneficial strategic information which it had so effectively harvested.

Under the momentum of world satisfaction with at least the subjective degree of international cooperation attained in the Geophysical Years, the United Nations resolved to undertake an International Cooperation Year hoping for objective technical, economic, social, and cultural achievements.

Six months ago President Johnson set in motion large scale civilian and government organization leading to vigorous U.S. cooperation in realization of the International Cooperation to be inaugurated in November of this year. However there are many spontaneously and privately initiated programs of world cooperation already underway. One of these is cited by the Cultural Division of the President Johnson's organizing committee. It is that of a world embracing, architecture, planning and engineering students' program which has the official blessing of the International Union of Architects, to which latter approximately all the countries of the world belong – without limitation by political ideology.

This world student undertaking which is now in its fourth year may well be the prototype of a myriad of further world cooperation activities. As such its motivations and strategies are of immediate interest to professional planners and may indeed indicate ways in which planners can begin to realize their most important conceptionings.

To turn the heretofore only subconsciously regenerative more-of-every advantage with less-of-every-resource revolution to highest human benefit in the shortest time with the most pleasure and satisfaction and with the least effort, pain or rupture for all, became the conscious focus of coordinated research by world around university student groups.

Identified as the Design Science Decade, the students' ten-year plan is divided into five evolutionary stages of two years each. Stage One was on exhibit in the Tuileries Garden in Paris, France for the first ten days of July, 1965 (under the auspices of the International Union of Architects' Eighth World Congress.) The students' football field sized exhibit confronted the world with the facts which have led the students to the research conclusion that human survival apparently depends upon an immediate, consciously coordinated, world around, computerized, research marshalling of the theoretically required additional inventions and industrial network integrations--for the swiftest attainment and maintenance of physical success of all humanity.

It is to be noted that while the International Union of Architects senior congress was greeted hospitably by the French press, the occurrence of its congress and their proceedings did not get dispatched over the international news wire service. On the other hand the student's Design Science Decade did receive wide coverage in the international dailies and magazine press.

Let us examine the students' arguments.

The metals in eighty percent of all the scrap of yesterday's obsolete mechanics and structures have been recovered, refined as 'pure metals' and put to work again. But the rate of discovery of additional metal ores is slower than human population increase.

Throughout the twentieth century, therefore, the metals mined or unmined have been continually decreasing per each world man. At the present moment the cumulative total of metals – mined and refined by man throughout history – is wholly employed in machines or structures which, operating at full limit capacity, can accommodate and serve only 44% of living humanity. No exclusively political act of any political system can make the world's resources take care of more than 44% of humanity.

Despite the constant increase in human population and constant decrease of metals per person, between 1900 and 1965 the number of people attaining economic and physical success by full participation in the highest standard of living

progressively developed by world industrialization--a personal standard of living and health superior to that ever enjoyed by a pre-twentieth century monarch--rose steadily from less than 1% to 40% of all living humanity. The 40% of humanity thus surprisingly grown successful, despite constantly diminishing physical resources per capita, can be explained, therefore, only by the doing-more-with-less invention revolution. The doing-more-with-less revolution has in turn been generated almost exclusively by the technology of the world's weaponry race whose ultimate objective has always been to deliver the greatest blows the furthest, most accurately and swiftly with the least effort.

The doing-more-with-less economic success of 40% of humanity accomplished in only a half century cannot be attributed to any political doctrine. It has flourished equally under opposing ideologies.

> Take away the energy distributing networks and the industrial machinery from America, Russia and all the world's industrialized countries, and within six months over 2 billion swiftly and painfully deteriorating people will starve to death.
>
> Take away the politicians, all the ideologies and their professional protagonists from those same countries and leave them their present energy networks, industrial machinery, routine production and distribution personnel and no more humans will starve nor be afflicted in health than at present.

Fortunately, say the students, the do-more-with-less invention initiative does not derive from political debate, bureaucratic licensing or private economic patronage. The license comes only from the blue sky of the inventor's intellect. No one licensed the inventors of the airplane, telephone, electric light and radio to go to work. It took only five men to invent these world transforming developments. Herein lies the potentially swift effectiveness of the world students' research revolution.

The students have no political motives. They are not supported by any political organization. As amateur design scientists, the students deal only in resource statistics, computation, inventions, schematics, drawings and models which treat with the world's industrial network growth. They deal theoretically and experimentally with man's external inanimate, industrial network organism in the same way that medical science deals with mankind's internal organism. Their design science findings may be employed alike by all political states whenever, in emergencies, the students' inventions and network integrations become as logically employable as are medical science's research 'breakthroughs'. Anticipating a broad spectrum of critical needs, the students' design science 'breakthroughs' are placed upon the, world news published, standby awareness 'shelves' in the same way that medical breakthrough techniques and antibiotics become standby.

When they are available to him, a healthy man each day eats 2 lbs. (dry weight) of food, drinks 6 lbs. of water, and breathes 60 lbs. of air. Enough food for all has always been scarce, and water sometimes scarce but air has been almost always plentiful. Where there is abundance, competition is unnecessary and unthought of. When, however, fire in a theater suffocates them, men trample one another to death in the utter panic of unaccustomed competition for air. There is nothing unnatural about competition over scarce essentials of life. There is nothing unnatural about the absence of competition in the presence of universal bountifulness of a vital resource. Though wars are usually precipitated by secondary and sloganable causes we have always had war because of the underlying fact that there was not enough to support all. We will drop war only when we have enough of all essentials for all humanity.

Science and engineering say that design science's peaceful accomplishment of 100% industrialization and its comprehensively bounteous support of man is eminently feasible. It is feasible because the world's economy is now operating at the appalling low overall "mechanical efficiency" level at which only 4% of the energy consumed is realized as effective work. Reciprocating engines are 15%, turbines 30%, jet engines 65% efficient. Efficiencies of 72% in atomic reactors – employing their by-product heat in de-salination and up to 80% in fuel cells are now everyday design realities. Increasing the overall mechanical efficiency of the world's prime movers and machinery to only 10% from the present 4% will result in 100% of mankind being benefited by higher living standards than the present highest.

It will be well if the American Institute of Planners takes official cognizance, not only of the magnitude, nature and imminence of the "critical massing" point acceleratingly approached by world trends, but also it will be well for the American Institute of Planners, at this strategic moment in history, to take advantage of its national meetings' plennary session authority to vote (a) for the resolution given below, and (b) to participate actively in the International Cooperation and Planning as demonstrated by the International Union of Architect's world students' Design Science Decade.

When President Eisenhower was first confronted by the strategic data on atomic warfare he said, "There is no alternative to peace" but did not define the latter or indicate how it could be secured. Professor John R. Platt, Chicago University physicist and biophysicist in a thorough survey of the overall shapes of a family of trend curves which comprehensively embrace science, technology and man in universe, said in 1964, "The World has become too dangerous for anything less than Utopia," but did not suggest how that might be attained. Jerome Wiesner, head of the department of Nuclear Physics at the Massachusetts' Institute of Technology and past science adviser to Presidents Kennedy and Johnson, writing in a recent issue of the "Scientific American" states, "The clearly predictable course of the arms race is a steady downward spiral into oblivion." So far the only known and feasible means of arresting that spiral, by elimination of the cause of war, is that of the World Students Design Decade. Let us at least give ourselves a chance to

commit ourselves cooperatively for the Design Science Decade type of attaining Utopia for it is clearly and only to be —— and sooner than can be anticipated, ——either Utopia or Oblivion.

(It has been noted by recent congresses of architects that their professional employment pattern is bulging in the direction of regional and town planning and vice versa; regional planners are of necessity increasingly drawn into architectural undertakings. It has been noted also that architecture is trending swiftly toward general environment controlling problems. Recently the University of California's Department of Architecture was renamed and enlarged under the title "College of Environmental Design." Environmental design has also brought architecture into the realm of general ecology, while again (vice versa) bringing ecologists and anthropologists into the general curricula of architectural schools as well as into consultation by practicing architects. As a direct part of the same trending, the most recent world congresses of professional geographers noted an importantly increasing trend of their employment in regional and town planning activities.

With the world-around building of the next score of years doubling that of all history before us and the architects' work already deployed through modern transportation and communication, architectural offices which yesterday found themselves for the first time occupied in the design of buildings outside of their home territory are now being retained to build all around the world. The world-around architectural undertakings are trending from one building undertakings to design of whole new towns and regions. Ergo – the increasing needs for geographers, ecologists, geologists, climatologists, sociologists, international economists, et al.

Furthermore, the astronautic, defense, social welfare and health subsidies of major nations, now going increasingly into behavioral science researches, have brought discovery by behavioral scientists of the profound effect of environment upon human behavior. It has been found for instance, that 80% of the capacity to improve I.Q. has been brought into play before seven years of age and that the probability of becoming a success in higher education vs. becoming a 'drop-out' is now undoubtedly attributable almost in entirety to the environmental factors of the first seven years of life. This has drown the architects' environment controlling knowledge and designing capabilities into close couple with the behavioral scientists' research and development work. Lastly, the close couple of architecture and engineering has long been obvious. Architecture is now being joined with advanced science.

The foregoing progressive integration of professional art and science activities has inaugurated a unifying trend in advanced architectural research towards preoccupation with general systems theory. The importance and power of general systems theory as applied to contemporary large scale planning problems becomes ever more apparent as the adequacy of private or public client opinion,—— as the design authority, dwindles and is replaced by joint private and government undertakings in which large teams of scientists and humanists now collaborate as the, computer informed, prime clients.

Ergo: It will be appropriate to introduce a resolution by the American Institute of Planners similar to one introduced and adopted by the Resolutions Committee of the International Union of Architects at their VIII World Congress held at Paris in July, 1965, which resolved that the U.I.A. recommend to the national architectural societies, comprising the world-around official membership of the U.I.A. that the national societies in turn recommend curricula changes in their university architectural schools; these changes to be adopted by the national architectural societies' professional accrediting boards, whereby, in addition to the presently established set of architectural disciplines, an important new percentage of the architectural curriculum be devoted, firstly, to general systems theory and, secondly, to acquisition by the architectural students of ecological geographical, behavioral and industrial economics capabilities and understandings.

The wisdom of such a recommendation will become ever more apparent as the emerging nations and the lesser developed older nations find that their economic well-being is vitally dependent on their becoming integral participants in thw world's industrial network. The emerging nations bid foir to become the major clients of the world's architects and planners.

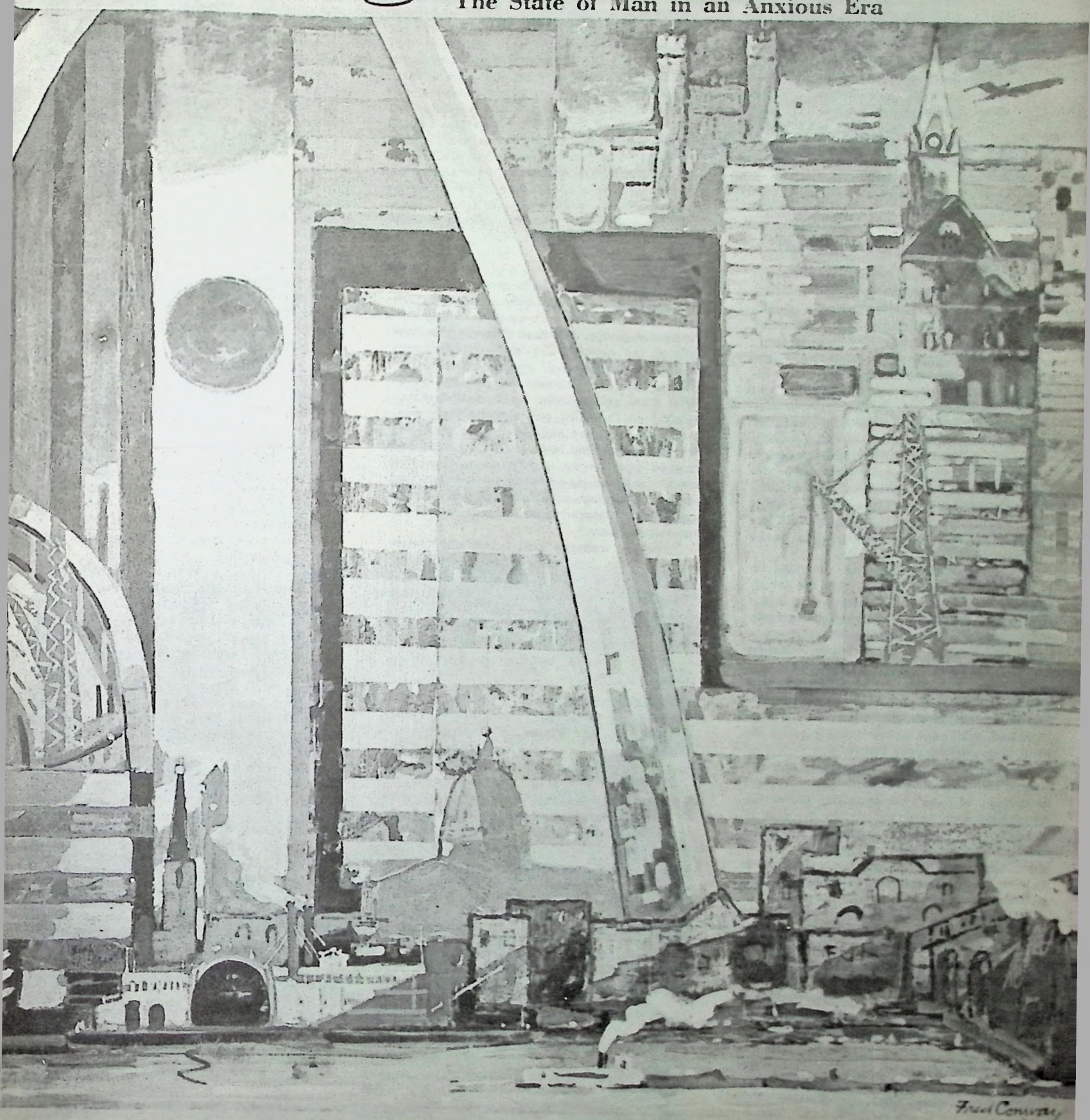
Agriculture, fishing and craft permit non-industrialized survival in isolation only when geographical, geological and ecological circumstances are propitious. These conditions of independent survival are not characteristic of the emerging lesser developed nations whose lesser development was initially accounted by their low yield environment.

Participation in industrialization cannot be exclusive due to the idiosyncrasies of the world's industrial resource distribution. For example, Ghana is rich in manganese -- with no iron or coal it cannot make steel, without this developed capability manganese is just so much useless geography. To be useful the manganese will have to be exported to steel making countries. Ghana's bounty of bauxite plus the Volta Dam power will make more aluminum than Ghana can use. This too must be exported. Both will bring Ghana buying power to participate in the industrialization. Altogether, this means intimate tie-up of all countries with world industrialization.

At the present point of development of the world industrial network, no one nation is or can be wholly self-sufficient in those resources necessary to sustain the full industrial process. The evolution of industry has merged cities, states and nations into complex networks. Full industrialization ultimately requires complete integration of world resources effort and wisdom. Industrialization is successful in direct proportion to the number served. As automation reduces man's participation in industry as a producer it increases his importance to the total systems economic efficiency -- as a consumer. The larger the system the more economically it functions -- this portends comprehensive world network integrations withever greater benefit for all.)

Challenges and Choices

The State of Man in an Anxious Era



A SPECIAL SUPPLEMENT

ST. LOUIS POST-DISPATCH

SEPTEMBER 26, 1965

The inventor of the geodesic structure describes a translucent, air-conditioned shell, one mile high and two miles in span, that could rise protectively over mid-Manhattan

The Case for a Domed City

By R. Buckminster Fuller

There are persuasive arguments in favor of cities under single umbrella shells. Whether the economic advantages can overcome the antievolutionary inertias of large social bodies is, however, questionable. When whole new human settlements are to be installed on virgin sites as, for instance, on the Antarctic continent, the doming-over may be realized. The doming-over of established cities in the moderate climates will probably not occur until domed-over cities in virgin lands have proved successful enough to persuade the established cities to employ comprehensive umbrellaing. The established cities will probably not adopt the doming until environmental and other emergencies make it imperative.

A number of advantages are provided by domed-over cities. First is the advantage accruing exclusively to energy quantum changes inherent in size changes and growth rates. When we double the diameter of a dome, its surface area increases fourfold and its volume increases eightfold. This also means that the number of molecules and atoms of the gases of the atmosphere inclosed by the double size dome is multiplied eightfold, while the number of atoms of the shell is multiplied only four-fold.

Variations in atmospheric temperature are caused by increased motion and resultant crowding of the atmospheric molecules. Therefore, each time we double the size of a dome, the amount of surface of the dome through which each molecule of interior atmospheric gas could dissipate its heat is halved; also, the number of molecules able to reach the surface in a given time is halved.

We can say that the larger the dome, the slower the rate of energy loss as heat—that is, when the heat is greater inside than outside; conversely, when the exterior heat is greater, the larger the dome the lower the rate of energy gain as heat from outside is received and transmitted through the dome's surface to the gaseous molecules inside the dome.

The energy conservation of a closed local system improves twofold each time the system's linear dimensions are doubled. This principle is demonstrated in stars and in icebergs. Icebergs can melt only as fast as they can import heat from their surrounding environment of air and ocean through the surface of the iceberg. The larger the iceberg, the lower the ratio of surface area to its volume or mass. However, as icebergs melt, their mass gets smaller at a mathematical velocity of the third power while their surface area decreases only at a velocity of the second power. This is to say the volume decreases much more rapidly than does the surface area, so, as icebergs get smaller, the amount of surface area for each unit of volume of its interior mass increases at an accelerating rate.

Therefore, icebergs melt faster and faster and when the final piece of ice dwindles to pea size it can be seen, by the human eye, to accelerate to extinction. Due to the principle of energy conservation improvement with size, the larger the domed-over city the more stable its atmospheric conditions become, and at ever-decreasing cost per unit of volume.

A second advantage also relates to relative surfaces. When we wish to design a good air-cooled gasoline engine, we design it with many fins, as with the typical motorcycle engine. The greater the external surface the more effectively will the heat be conducted from the small interior to the large exterior surface. Though it would be impractical from a service viewpoint, the surface of the air-cooled engine could be further increased by modifying the same amount of metal, used in the fins, to take the form of spines or spindles like the quills of a porcupine.

If one looks at an aerial photograph of Manhattan Island, New York, there is seen just such a spined, or spindled, high-speed cooling system. The energy consumed by New York City to heat it in winter and cool it in summer is employed in a structural system that operates most effectively in the swift release of the energy to the surrounding atmosphere. There is no structural method of inclosing the circulation space of the city's dwellers that is more effective in wasting heating and cooling energy than that structural system employed by New York and other skyscraper cities of the world. Spheres inclose the most volume with the least surface and, as we have seen before, the larger the sphere the lower the ratio of surface atoms to inclosed atmospheric atoms.

A dome over mid-Manhattan, reaching from the Hudson to the East river at Forty-second street, on its east-west axis, and from Twenty-second to Sixty-fourth street on its north-south axis, would consist of a hemisphere two miles in diameter and one mile high at its center. The peak of the Empire State building's television tower would reach only a third of the distance from the street to the domed surface above it. The total surface of the dome is just twice that of the base area of Manhattan that it would occupy.

A cube has six square faces. If we build a cubical building on a square of land, five of its six faces are exposed to the air. If we build a square-based building, two cubes high, the exposed vertical and top surfaces of the building are exactly nine times the area of the land occupied by its base. If the building is 10 times as high as the edge of its square base, its exposed vertical and top surfaces are 41 times the area occupied by its base. If 20 stories high, it is 81 times the base area.

Using such calculations and taking an inventory of the building heights in each of the city blocks of midtown Manhattan that

R. BUCKMINSTER FULLER, the engineer-scientist-designer who invented the geodesic dome, has been offering dramatic environmental innovations since 1917, from a one-piece die-stamped bathroom to a plan for a mile-high roof over midtown Manhattan. The web-like geodesic dome, light and strong, has been Fuller's most eminent contribution and thousands of them have been built in all parts of the world. Fuller is associated with Southern Illinois University, Carbondale, where he lives in a geodesic dome.

Art by ARTHUR OSVER

would be covered by the dome, we find that the total surface of the dome is only one fiftieth of the total exposed surface areas of the buildings which it would cover. The energy losses of midtown Manhattan, under such a dome, would be reduced approximately fiftyfold and the energy lost through the building walls, during both the heated winter and air-cooled summer conditions, would not be lost to the outer atmosphere but lost only to the controlled interior environment of the dome, and therefore could not be considered as lost. We have already learned of the extraordinary energy conservation of big domes, so that the very moderate temperature level the dome would be effectively maintained, with energy savings to the city and its inhabitants of probably better than 90 per cent as against the undomed conditions.

The cost of snow removal in New York City would pay for the dome in 10 years.

Studies made at the Snow Institute of Japan and by Mitsubishi Co. (the General Electric of Japan) indicate the cost of heating the surface of the domes. With electric resistance wires bedded in the skin, to maintain a temperature sufficient to melt snow and ice —with the electric heat turned on only during the time of snow and ice formation, for cities in the snowfall magnitude of New York—would be far less than the cost of amortizing the expense of the additional structure necessary to support the cumulative snow loads throughout the winter months.

When rain falls on New York City and its counterparts around the world, it runs down the buildings into the streets, then into the gutters and on to the sewers to be polluted with all the other waters. Year after year New York and other cities have suffered water shortages, though they are deluged with summer thundershowers when enough water falls to take care of the city for days. With a domed-over city, both the melted snow water and the rain would run neatly to a guttering, clear of the pollution of the streets, down into a canal around the dome's lower rim from whence it would flow to great collecting reservoirs. There would be enough altitude in the dome to cause the water to flow gravitationally back to the storage reservoirs in Westchester.

Because the energy losses would be so greatly reduced for the covered portion of the city, the heating and cooling could be handled most economically by electrical energy wired in from generators, far from the domed-over city. A new ultra-high-voltage electrical conducting system will soon bring New York electrical energy, by wire, all the way from the Pennsylvania Hills, where the coal is to be mined and burnt in steam-driven electric generators at the mine mouths. This will eliminate all fumes from the atmosphere covered by the dome. The dome would also be able to umbrella away the fumes occurring outside the dome and originating inside the satellite industrial areas.

Those who have had the pleasure of walking through the great skylighted arcades, such as the one in Milan, Italy, are familiar with the delights of covered city streets in which it is practical to have outdoor restaurants and exhibits. They will be able to envision the arcaded effect of a domed-over city in which windows may be open the year round, gardens in bloom and general displays practical in the dust-free atmosphere. The daylight will be bright inside the domes, without direct sun. All the part of the dome through which the sun does not shine directly will be transparent. These domed-over cities in the northern hemisphere will have the southern part of the dome, which receives the approximately perpendicular rays of the sun, protected in summer by polarized glass so that the dome will not gain heat during the sunny hours. In the winter the sun will be allowed to penetrate, to impound the sun's energy.

The Fuller dome, as it would appear if installed over central Manhattan island

"In a domed-over city, fumes will be eliminated from the atmosphere, windows may be open the year 'round, gardens in bloom."

Structural calculations on the two-mile dome for mid-Manhattan indicate that the individual structural elements would have a girth less than that of the masts of the S.S. Queen Mary. In the accompanying picture of this dome, hypothetically imposed on an aerial view of Manhattan, the Queen Mary is to be seen through the lower left part of the dome, lying at her dock at Fifty-eighth street and the Hudson river. The smokestacks of the ship can be discerned but the masts, which are just a fraction of the diameter of the funnels, are invisible from the height of the photographing airplane. For the same reason, the structural members of the dome also are invisible. They are as invisible as are the wires of a screened-in porch when viewed from 100 feet distant. For this reason the appearance of the dome would be as seen in the picture—that is, as a glistening translucent form. One would get the same effect if he photographed an ordinary kitchen wire strainer, turned upside down and placed 100 feet away.

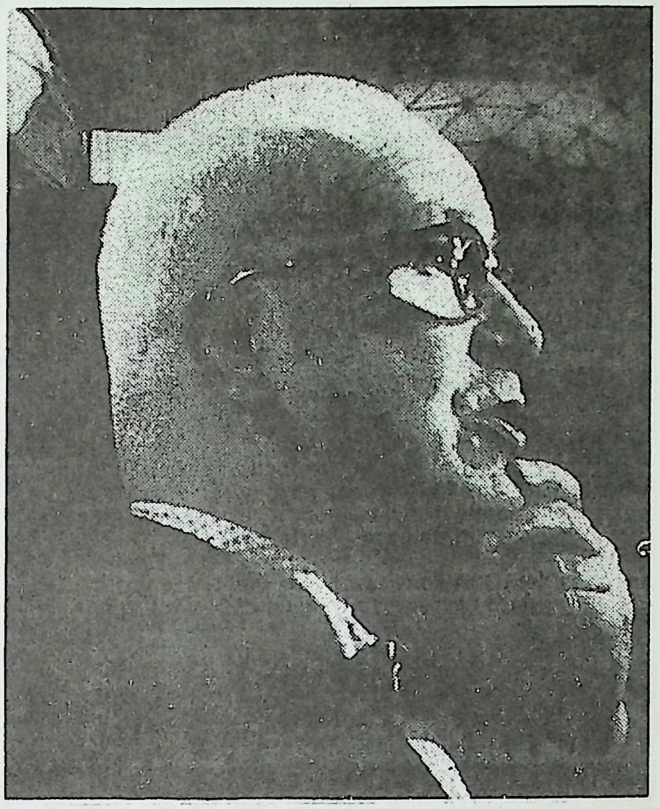
Such a shielding dome would also, very effectively, exclude the sound of passing jet planes. The lower edge of the dome over the city would be at such a height above the city as to make it appear as a high umbrella, with plenty of blue sky visible under its rim. The dome would appear from below as a translucent film through which the sky, clouds and stars would be visible. It would not create a shut-in feeling any more than carrying a parasol above one's head on a summer day.

The dome's skins, consisting of wire-reinforced, one-way-vision, shatterproof glass, mist-plated with aluminum, will have the exterior appearance of a mirrored dome, while the viewer inside will see out without conscious impairment. This will cut down the interior sunlight to a nonglare level. Most importantly, such domes would provide a prime shielding against atomic radiation fallout, reducing the radiation effects of neighboring regions' atomic explosions to below lethal or critical impairment magnitude.

City-covering domes of prestressed and poststressed steel and concrete could be made so powerful that they could be covered with earth and become man-made cave mountains, completely air conditioned. When such large domes are made the captive atmosphere in itself is enough to support the structural shell, as does a large pneumatic tire. The larger the dome, the lower the pressure necessary to carry a given load. With such very large domes, the air introduced with the air conditioning would keep up the shell-sustaining pressure.

Nature's 'Extraordinary' Order

'I look for what needs to be done and then try to work out how to do it best. After all, that's how the universe designs itself,' R. Buckminster Fuller remarked during an interview.



R. Buckminster Fuller, Designer-Engineer

By Robert Colby Nelson

Chief of the Midwest Bureau of The Christian Science Monitor

Chicago

RICHARD BUCKMINSTER FULLER flipped his pen through the air. It fell to the rug, rolled, and stopped. "You see," he chortled, "nature knew just what to do." For nearly 40 years, designer-engineer Fuller has been mentally probing the universe to discover just what nature is doing. He calls it "theoretical prospecting." It leads, he says, to an appreciation of the way nature plays the game.

His intuitive probings have evolved a unique philosophy of engineering design. They are embodied in practical achievements that testify to his genius.

Implementing inspiration with a dazzling grasp of the laws and applications of mathematics, engineering, and design, Mr. Fuller has, for example, conceived the famed geodesic dome.

These structurally durable domes, with their webbings of octahedral or tetrahedral patterns covered with various types of skin, have become familiar as housing for radar installations, restaurants, railroad repair shops, fair pavilions, and mobile military facilities.

"I saw the industrial era operating fundamentally differently from the periods of hunting and fishing, farming and crafts," he explained. "Industry deals with the whole world — all men, all experience, and all resources."

This theme of comprehensiveness recurs throughout his writings and comments. Indeed, Buckminster Fuller calls himself a "comprehensive" designer.

Design Revolution Asked

His comprehensiveness is also evident in his call for a world design revolution. It is a revolution, he contends, that is "taking the place of political revolutions."

From his professorship of design science at Southern Illinois University, he recently launched a "world redesign" project which begins with an inventory of world resources, human trends, and needs. The International Union of Architects has adopted the "world redesign" plan as a 10-year program to be carried out by architectural students at universities throughout the world.

Mr. Fuller's object is to "discover new ways to make more and more out of less and less material — to redesign everything that man uses — so that 100 percent of the world's people can have their basic needs fulfilled."

He says that the architect is the best qualified person to utilize all the tools of science and industry for the development of new concepts in producing and structuring the things needed for mankind's benefit — housing, transportation, communications, utilities, clothing.

"Only 44 percent of the world's population now enjoys the benefits of modern industrialization," he says, "yet the per capita physical resources of the world — its metals, minerals, and other strategic elements — are continually diminishing because the people are multiplying faster than new and additional resources are being found."

'The Universe Is So Successful . . .'

Only a design revolution, he says, can improve such fundamental criteria as performance per pound. "I propose," he says, "that architecture and engineering become completely anticipatory."

"The universe is so successful, I simply want to learn its principles and to apply them rather than to exploit it blindly and fear for survival," he adds.

But to really begin to understand and appreciate the work of R. Buckminster Fuller one must look to the thoughts rather than the things of his making.

His domes, his dymaxion (a blending of the words "dynamic" and "maximum"), houses, maps, and car, are merely the outward manifestations of his inspiration. It is an inspiration often expressed in terms and concepts of his own making.

Gravity Called Tension

For example in thinking about structural forces, he finds that "nature prefers to view compression in the form of islanded spheres" within what he terms a "comprehensive tensional system such as the solar system, whose planets are held together by gravity, which is tension."

He notes that "compressional structures such as Greek columns, masts, and trees are limited in length in respect to their cross-sec-

tional diameters. Greek stone columns are limited to heights which are only eighteen times their diameter. Tensional relations are unlimited in length to cross section. . . ." Speaking of the invisible forces of gravity, he observes, "The moon-earth tension has zero section."

Mr. Fuller believes that "tension is the great integrity" that gives coherence to the structure of the universe. "Tensegrity," is his word for it.

By this he means the ever-increasing capacity of materials to be flexible without breaking, "to give," to demonstrate high strength-to-weight ratios as they support structures — as with great bridge cables, or the fibers of a palm tree, or lightweight but extremely strong modern tensile metal alloys, plastics, and glass. Tension, to him, is a dimensionally unlimited principle.

'An Extraordinary Order' Disclosed

Ponderings such as these mark Mr. Fuller's restless tracking of the world around him.

"In 1927 I started everything I'm doing," he explains. "I asked myself if there was an intellect greater than that of man. Not out of what I'd been asked or taught to believe, but out of my experience, I knew there was. That quite clearly to me was in contradistinction to the popular words that the scientist wrests order out of chaos.

"I knew from having read the actual work of people who have made great discoveries that every one of them started with a working assumption that was really very crude and chaotic but made a discovery of the behavior of nature which disclosed an extraordinary order.

"These discoveries have been made on a number of levels, relative to the atom and then molecules and cells, gravity and the microcosm. The instruments with which observations are made have continually increased in their power so the range of observations is increasing.

"And as they do we are beginning to find the orderliness overlapping, whereas in my early days the sciences were thought of as being very different, dealing with utterly different parts of the universe with no relationship whatsoever. They are now beginning to see that the orderliness is associated and joined.

Intellect Called Key to Discovery

"And when I came to order and principle, I said a principle has no beginning or ending or it isn't a principle. Therefore, there seems to me to be an a priori order and very complex order.

"I don't know just how complex this basic game is but every one of its principles is pure, weightless, and discoverable only by intellect. The principles and intellect are alike anticipatory. That is, nature is never caught unprepared.

"Understanding that this intellect which is anticipatory, comprehensive, and a priori deals with principles which are limitless while man is inherently limited," he went on, "I realized that the intellectual integrity and infinite order of the universe obviously is vastly greater than man. Man is an invention within it. I became utterly convinced then of the existence of an intellectual integrity greater than that of man.

"Then I came to my next philosophic decision, that what one did about this understanding would have to be through design. That if I was to affect a lot of other people I would have to design something utterly impersonal.

"I won't have time to go around trying to reform people, I decided, so I had better design something like a pencil, say, so that when they need to communicate they will have this thing handy. I must reduce my understanding to some rearrangement of the environment instead of trying to reform the man.

"I decided to understand man in terms of what he can do rather than what he cannot do as outlined by so many limited beliefs. I respect all religions and every other human being. But I decided my kind of understanding of a supreme intellect needed no proselyting. I decided I must not be a persuader, but a doer."

Mission for Designer Suggested

The world-redesign project beginning in 1965 epitomizes the comprehensive "doing" of Mr. Fuller.

Specialization, he contends, has led man into a kind of slavedom and "now we're going to have to break out of that slavedom. The stage is now being set. The environment is going to force us back into being comprehensivists.

"Which brings me back to my earliest thoughts: that you can design ways of handling environment in such a manner as to increase the degrees of freedom of man while freeing more of his time for investments of his own choosing. You can reform the environment instead of reforming the individual. And then the individual will really adapt himself — you bring back his general adaptability."

Mission No. 1 for the world's designers, he says, is to "provide new and advanced standards of living for all peoples of the world."

A marathon thought delivered before the Faculty Club of the Massachusetts Institute of Technology in 1950 puts the terms of this priority in somewhat labored but, if taken bit by bit, illuminating Buckminsterian prose.

'A Continuity of Roofs . . .'

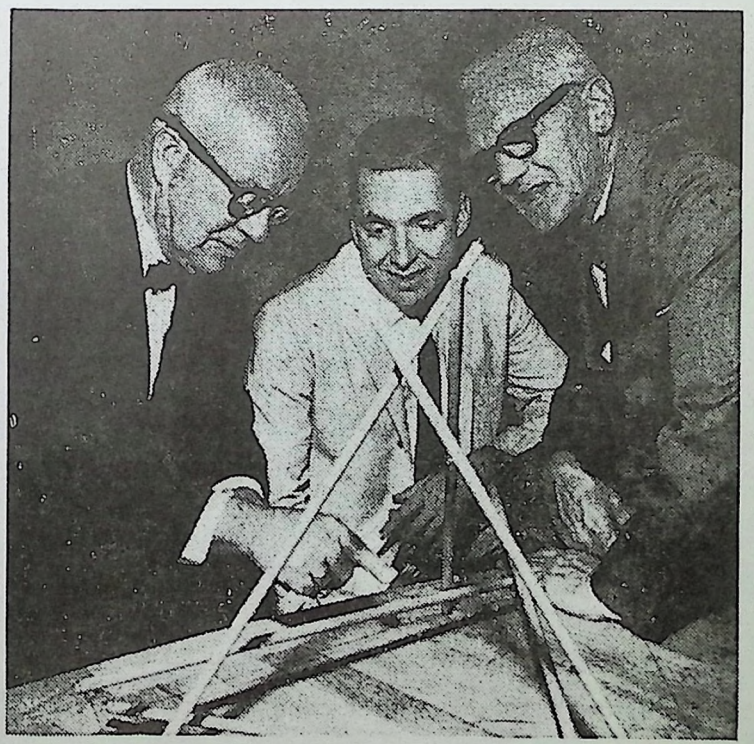
"He [the designer] must progressively house and rehouse 2¼ billion people in establishments of advanced physical control. The mechanically servicing sheltering must be a continuity of roofs, stationary and mobile, sufficient to allow for man's increasing convergent-divergent interactions of transciency or residence, of work, play or development. . . .

"The logistics of this greatest phase of industrialization must impound cosmic-energy wealth, within the inventory of 92 elements, to magnitudes, not only undreamed of, but far more importantly, adequate to the advancing needs of all men."

"Implicit," he concluded, "is man's emancipation from indebtedness to else but intellect."

To R. Buckminster Fuller, these realizations are merely part of getting to know the universe, learning its "game," as he puts it.

"If you know something about your game," he concludes, in a precise footnote to his own experience, "you dare to look ahead."



Fuller Discusses Design

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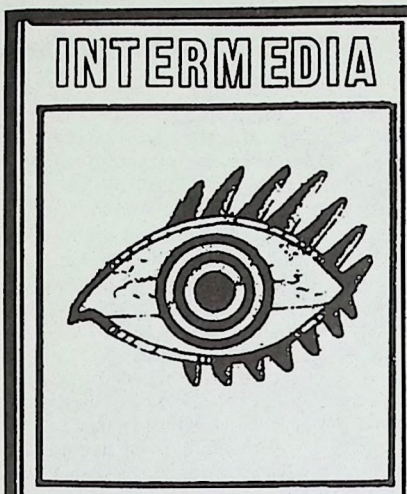
INTERMEDIA



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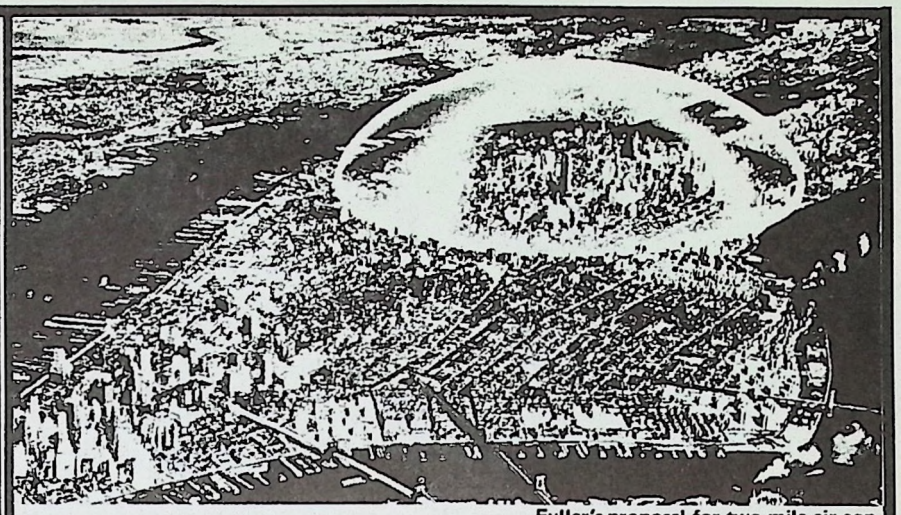

Fuller's proposal for two-mile air conditioned geodesic dome over midtown Manhattan.

I travel around the world a great deal, and everywhere I hear humanity saying, "We are not against any other human beings; we feel the world ought to work properly." Everywhere they say it's our politicians that get us into trouble. This is the majority viewpoint all around the earth today. — R. Buckminster Fuller

GENE YOUNGBLOOD

A concrete scientific alternative to politics now exists. For the first time in history it is now possible for society to shape its destiny completely outside the realm of political activity as we know it. Even the remotest possibility of a true alternative to politics should be sufficient motivation for each man to discover for himself whether or not it exists. But Buckminster Fuller's World Game is far beyond the planning stage. It is presently under way at Southern Illinois University, where a $16 million computer complex is being constructed to serve as World Game headquarters.

There, at the site of Fuller's World Resources Inventory, a football field sized map of the world will be stretched out horizontally in the center of a huge arena some 600 feet long and 400 feet wide. From two levels of balconies approximately eight to ten floors above the map, viewers will be able to see the entire earth's surface simultaneously without any visible distortion of the relative size and shape of the land and sea masses. This huge cartographic Dymaxion projection of the earth will display the continents arrayed as one world-island in one world-ocean with no breaks in the continental contours.

The great map will be wired to serve as a giant visual display surface for information from a battery of high-velocity digital computers with megabit capacities approaching four million bits each. The computers will be located beneath the map in subterranean chambers, or in special structures adjacent to the display arena. The map's surface will be activated by the computers to show proportional data regarding the planet's raw and organized resources, world conditions and events, together with the history and trending patterns of world people's movements and needs. Remote viewing and operating consoles will be situated throughout the double balconies for personal interaction with the computers and their visual displays.

While the Illinois complex will serve as the central brain, World Game extension groups are being established at universities, colleges and centers all around the world. They'll be equipped with remote-control viewing and input/output subsystems linked with the central World Game Inventory. (I'll be conducting one such group next year as a faculty member of the California Institute of the Arts.) With this network of ultra-sophisticated technology, a giant world logistics game will be played by individuals or groups all around the world, using a series of computer programs based on principles of Game Theory, General Systems Theory, input/output theory, etc. Called "The World Game," it is basically a reversal of Dr. John Von Neuman's widely-used Game Theory of military strategy, such as practiced in the computerized brain trusts of the Rand Corporation and the Pentagon.

Militarists attempt to pre-experience the probabilities and consequences of world war by using Von Neuman's Game Theory in terms of optimum logistics and ballistics presently available. Game Theory is always played on the axiomatic assumption that it's either "them" or us, that there's not enough world resources to support humanity, and therefore only the fittest survive, armageddon is inevitable. (This is the only reason sovereign nation-states exist in the first place.) According to Game Theory, someone must lose. The name of the game is Divide and Conquer.

According to World Game, no one loses. The name of this game is United We Stand. The World Game is mankind's first historical attempt to solve whole-earth problems, not just local ones (because no problem is exclusively local), and on a scale previously available only for war gaming. The object of the World Game is to make the world work successfully for all human beings. "The objective," Fuller explains, " is to explore for ways to make it possible for anybody and everybody in the human family to enjoy the total earth without any human interfering with any other human and without any human gaining advantage at the expense of another. The programs that the computers will select as being most favorable for all humanity will go far beyond man's ignorant ways of assessing what he 'can afford.' The computers will demonstrate that he can afford nothing short of the best, which is to make spaceship earth a successful environment for man. If anyone playing the game employs ideological biases and attempts to enforce the dominance of one by another, that player will be disqualified. The game must be won by peaceful means, by the use of intelligence and proper use of our resources. The players will not compete. They will engage in cooperative exploration to see how all humanity can win a successful, pollution free life."

Fuller asserts, after fifty years of study, that science has proven this possible. He asserts also that world history during these seventy years of the 20th century has proven that mankind increasingly accomplished more with less, thus nullifying the universally-accepted Malthusian dictum that there's not enough to go around, that we must survive by a system of economics of scarcity. Fuller points to the fact that humanity has progressed from one per cent living in appreciable health and comfort in 1900 to forty-four per cent currently living at a higher standard than ever before—while at the same time the earth's physical resources have been steadily decreasing. Since this was not the objective of any na-

tion, it is obviously the result of science and industry doing ever more with ever less.

For fifty years Fuller has been compiling an inventory of world resources, both physical and metaphysical. For the past two decades he's had a large staff and computer facilities, and the World Resources Inventory has become the world's most comprehensive collection of information about the status of planet earth. (A partial cross-section of this information is available in the six-volume set of "World Design Science Documents," published at Southern Illinois University.) It includes all the known amounts and locations of the physical resources of earth, their rates of consumption and regeneration, as well as all the metaphysical resources as represented by mankind's ideas, concepts and theories throughout history. It contains trends, known human needs, fundamental behavior characteristics as determined psychologically, anthropologically, ecologically and sociologically. It includes trends in population growth, population migration, birth and death rates globally, all political events, trends and consequences, all socio-economic developments around the whole earth.

In addition, the World Game now has access to all information from NASA's meteorological planet analysis and earth resources satellites. Equipped with special high-resolution 5000-scanline TV cameras in relatively low orbits, the satellites yield pictures equivalent to 100 feet above ground. (Higher resolution is possible but some countries complain of "invasion of privacy.") Sensors aboard the satellites are able to pick up unique electromagnetic and thermodynamic frequencies, and thus can recognize the specific temperature of different types of woods, flesh, furs, metals, etc. The satellites have been identifying, locating and counting the number of beef cattle grazing around the earth. Other sensors have been able to tell exactly what and where the living grain crop is. For the first time in history, world man can learn exactly where both his shifting and fixed resources are, and in the digital computer he has a brain capable of storing and retrieving this information on a scale impossible for all of humanity to match.

Not only does the World Resources Inventory show where all the people on earth are located and how they're moving about, but the total weather pattern as well. The total weather pattern will be correlated with the total crop pattern. We will know where the rains are, where the cattle and crops are, and how the weather may eventually be guided to insure the crops. The inventory includes world food production per year in metric tons, locally, nationally and globally. It shows the entire coal and iron resources of the earth and their rates of consumption. (A typical finding of the World Game is that there's more tin above ground in the United States than there is underground in the rest of the world.) You can learn the total tonnage of fibers produced per year, globally or locally, broken down into kinds of fibers. The inventory shows how many persons in Africa and Asia own radios, television sets and appliances. Trends show total energy consumption, electrical and thermal, around the whole globe.

Armed with this arsenal of constantly-updated information about the world's wealth, dedicated revolutionaries around the globe will set out to render politics obsolete as they disclose methods to make the whole earth successful by playing the World Game. Humans everywhere, from students to scientists—disenchanted with politics yet finding no solution in violent revolution—will discover a direct and constructive mode of activism in the World Game. Global information is the natural enemy of local government, for it reveals the true context in which that government is operating. Global television is directly responsible for the political turmoil which is increasing around the world today. The Nixon administration senses this and is beginning to react, but it's too late. Television makes it impossible for governments to maintain the illusion of sovereignty and separatism which are essential for their existence. Television is one of the most revolutionary tools in the entire spectrum of technoanarchy. World Game players will make dramatic use of television all around the earth.

The Game will proceed in the following manner: with the hardware and software described above, coded displays of world problems will be viewed singly or in relation to one another, and will permit retrospective viewing of past historical and present trending patterns. Various trends will be extrapolated and compared in future time increments. On the basis of this totally comprehensive time/energy continuum, players will formulate World Game "moves" in terms of variable solutions to the problems based on availability and development of resources at present and in the future, always doing more with less. A move which does not accomplish more with less will be considered invalid. These solutions will constitute individual "sessions" or playings of the game, but they'll never be added up or offered as "answers." Instead they'll be reinserted into the computers where they'll be evaluated against the many other incoming solutions. The game will never end. The overall program simply will be continually modified to accomodate mankind's increasing metaphysical wealth as represented by World Game solutions, which in turn will mean greater control over our physical destiny without resorting to ideological premises.

A branch of the World Game effort will be devoted exclusively to disseminating its findings to the communication channels of the world—the intermedia network of television, radio, newspapers and magazines—in ways which will dramatically relate World Game discoveries to political and social events occurring simultaneously. For example, it will be possible to prove with undeniable scientific accuracy that a food shortage in a particular section of India was the result of this or that political maneuver. It is expected that within five to ten years the World Game will have attained such a high degree of analysis and evaluation that the entire physical and metaphysical events of the day may be explained and solutions offered on a daily basis concurrent with the evening news.

Fuller: "Politicians are going to confess the obvious —that no human beings can keep in mind all the special interests of all people and all the whereabouts and unique behaviors of all the resources of earth. No human beings can persuade other people to behave in unfamiliar, untried ways, but the computer can integrate and disclose the critical information and be completely convincing... As the World Game is played progressively it will disclose a myriad of politically untried, unprecedented yet effective ways of solving hitherto unsurmountable problems. These will become big news items of the world's press and international wire services. As man gets into more critical proximity to a full-scale World War Three, the people of the world will begin to say in increasing numbers, 'Now that we can see a way in which this and that can be done, we must obviously adopt the policies indicated by the World Game.' Popular pressures will gradually force world politics to yield to these mutually-beneficial World Game programs."

Fuller admits that mankind may already have violated its occupancy of spaceship earth beyond the point of tolerance. Of all the trends and patterns which his work has revealed, none stands out so clearly as that of man's inherent blindness, ignorance and indiscretion. Never in history has mankind consciously behaved in its own interest, but rather has stumbled blindly and accidentally into success, leaving a trail of waste and pollution. But time has run out. This wheel's on fire, and it's rolling down the road. "Our greatest problem," he says, "is the educational problem of getting man to realize in time what his problems are, and what the most effective priorities may be for saving them."

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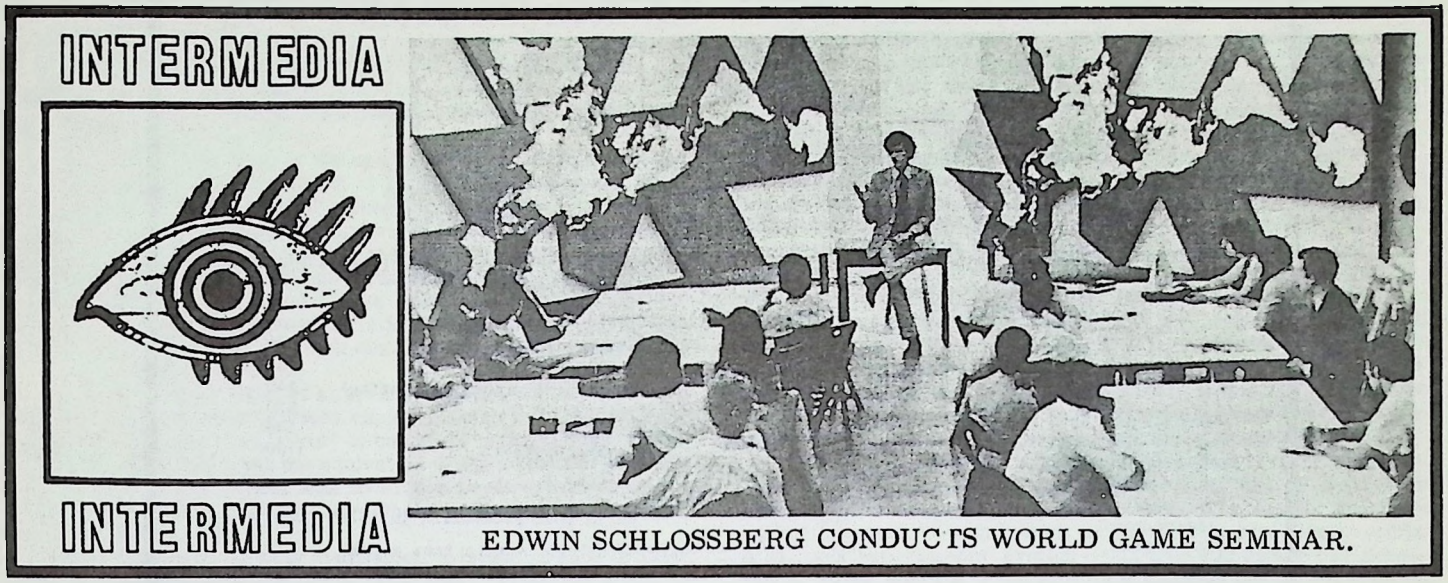

EDWIN SCHLOSSBERG CONDUCTS WORLD GAME SEMINAR.

TECHNOANARCHY

Part Five

World game report

GENE YOUNGBLOOD

Last week I introduced the concept of Buckminster Fuller's World Game, mankind's first practical alternative to politics. I described the physical hardware and the metaphysical software which constitute World Game Headquarters at the World Resources Inventory, Southern Illinois University. I gave a brief description of how the system works, and explained that it is now possible for anyone anywhere to take positive constructive action in shaping the destiny of our society completely outside the realm of politics as we know it.

Following is a report on the first World Game Seminar as conducted by Fuller and Edwin Schlossberg at the New York Studio School from June 12 to July 31 of this year. The seminar was offered as a prototype of the World Game and should not be considered a formal "playing," since the necessary computer systems were not yet available. However, this report should demonstrate the vast scope and authority of the World Game even when practiced by amateurs without the optimum technological facilities.

Schlossberg, 24, is working on a Ph.D. in physics and literature at Columbia University, considering both of them as languages. He teaches a combined course in physics and literature. He is a generalist, a comprehensive thinker, a poet, a revolutionary, a technoanarchist. He publishes GOOD NEWS, a periodical of the whole earth design systems revolution. The remainder of this article is in his words, taken from the World Game Report:

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We worked with the students in mind. We worked to develop a research and design team to effectively deal with the data and concepts necessary to play World Game. The first four weeks of the seminar were devoted to input. Mr. Fuller thought aloud about his ideas, concepts, inventions, and discoveries. The students did individual research into trends, energy sources, and many other information areas. They were constructing a base on which to develop ideas about the whole earth. We saw films, read extensively, and traveled through the minds of the others in the room. We watched as man successfully stood on another body in space and could see the earth as a spaceship. The students were working to make visible the coordination of that spaceship in order to accelerate the trend toward physical success for all humanity.

Each day the growth of the students and the growth of World Game was extraordinary. Without fear, without competition, the students worked together to realize World Game as fully as they could. The last three weeks were intense with research and organization on how to display the findings that were being made. The energy and information grew visibly before us. We were working at the frontier and each student was working at his frontier. It is dramatic to see human beings so concerned with the operation and well-being of the earth. Mr. Fuller said at the start of the project that it was the most important work to be done.

I. PRE-SCENARIO FACTS.

Our pre-scenario facts consist of the conceptual tools which we found ourselves using most often in our dealings with the whole earth. They are by no means even an attempt at being complete, but are merely a general frame of reference for us, as individual participants, to fit our respective specializations into. To a large extent the specifics of World Game left with its participants; what is here is the general base we started with and evolved through as our individual understanding and refinement grew.

Finding the needs of one man led us to finding the needs for mankind. As we began to deal with man on the collective level we realized the need for establishing a frame of reference, or conceptual tool, to deal with collective mankind's needs. The "bare maximum" was what evolved. Rather than take what was thought to be the bare minimum for mere subsistence levels, we elected to establish levels which would allow man to realize, not his minimum potential, but his maximum potential, anything less than this being, by our definition, sub-human. So, in looking at calorie levels, we found the highest calorie needs to be that of pregnant women who need 3300 cal/day, and that of working men who need 3500 cal/day. Thus if we could insure that caloric level for the world, no one would be deprived. We did the same for protein levels. Between 30 and 45g of total protein per day is the minimum level of protein that must be replaced by the body. We therefore took 90g of protein/day as the bare maximum which should be available to everyone. We then asked: How many acres per capita are necessary to produce the bare maximum food requirements?

In order to supply mankind with his internal needs we found it necessary to evolve a bare maximum parameter for external metabolics which would guarantee the maintenance of man's internal metabolics. This bare maximum is 1242 energy slaves per capita by the year 2000 (Note: one "energy slave" is defined as a machine or system equivalent to 37.5 million foot-pounds of energy). Broken down, that is 15,000 kwh and eight metric tons of coal-equivalents per capita per year. This non-linear yardstick for establishing external relative levels of the development of man's potential to be "human" was arrived at by taking the projected U.S. needs for the year 2000 (present need is 7000 kwh), because it was the maximum. Using these parameters we found that mankind will need a total 100 trillion kwh, 8.5×10^{15} calories, and 21.9×10^{7} tons of protein in the year 2000. (We used the U.N. figures on projected populations for these calculations.)

One man needs per day today:

Internal Metabolics

1.4 lbs. pure air
5.0 lbs. pure water
3500 Calories
90 grams of protein
12 milligrams iron
0.8 grams calcium
0.86 grams phosphorus
vitamins and minerals
5-9 hours sleep
63-77 degrees Fahrenheit
medical attention

Efficiencies of Power Sources:

fossil fuel (coal and oil)	40%
nuclear power plants	40%
magnetohydrodynamics	55%
fuel cells	40 to 60%
thermoelectric	40%
thermionic	10%
heat engine	32%
solar furnace	70%
silicon battery	15%
fusion	10%
hydroelectric	80%

it takes 371 kwh to produce 1 automobile

(What is the net physical wealth of world man? How are we presently using our resources?)

daily newspapers ('62):

Asia	1736
Oceania	114
Europe	2403
USSR	457
Africa	188
N Amer	2161
L Amer	765

World ('65) book production (titles) 450,000
periodicals 200,000
journals, tech. reports 200,000

radios per 1000 inhabitants ('60):

Africa	28
N Amer	720
Asia	22
Europe	220
Oceania	198
USSR	205
world avg	130

Calories used in different activities (per hour)

lying in bed	77
sleeping	65
sitting at rest	100
walking slowly	200
standing	105
working (painting, carpenting)	240
running	570
swimming	500
walking upstairs	1100

world food production in '67:

570.82 million metric tons animal products
1,457.65 million metric tons vegetable products

trends towards:
use of 92 basic elements
transportation of man around earth
abstraction
specialization
comprehensiveness
doing more with less
self-fulfillment
increased life expectancy
higher education
automation
non-ownership (leasing)
multiple citizenship
increase of energy slaves/cap
increased leisure
increased weather prediction
omni-directional (away from linear)
miniaturization
autonomy

We compared bare maximum requirements with present per capita consumption. We sought to establish a bare maximum communications system for the world. We learned what percentage of world people can presently be guaranteed the bare maximum. We sought to find the bare maximum for world transportation. We asked how much bulk food is produced in calories? How much copper, aluminum and steel is involved in food production? (At present, it takes 42 kwh to produce one metric ton of food.) We sought to find the average per capita protein consumption for the world (68 grams, of which 20 are animal protein).

In order to correlate the vast amounts of data we were accumulating about the world, we devised a chart with which we could clearly display visually our basic working information. This chart was a triangular grid on which one of the three axes were the 22 major geographical areas of the world and their individual countries. The second axis consisted of, in five-year increments from 1965 to 2000, figures on population, population density, calorie and protein intake, total kwh, metric tons of coal-equivalents and energy slaves. The last axis could indicate up to 20 possible world trends for each area and country. We used thirteen: fossil fuel potential, life expectancy, mortality rate, arable land, housing, amounts of copper, aluminum and steel, food literacy, reinvestable time and hydropower.

The chart was four feet high and stretched 60 feet around the game room. We also employed two 10-by-15 foot Dymaxion maps with five clear acetate overlays each to visually present our data on a geographical whole earth. Information about the world's metals sources, world man, the power network, alternate power sources, present population and Year 2000 population projection, food production and transport, was presented on seven of the overlays while three remained free for use during game playing.

II. SCENARIO.

Once we knew what mankind had and what he needed to have, we began to experiment with ways he could go about getting his needs. These ways we called "scenarios." (What are the ways in which man may be enabled to participate more effectively in his relation with the universe?). Throughout our work we found ourselves returning to one common denominator: Can you industrialize an area without electrical power? How can man take care of all of his essential physical needs so as to allow himself to develop his unique metaphysical abilities? Whether we had researched food, communications, travel, housing, or economics, we always returned to electrical energy once we began to formulate any hypothesis about satisfying man's needs. In order to enable people to be fed properly we found that they would first have to have a sufficiently high input of electrical energy to process, transport, and store food and dispose of wastes. We found that, when dealing with collective mankind, it was imperative that we attend to man's external metabolics first, and these would then take care of individual man's internal metabolics. Thus the "Energy Scenario" became our first move in the World Game.

After researching and then plotting the world's electrical network (generating stations and transmission lines) we devised a way of developing and improving its overall efficiency as the first step towards the bare maximum for all mankind. (How long would it take to get a minimum of kwh distributed throughout the world?) By utilizing the world's hydroelectric power (rivers and tides), without any further development of thermal plants, and taking advan-

tage of the increased efficiency of super-high voltage long-distance transmission lines (one million volts, 1500 miles) in a day/night seasonal hookup, we were able to demonstrate that with present methods, technologies, projected population figures, metals resources, and efficiency levels in power generation and consumption, it would be possible to bring everyone on earth to a minimum of 2000 kwh per year by 1980.

The present kwh level of Europe is 2000, and as such not below our projected bare maximum of 15,000 kwh for the year 2000, because with Europe's level of industrial development it would be possible to raise the per capita kwh to 15,000 by the year 2000. We asked: How much copper wire is needed to carry the power necessary for the year 2000 for both industrial and home use throughout the world? How far ahead can we conceive a future life-style? What's the time-lag between installation of electrical energy and an adequate food supply? How much metal is involved to produce the kwh needs for the year 2000?

When the energy input of an area is raised, there is a corresponding rise in communications capacity which in turn increases the necessity of the "have-nots" to become "haves." (In 1938 Fuller determined that when the equivalent of the work that could be done by 200 human slaves was available in electrical and other energy units used by a family of five, that family is included among the "haves.")

In the scenario, the vast hydroelectric potential of both South America and Africa is utilized to raise their respective levels to the per capita figure of 2000 kwh, and the surplus is transmitted via the electric network to areas where there are deficits of electric power. Because we do not have a global network at the present time, the U.S. and other industrialized countries produce and use during the night hours only a small percentage of their electrical power capacity. With a global electric grid, power could be generated at day and night total capacity and transmitted to the daytime peak needs around the earth. (Using our present technology, can we provide electrical needs for everyone without polluting our air beyond endurance? What is pollution?)

The scenario utilized hydroelectric power for other considerations than what is presented above; besides the efficiency and pollution problems of thermal plants, it became overwhelmingly apparent that our "savings account" of fossil and nuclear fuels would soon be depleted at the bare maximum level of consumption. Our constantly-replenished "income" energies were the obvious choice. The amounts of metals, principally copper, aluminum and steel, that would be needed for such an undertaking are within grasp of earth's present economic and industrial development: approximately 9000 tons of steel per 1000-million watt hydroelectric plant, and 60 tons of steel and 25 tons of aluminum for a mile of power line at present efficiencies. (How can we accelerate efficiency throughout the world?) We chose to keep efficiency levels and technological competence at present levels to show we could do this today, with what we have. (How much metal is needed for 100 miles of power lines? When is a game a game?)

After demonstrating man's potential competence for bringing the world average per capita kwh up to 3613 with no one below the present European level of 2000 kwh, stage two of the electric scenario began. Utilizing increased efficiencies, technological progress such as laser-beam power transmission, and some of the earth's varied income energy sources (What is the potential kwh from wind power? Tidal power?), the per capita level of kwh is brought up to the 15,000 bare maximum in the year 2000.

Furnishing an area with enough electric power for its industrialization brings to that area the potential to satisfy its bare maximum food requirements. Knowing from the energy scenario that we could count on using two per cent of the total electric power for agricultural uses, we then looked at ways to increase the per capita calorie and protein levels to the bare maximum. (What percentage of electric energy is essential for food production?) A startling fact which became obvious upon looking at food production was that the world produces more than enough to feed its people adequately, but that in transport, storage and processing, 90 per cent of the tonnage of food is lost (how do we identify waste?). If we could bring methods to increase worldwide efficiency, at the rate we increased food production in the past, the world could feed its population for some time to come.

Shipping food halfway around the globe is inefficient. For example, in 1967, Asia imported and exported the same amount of rice. Ships could be used to transport materials not native to a particular area, or the metal from the ships could be used more profitably elsewhere. Part of the electrical power set aside for agriculture could be used to increase efficiencies in short transport to some areas with low farming efficiency. The increased use of fertilizers and farm equipment, in addition to the increase in knowledge of farming brought about by higher communications capabilities, would help bring the needed increase in efficiency necessary to have the entire population at bare maximum by 1980.

The efficiency would be somewhere between the U.S.'s (feeding about two people per acre) and Japan's (feeding six people per acre). It would be difficult to raise the world's efficiency to that of Japan's, using her methods, because a tremendous amount of manpower would be drawn into agriculture. (Approximately 40 per cent of Japan's people are engaged in agriculture as opposed to nine per cent in America.) There are many new ways to produce food. Examples: using algae (chlorella and others) for food; feeding bacteria plant wastes such as stalks, sawdust, and letting them convert these to food for man; and synthesizing amino acids. However, we didn't employ them in our scenario because we did not want to make a move which would assume changing people's food habits.

At present, most of the important variables in farming are not controlled because the system is as yet open. In a closed system such variables as weather effects, insect pests, loss of water and nutrients would be controlled, or the detrimental effects eliminated. One experimental system could feed 500 people per acre—which would mean a population of six billion people could be fed using only 24 thousand square miles of land. (We're now using around 7 million square miles.) This would be approximately the area Japan uses to feed her people today.

Given enough electrical power, the external metabolics, the earth could feed as many people as she needed—up to 7.8 trillion, for example, on presently-farmed land using the aforementioned experimental system. From this scenario we went on to examine some of the effects these scenarios would have on other areas of man's life.

III. FUTURE DIRECTIONS.

After working out scenarios for satisfying what we considered the two most vital bare maximums—external electric energy and internal food supply—we evolved into some of the possible synergetic scenarios that would result from the first moves. The establishment of bare maximum levels of the above throughout the world would engender the need for bare maximums in housing, medical attention, income, communications and travel.

The housing scenario we were working on clearly showed the inadequacy of our present system. At the present rate, the use of metals in housing would prove to be totally insufficient. Metaphysically-engendered materials such as plastics will have to be developed if we are to solve mankind's housing needs. The housing scenario encompassed more than just the shelter needs of the world. As it evolved we saw that it would encompass communications and mobility. With the trends of increasing mobility throughout the world, we foresaw the possibility that no one would be staying at any one place long enough to warrant the construction of "permanent" shelters. As a total service facility, the housing needs would encompass not only shelter but communications—with its own resultant education, medical information and attention, personal telephone contact with anyone, anywhere, and mobility with anyone going anywhere. These would be accomplished via closed-circuit television and telephone to a world central medical, educational, and travel-routing computer system.

Some future directions and scenarios we touched upon were the possibilities of a world guaranteed annual income; the potential of fluidics as a source of energy; information and automation; the use of heat pollution from thermal electric plants to heat soil to improve crop output; the efficiency-gain by using gasoline or alcohol to run electric power plants and electricity to run cars; the production of alcohol from algae, farm wastes, or garbage and its substitution for gasoline in present-day combustion engines; the laser beam transmission of power and information; the amount of reinvestable time that will be available to mankind as a result of freeing him from the drudgery of having to earn a living (by bringing man to the bare maximum food and energy levels by the year 2000 we will have 16 trillion more hours per year to reinvest into metaphysical regenerative functions); the increase of efficiency rates for power production and consumption, communication, transportation, etc., and the possible surplus and increase of efficiency through the stabilization of the population.

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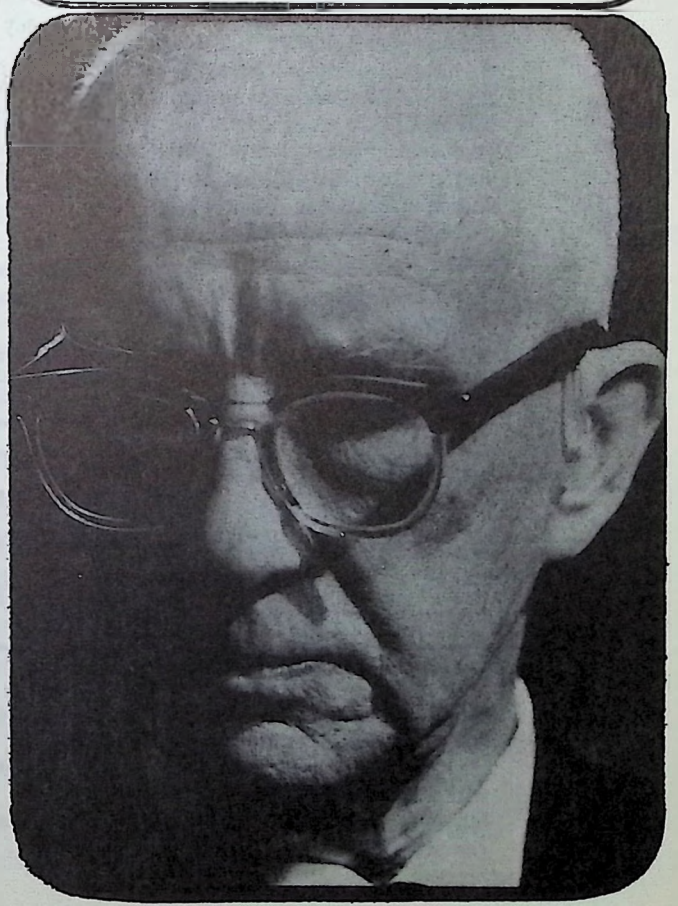
OCT. 3, 1969

THE WORLD GAME: how to make the world work

by R. Buckminster Fuller
edited by max ackerman



To some large extent most "innovations" are variations on a previous theme. Once in a lifetime, though there is an Archimedes, an Aquinas, a da Vinci, a Newton, a Darwin, or an Einstein whose thought is so startlingly fresh that its insights become an enthusiastic start for a new age of endeavour. One such man is R. Buckminster Fuller.

The "World Game" represents Fuller's ultimate faith in man's ability to discover and design objectives for realizing true concord among his fellows. The technology and resources are available to make every man on earth a success. The "World Game" as presented in the following article illustrates a computerized gaming concept through which we can make 100% of humanity a success on our Spaceship Earth.

- Thomas B. Turner, Director
Spaceship Earth Design
Science Exploration
(The World Game)

The World Game idea forsakes the political expedient of attempting to reform man and commits man to reforming his environment. This is to be achieved in such a manner as to "up" the performance per each unit of invested world resources until so much more is accomplished with so much less that an even higher standard of living will be effected for 100% of humanity than is now realized by the 40% of humanity who may now be classified as economically and physically successful. "Peace" will then be not just a catch-word, but an experienced reality, which has been assimilated and chosen as the best of all possible alternatives open to human design experience.

Society has established fundamental confidence in the reliability of properly maintained and programmed computers. The fact is that in going from here to there by some kind of transport in 1969 the most dangerous way is by automobile. Next most dangerous is by railroad, and it is safest to go by airplane. That is a new era condition brought about by the extraordinary degree of reliability of computerized controls. As a consequence much more automation is about to take place and the computers, to do the myriad tasks, are proliferating at an amazing and popularly unrecognized rate.

I propose that a great world logistics game be played by introducing into the computers all the known inventory and whereabouts of the various metaphysical and physical resources of our Spaceship Earth as most accurately represented by my cartographic projection. We would enter into the computer all the inventory of human trends.

known needs and fundamental behaviour characteristics.

Individuals and teams would undertake to play the "World Game" by developing their own theory of how to make the total world work successfully for all of humanity. Each individual or team would play his theory through to the end of his predeclared program. The objective of the game would be to explore for ways to make it possible for anybody and everybody in the human family to enjoy the total earth without any human gaining advantage at the expense of another. To win the World Game everybody must win.

If Dr. Von Neuman's "theory of games", predicated upon one side losing 100%, can be called "Drop Dead", we can call our game "Let Live".

How can we explain that during the two-thirds of a century in which we rose from less than 1 to 40% of all humanity enjoying a higher standard of living (than had been realized by any pre-twentieth century monarch), that this realization occurred despite a continually diminishing percentage of metals per each world man-a ratio occasioned by human population increasing faster than humanity's discovery of new metallic ores.

We can explain the escalated physical success only by the fact that we have produced vastly higher products, services, and performances with ever less time, energy and weights of resource invested per each accomplished unit of end functioning, within our comprehensively evoluting world-around technological complex.

All the historical concepts of economic security of dry land man are predicated on doing more with more, that is, with wider, heavier and higher walls to protect him, more and more food in ever bigger grain bins and ice-boxes, more and more money in ever bigger and more numerous banks – "secure as the Rock of Gibraltar."

"The whole is not the sum of its parts. The word synergy is unknown popularly and it is the* only *word that means "behaviours of wholes unpredicted by behaviour of their parts."

The doing-more-with-less technology which has now eightyfolded the numbers of economically successful humans came into being entirely within the "top secret" weapons-carrying technology of the sea, sky and space.

So the great economic change that has come about in the last two-thirds of a century has not come as a consequence of the declared policy of any of the political ideologies. To prove that statement we will employ the mathematical strategy of "Reductio ad absurdum." Let us take (hypothetically) all the machinery, engines, motors, pipes and wires away from all the countries around the world; from the Europeans, Asians, North and South Americans, Africans and Australians, and dump all that machinery in the ocean. We find that without the industrial network of machinery, within six months two billion people – (not two million) i.e. half of humanity – would die of starvation. That is how intimately the world's machinery is tied into the regeneration of human life. Since that proved to be a disastrous idea we will leave all the machinery where it now is, and instead we will (hypothetically) take away from all the world's countries, all the politicians of all and every kind of ideology and we will send them on a perpetual trip around the Sun accompanied by all their militarists. We will melt up all the guns and other weapons and stock pile the metals for manufacturing more machinery to produce goods and services for humans.

As a consequence of the politicians' removal (computations quickly indicates) that as many people as had been eating would keep right on eating but that with the international political boundaries removed – the politicians being no longer present to enforce their barrier schemes and laws – man would stop "plowing under" and instead begin shipping more food and goods freely across the borders.

Since human babies and children demonstrate an intense interest in all things in all directions from the stars to the atoms, from whales to butterflies, and from wintry indoors to summery outdoors, it is obvious that they are not designed to be specialists. If nature intended humans to be specialists, she would have delivered them at birth with a vast variety of integral equipment, for instance with one eye and a microscope attached. Nature designs all kinds of specialist

"I think we are at that critical historical moment in which we have just broken our shell of permitted ignorance and henceforth we can survive only by learning to operate in our universe in a very different way."

birds with integrally attached wings which greatly hamper the birds bobbled walking.

Humans are unique amongst all living creatures in their degree of general adaptability to all the extremes of environmental changes, which include the capability of the human to extract generalized principles from his special case experiences and his teleogical capability developed thereby to rearrange the environment, as by the generalized principal of leverage. Man is teleologically equipped to cope with and survive within extreme variations of the environment that would be lethal to any naked human or other living species. Man can put on and take off his wings and telescopic eyes.

We may conclude that human society's deliberately cultivated specialization is unnatural and debilitating to both its group and individual welfaring and evolutionary development. We may well ask how it happened that the entire scheme of advance education is devoted exclusively to even narrower specialization.

We find that the historical beginnings of school and tutoring were established, and economically supported by the illiterate and vastly ambitious war lords who required a wide variety of highly specialized brain slaves with which to logistically and ballistically overwhelm those who opposed their expansion of physical conquest. They also simultaneously DIVIDED and CONQUERED any all "bright ones" who might otherwise rise within their realms to threaten their supremacy. The war lord vitiated their threat by making them all specialists and reserving to himself exclusively the right to think about and act comprehensively. The war lord made all those about him differentiators and reserved the function of integration to himself.

So important were the brain slaves' developing schools, as assets of the physically mighty, that they had their own sons and their henchmen's (noble's) sons attend the brain developing schools as liberal arts bachelors in order to familiarize themselves with the ramifications of this most important resource for effectively detailing the realm's capabilities, which they, the top men, would secretly integrate into the grand strategy of their realms' conquests and the guarding and maintaining of this ruling might, over the commonwealth productivity of the realms' peasantry and the latter's support of the non-productive soldiers. Then they schooled their "noble birth" sons, equally diligently, in the mastery of arms, horses and fighting men. So old and dignified by time have such brain slaves developing schools become, that their origins have been forgotten and remain as yet undiscovered by an ever more widely literate society whose often illiterate political leaders always have been assured of election through their promises to get the rich man's schooling facilities for their low-or-no income constituents.

Now, biological and anthropological scientists have discovered and verified that extinction of past biological species and human tribes always has been the consequence of overspecialization.

The extinctions are consequences of the following set of scientific facts.

"As" Nature's high energy devastations are far less frequent than her low energy disturbances of the regenerative biological life patterns. In the physical interchangings and local transformations of universe the numbers of occasions on which nature will have large amounts of energy concentrated at any one locality to effect great changes is far less frequent than the number of times she will have small amounts of energy at any one locality to effect small changes. Insects and microbes are far more frequent and numerous than are tornadoes and earthquakes.

"If we do not comprehend and behave spontaneously with the highest, most unselfish integrity, I think man may readily not make it on this particular planet."

"If humans had to purchase their many separate organs and assemble those parts into logical interfunctioning, they would never do so. All those parts had to be preassembled and unitarily skinned in and coordinately operated by multi-quadrillions of atoms in the brain which after sixteen years of practical spontaneous coordination becomes so aesthetically acceptable one to the other that as it sings, dances and smiles one is inclined to procreate with the other."

"B" When inbreeding toward greater biological specialization occurs, the concentration of dimilar genes tends to dominate at the expense of general adaptability. Specialized, ergo, generally vulnerable species may survive during long periods of low energy environmental confrontations, all the time increasing their special advantage while losing their unused general adaptability.

Inevitably however the infrequent high energy change imposing event occurs. Bereft of general adaptability, the specialist is unable to cope with the unfamiliar and overwhelming magnitude and velocity of events. Thus devastated they became extinct. ,

Humanity lost its physical world masters soon after World War One, when they too abandoning their comprehensive command to the world military, became extinct through their over-specialization in exclusively sensorial judgments and their brain slave scientists wandered off into the vast and utterly non-sensorial ranges of the electromagnetic spectrum's (invisible) reality.

With the old pirate masters extinct, society accepted unquestioningly the momentun of the utterly specialized educational trending. Specialization was never questioned as being other than logical, inevitable and desirable

Humans as super-specialists have now developed the atomic energy capability to blow themselves to eternity, with no integrating capability to turn the vast energies to the comprehensive advantaging and regeneration of all humanity, and thus avoid swift, self-imposed extinction.

But evolution, apparently intent to continue man's existence aboard SpaceshipEarth as its most effective metaphysical protagonist, has produced the antibody to his extinction. The anti-body to his extinction is man's invention and development (under exclusively cold warring auspices) of the electronic computers. The computers are about to make humans obsolete, as either intellectual specialists or as specialized muscle and conditioned reflex automations. The computers and automation can completely out – perform man as either specialized intellectual differentiators or as wealth producing tools which will be able to secure humanity's forward days of metabolic regeneration. The computers can work all night, at super human speeds, selecting the blues from the greens under environmental conditions intolerable to man.

So the computer will, as an enormously expanded and accelerated brain facility, enter into an omni-man-serving function altogether replacing the inadequate public policy formulations of politicians. Men will act as local managers of the computer-discovered ways and means of serving the best interests of all men for the longest forseeable ages.

The programs that the computers will select as being most favorable for all humanity will go far beyond man's ignorant ways of assessing what he "can afford". The computer will demonstrate that he can afford nothing short of the best, which is to make all the Spaceship Earth a successful developmental environment for universe-exploring man.

A study group is being formed at McGill to hold seminars and start projects to develop and promote the WORLD GAME strategy. Results of these activities will be published in the beginning series of World Game Studies in July, 1970.

Students and faculty members interested in participating can contact Max Ackerman through The Daily Office.

the Review

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Fuller insists world can end poverty within 25 years

By Eric Burgess

Staff correspondent of The Christian Science Monitor

Denver

All wealth is two-edged—it is at once physical and metaphysical. Moreover, it is not only inexhaustible but also keeps multiplying itself.

Using the thesis that a man gets smarter, the earth grows richer, R. Buckminster Fuller reasons that every human being in the world can be brought out of poverty in the next quarter century.

Mr. Fuller, the celebrated architect-philosopher from Southern Illinois University, spelled his thesis out at the recent joint national meeting of the American Astronautical Society and the Operations Research Society here.

It is nonsense, he says to say we cannot afford to do things the right way, that it costs too much.

Earth, he contends, is continually receiving material from space and energy from the sun and stars. The solar energy stirs Earth's atmosphere and heats its oceans. It supplies motivating force for the growth of plants, the falling of rain, and the physical activities of people.

'Metaphysical wealth' noted

There is, however, another, more important wealth contributed by human intellect. Man's unique function is to discover and use the generalized principles of the universe—the metaphysical wealth, he says.

Man does not put anything into the universe, Mr. Fuller continues. It is already all there. Man only finds and employs what is already available. Man always learns more, never less. Hence this metaphysical wealth of mankind forever increases.

"Spaceship Earth" is thus an energy gatherer, an accumulator of material wealth, he says. Men on it continually tap the inexhaustible source of metaphysical wealth vested in the ordered physical, generalized principles of all that exists.

Mr. Fuller contends that these are facts shown in many ways. Man continually learns to do more with less. The communications satellite, weighing only 1¼ tons, does the same job better than 175,000 tons of copper cable.

Chrome-nickel-steel is six times as strong as mild steel.

The airplane internal combustion engine is many times more effective on a power-to-weight basis than the automobile engine from which is was developed.

Poverty pushed back

The continued increase in metaphysical wealth has enabled mankind, within 60 years, to use technology to increase from less than 1 percent to 40 percent the proportion of all humanity who are beyond poverty.

By planning wisely and applying technology effectively, Mr. Fuller says, we can elevate the rest of humanity to the same or better standards within 25 years. We have the energy resources (material wealth), and the know-how (metaphysical wealth) to do it.

Mr. Fuller thinks man can do this by playing the "world game."

The world game is a new version of the war games that military strategists long have played on computers. In the usual war game the computer is programmed to take into account factors such as number of weapons, men, and supplies, and relate them to geography, weather, industry, and the like.

A war is simulated electronically as the computer plays a "what if?" game: "What if we use all our bombers in a single raid? What if our factories are put 80 percent out of action? What if the weather is bad and slows down landings at a beachhead?"

The enormous computational speed of a modern computer makes it possible to calculate theoretical answers to such questions in reasonable lengths of time.

Premises challenged

But current "war-game" techniques are no good to solve the world's problems, claims Mr. Fuller. They are based on the shaky foundations of Darwin's "survival of the fittest" theory and Malthus' dictum that population increases must inevitably lead to world starvation. On these false assumptions the war games are programmed to make victory the obliteration of the opposite side.

The world game uses a new set of ground rules. Its $16 million computing system at Southern Illinois University will be programmed to play a mutual-success seeking game. An attempt will be made to solve world problems in terms of the question. How can both sides profit the most?

It will examine the consequences of men's acts in a way that before was too complex to understake or was shrouded by political or personal biases.

Redefinition asked

Planning for the 70's, claims Mr. Fuller, should be a redefinition of mankind's problems as solvable, followed by the computerized solution of the problems based on the ground rules of saving all humanity.

In analogy the world game computer finds out all the moves by which a whole field of climbers would win as each helps the others to climb successfully to the top of a mountain. Present computer games find out how one group can get to the top of the mountain by scrambling over all others.

In the world game the computer takes over all the specialized brain laboring tasks of humanity and frees men to discover and apply the comprehensive system of perfect technology displayed by the universe. This perfection is evidenced by the smooth interrelationships of all the already existing principles that man has so far discovered through natural science.

Jan. 8, 1966

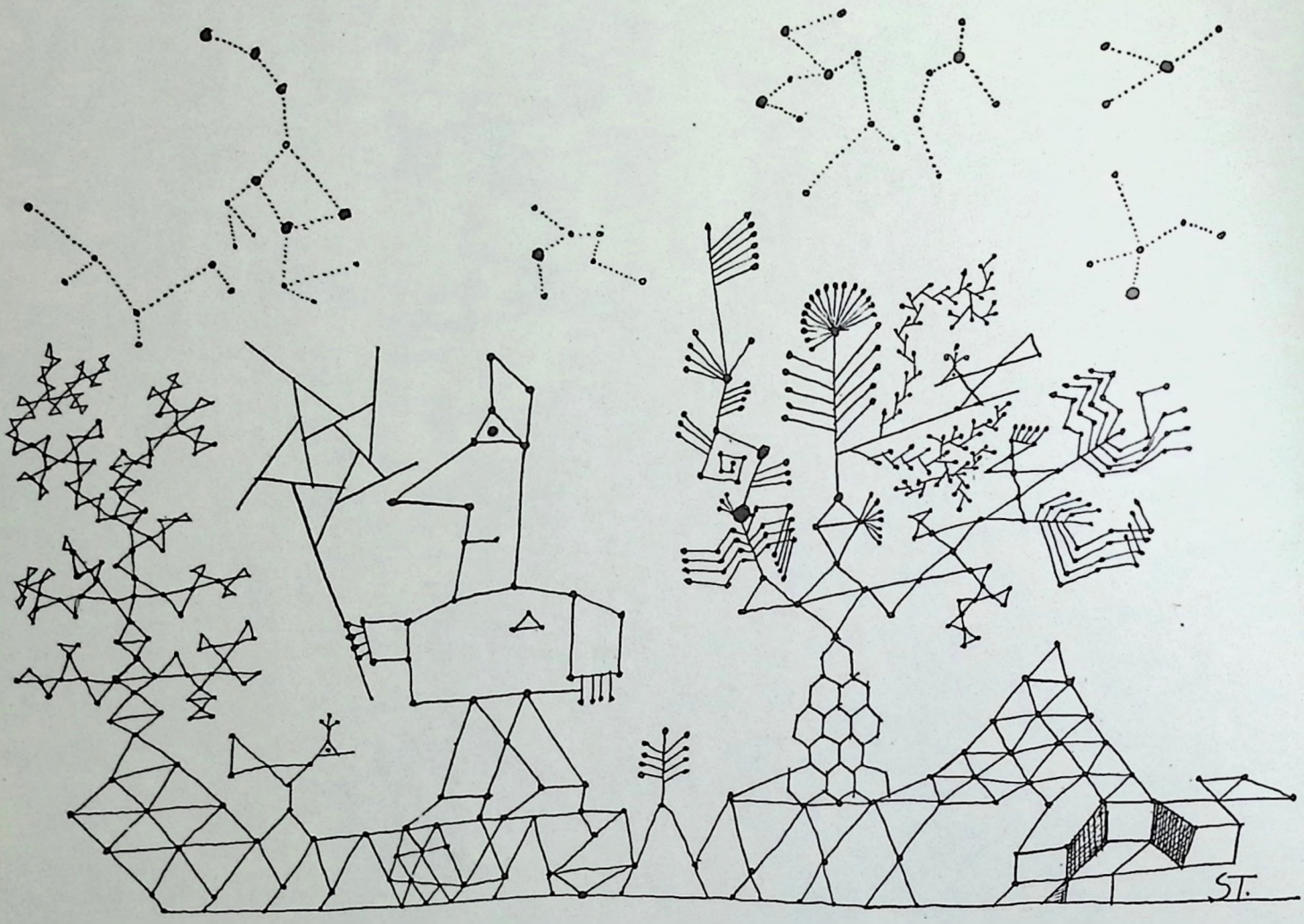
THE NEW YORKER

Price 35 cents

LAURA JEAN ALLEN

PROFILES

IN THE OUTLAW AREA



WHEN Richard Buckminster Fuller was in New Zealand a year ago, he spent several rewarding hours at the University of Auckland with a friend of his, a cultural anthropologist who also happens to be Keeper of the Chants of the people he belongs to, the Maoris. These chants go back more than fifty generations and constitute, in effect, an oral history of the Maoris, and Fuller, a man who is intensely interested in almost everything, undertook to persuade his friend that it was high time they were recorded on tape and made available to scholars, himself included. The anthropologist said that he had often thought of recording them, but that, according to an ancient tradition, the Keeper of the Chants was allowed to repeat them only to fellow-Maoris. Fuller thereupon launched into an extensive monologue. It was buttressed at every point by seemingly irrefutable data on tides, prevailing winds, boat design, mathematics, linguistics, archeology, architecture, and religion, and the gist of it was that the Maoris had been among the first peoples to discover the principles of celestial navigation, that they had found a way of sailing around the world from their base in the South Seas, and that they had done so a long, long time before any such voyages were commonly believed to have been made—at least ten thousand years ago, in fact. In conclusion, Fuller explained, with a straight face, that he himself had been a Maori, a few generations before the earliest chant, and that he had sailed off into the seas one day, lacking the navigational lore that gradually worked its way into the chants, and had been unable to find his way back, so that he had a personal interest in seeing that the chants got recorded. We have Fuller's assurance that the anthropologist is now engaged in recording all the chants, together with their English translations.

THE somewhat overwhelming effect of a Fuller monologue is well known today in many parts of the world, and while his claim to Maori ancestry must remain open to question, even that seems an oddly plausible conjecture. An association with the origins of circumnavigating the globe would be an ideal background for his current activities as an engineer, inventor, mathematician, architect, cartographer, philosopher, poet, cosmogonist, and comprehensive designer whose ideas, once considered wildly visionary, are now influential in so many countries that he averages a complete circuit of the globe each year in fulfillment of various lecture and teaching commitments. Fuller, who was seventy last July and whose vigor seems to increase with his years, gives every indication of enjoying to the hilt his more or less constant "toing and froing," as he calls it. He often points out that man was born with legs, not roots, and that his primary natural advantage as a species is mobility. Fuller has adapted himself so well to the extreme mobility of his present life that he considers it preposterous to be asked where he

lives. A New Englander by birth and heritage, descended from eight generations of Boston clergymen and lawyers, he has had his official base of operations since 1959 in Carbondale, Illinois, where he is a professor at Southern Illinois University in what he has designated as the field of "design science," and where he and his wife occupy a plywood geodesic-dome house built according to the patented specifications of the best known and most successful of his many inventions. By agreement with the university, though, he spends only two months of the year, at most, in Carbondale, and much of that is in brief stopovers between jet flights to other cities, often on other continents. Perpetual mobility, he feels, is a perfectly satisfactory condition for a "world man," which is what he firmly believes all of us are rapidly becoming.

The worldwide enthusiasm for Fuller's ideas is by no means confined to university students, though they are currently his most fervent supporters. Professional mathematicians will undoubtedly question some of the premises of his "Energetic-Synergetic Geometry" when he finally gets around to publishing the definitive book on it that he has had in preparation for thirty-five years, but it is no longer possible to question the practical application of these same principles in such eminently satisfactory structures as the geodesic dome, which has been recognized as the strongest, lightest, and most efficient means of enclosing space yet devised by man. Over the last decade, moreover, scientists in other fields have been finding that Fuller's research into nature's geometry has anticipated some important discoveries of their own. Molecular biologists have now established that his mathematical- formula for the design of the geodesic dome applies perfectly to the structure of the protein shell that surrounds every known virus. Several leading nuclear physicists are convinced that the same Fuller formula explains the fundamental structure of the atomic nucleus, and is thus the basis of all matter. As more and more people discover the comprehensive relevance of Fuller's ideas, he finds himself increasingly involved in all sorts of new areas. The government, for example, recently appointed him a "Distinguished Scientist" at the United States Institute of Behavioral Research, in Washington. While this sort of recognition is highly gratifying to one who has always been something of a maverick, working outside the scientific Establishment, it has come as no particular surprise to him. Fuller long ago reached the conclusion that nature has a basic coördinate system, and he has been convinced for a good many years that the discovery of that system would eventually reunite all the scientific disciplines.

To the younger generation, the most stimulating thing about Fuller is probably his exhilarating contention that we have arrived at the threshold of

> "an entirely new philosophical era of man on earth." For the first time in history, he argues, man has the ability to play a conscious, active role in his own evolution, and therefore to make himself a complete success in his environment. According to Fuller, this dazzling prospect was opened to us by Einstein's concept of energy as the basis of the universe. "Einstein shattered the Newtonian cosmos," he said recently. "In the famous first law of dynamics, Newton had said that a body persisted in a state of rest or constant motion except as it was affected by other bodies; he was assuming that the normal condition of all things was inertia. Einstein realized that all bodies were constantly being affected by other bodies, though, and this meant that their normal condition was not inertia at all but continuous motion and continuous change. The replacement of the Newtonian static

norm by the Einsteinian dynamic norm really opened the way to modern science and technology, and it's still the biggest thing that is happening at this moment in history."

More specifically, the new era was made possible by the phenomenal acceleration of science and technology in the twentieth century—a process that really began, Fuller says, during the First World War, when industry suddenly moved, in his words, "from the track to the trackless, from the wire to the wireless, from visible structuring to invisible structuring in alloys." A good example of this process can be found in the performance of chrome-nickel steel, an alloy that was used for the first time in the First World War, to make cannon barrels more durable; because of an invisible molecular pattern that is created when chromium, nickel, and iron are combined, the resultant alloy held up under conditions of intense heat that would have quickly melted all three of its components separately. Most of the major advances in science and technology since 1914 have been in this invisible realm, which Fuller calls "synergy"—a term that can be defined as the behavior of whole systems in ways unpredictable by the individual behavior of their sub-systems. So far, Fuller maintains, the newest technology has been applied principally to the development of military power, or weaponry, rather than to housing and education and other aspects of what he calls "livingry." Nevertheless, the shift of industry to the new invisible base has brought about such spectacular gains in over-all efficiency, such demonstrated ability to produce more and more goods and services from fewer and fewer resources, that mankind as a whole has inevitably profited. According to a statistical survey that Fuller made some years ago for *Fortune*, the proportion of all humanity enjoying the benefits of the highest technology had risen from less than six per cent in 1914 to twenty per cent in 1938. Today, Fuller places forty-four per cent of mankind in the category of technological "have"s, and it is his frequently stated conviction that by devoting a larger share of their industrial budget to world livingry the "have"s could very quickly bring the entire human race into contact with the highest technology, at which time the weighty problems that oppress us now—war, overpopulation, hunger, disease—would simply cease to exist.

To achieve this utopia, Fuller proposes a worldwide technological revolution. Such a revolution would not be led by politicians, and, in fact, would take place quite independently of politics or ideology; it would be carried out primarily by what he calls "comprehensive designers," who would co-

ordinate resources and technology on a world scale for the benefit of all mankind, and would constantly anticipate future needs while they found ever-better ways of providing more and more from less and less. One big question, of course, is whether the political and economic convulsions of the present era will allow the comprehensive designers time to carry out this kind of revolution. Fuller thinks that there is still time, but he also thinks that time is rapidly running out for humanity, and it is this belief that keeps him in virtually constant motion around the world, talking to students and training them to think comprehensively as they continue his search for nature's basic patterns.

IT is probably fitting that Fuller, as a true world man, should have no real home these days—or, rather, that he should feel at home wherever he happens to be. There is, however, one spot on the globe that comes reasonably close to being a fixed point in his life. Whenever possible, he tries to spend some part of each summer in Maine, on Bear Island, which has been owned by members of his family since 1904, and he has often referred to this place as the source of most of his ideas. "My teleological stimulation first grew out of boyhood experiences on a small island eleven miles off the mainland, in Penobscot Bay of the state of Maine," he writes of Bear Island in the first chapter of "Ideas and Integrities" (Prentice-Hall), a recent volume of essays that constitutes his intellectual autobiography. With this statement in mind, I wrote to Fuller last spring in England, where he was just completing a one-month visiting professorship in the Department of Architecture at Bristol University, to ask if I could spend a few days with him on Bear Island. He wrote back immediately, inviting me to select a date in August for my visit.

Bear Island, I knew, has been preserved in virtually the same state of development as when Fuller's grandmother bought it, in 1904—no telephone, no electricity, no running water—and this strikes some of Fuller's friends as an odd setting for a man whose life is devoted to making the highest technology serve a hundred per cent of humanity. At the same time, I thought, it could be an ideal setting for someone like Fuller, who has always been interested in finding out how nature really works. The island lies approximately in the middle of East Penobscot Bay, about twelve miles east of Camden. Visitors usually take a boat over from Camden, on the mainland, but I had been staying with friends farther Down East and had therefore arranged to come over from the town of Sunset, which is only five miles from Bear on Deer Isle and can be reached by bridge from the mainland. Fuller and several members of his household had spent the afternoon buying groceries and other provisions in Stonington, the nearest town of any size on Deer Isle, and I met them all on the Sunset dock. In addition to Fuller, there was Mrs. Alphonse Kenison, a younger sister of Fuller's, who has missed only three summers of her life at Bear Island, and who, more than anyone else, has kept the place going through the years; his niece Persis and her husband, Robert Alden, a young New York radio-network executive, and their two children; another niece, Persis's sister Lucilla Marvel, and two of *her* children; and Pearl Hardie, a Maine native who lives for much of the year on Bear Island, where he acts as caretaker of the half-dozen buildings on the island and man of all work, as his father did before him. For the first time in years, Fuller's wife, Anne, had not come to Bear Island this year; she was visiting their daughter, Mrs. Robert Snyder, in California.

Fuller put down a carton of canned goods he had been carrying, and came to greet me, smiling warmly and exposing what looked like a recently chipped front tooth. He is a rather stocky man, powerfully built, and with a massive squarish head and a stubble of white hair cut so short that it stands straight up, and he looked, I thought, about twenty years younger than someone who had celebrated his seventieth birthday the month before had any business looking. His face was almost unlined, and it was also deeply tanned from a recent Aegean cruise. Somewhat heavy features and owlish eyes, magnified enormously by thick lenses, which he has worn since boyhood, can make him appear a bit severe, and at times even forbidding, but that impression is immediately dispelled by his open, toothy, and utterly ingenuous smile.

Fog began rolling in as we finished loading the supplies aboard a motor launch, which was operated by Mr. Hardie, and by the time we had left Sunset Harbor, it was too thick for us to see much of Penobscot Bay. During the trip over, though, Fuller enthusiastically identified each landmark as it materialized through the mist. "There's Eagle," he told me, pointing out a large, wooded island. "And there's John Quinn's boarding house, where we stayed that first summer of 1904—the summer my father fell in love with Bear Island and talked his mother-in-law into buying it for the whole family. Nothing changes here, you see—that house looks exactly the same as it did then. I really think if my grandmother were to come back tomorrow she'd recognize almost everything." He went on to say that his grandmother, Caroline Wolcott Andrews, had also bought two neighboring islands, Compass and Little Spruce Head, which formed part of the same deed, but that it was on Bear, with its fine natural harbor, that they had built a large house in 1905, bringing in all the necessary materials and labor from Boston aboard the schooner Polly, a hundred-year-old vessel that had served as a privateer in the War of 1812. "I used to row over to Eagle and back every day for the mail when I was a boy here," Fuller said. "Four miles a day, often in very bad weather. It made me awfully tough—something I've never lost, by the way."

Although he scarcely looked it, Fuller admitted to me that he was feeling a little run down at the moment. His schedule had been particularly demanding lately, and he had arrived only the day before—several days later than he had planned. From Bristol he had gone to Paris, to address an international assembly of architectural students, and from there to Athens, where he took part in a symposium sponsored by Constantinos Doxiadis, the Greek city planner, on board a chartered cruise ship; then he had flown back to the United States for a round of engagements, the most recent of which had been a conference at Princeton on how to improve the level of scientific education in the nation's secondary schools. Fuller told me that for the first time in his life—perhaps because he had turned his ankle rather badly one evening on the Greek yacht while dancing the Twist—he had actually begun to feel his age. "I gained twenty pounds on this last trip," he added confidentially. "It's one of the really big problems on this kind of schedule—big, rich dinners everywhere, and all that airline food. I really need a few weeks of this Bear Island atmosphere."

Approaching Bear Island in the fog, we could catch only occasional glimpses of its rocky shoreline. The island is

about a mile long and half a mile wide, and is heavily wooded with spruce, pine, and white birch. Rounding the northernmost point, where the land rises sharply to a high bluff, we caught sight of the shingled roof of a large house, and a minute or so later Fuller pointed to an opening in the trees where we could just make out the shadowy arcs of an unfinished geodesic dome that had been, I was told, a family summer work project two years before. "I think it's marvellous coming in with the fog this way," Fuller said as we nosed slowly into the quiet harbor. "With any luck, it will clear tomorrow, and then you'll be able to see where you are. We have a seventy-five-mile sweepout here, so there's quite a lot to see." (Like many other unfamiliar words that crop up in Fuller's casual conversation, "sweepout" is a term borrowed from one of the scientific disciplines—in this case, astronomy; he used it to mean the range of activity that the eye could take in on all sides of Bear Island on a clear day.)

On the dock to meet the boat were a number of small children, most of them members of Mr. Hardie's family, and several adults, including Mrs. Leslie Gibson, another niece of Fuller's, and Professor Sidney Rosen, from the University of Illinois, and his wife. Professor Rosen, a science teacher who also writes biographies of great scientists for young readers, had been assigned by his publisher to write one of Fuller, and he was there to gather material for it. All the small children immediately began clamoring for Fuller's attention. (They all called him Uncle Bucky, and I have observed that nearly all adults who have spent more than five minutes with him find it natural to call him Bucky.) He had to ask the children to repeat their questions several times into his ear, which he cupped patiently with one hand—his hearing, damaged during the First World War, has deteriorated quite a bit in recent years. This difficulty did not appear to discourage the children in the least, or to make even the youngest ones shy of him. After a certain amount of confusion, the supplies were transferred from the launch to a weathered jeep driven by Fuller's sister, Mrs. Kenison, and the rest of us walked up to the main house, on the bluff.

WHEN most of us had assembled in the big house before dinner, Fuller came downstairs carrying a large blue bullhorn, which he had purchased during his stay in England. He explained that he had found it a great boon at conferences and seminars, where he used it not as a loudspeaker but as a directional antenna; the horn had an electronic amplifier that worked both ways, he said, and by pointing the cone at a speaker across the room, holding the voice box near his good ear, and pressing the amplifier button, he could hear perfectly. "I used to be a real menace at conferences," he told us. "I had to have everything repeated. People kept telling me I should get a hearing aid, but, you see, I've tried that several times, and it has convinced me that nobody really knows anything about how we hear. Hearing aids are non-selective—they just amplify *all* sounds. But I hear some sounds perfectly well—maybe even better than you do—and when those are amplified for me, it's actually painful. With this marvellous device, though, I can be selective. I can pick up sounds just by pointing." He held the horn to one ear and pointed it at Professor Rosen, across the room. "Say something in your normal voice, Sidney," he demanded. Rosen said something too low for me to catch. Fuller said he could hear him perfectly. He passed the bullhorn around the room, so that everyone could try it out, and he slung it around his neck on a white cord when we went to dinner, which was served, like all meals at Bear Island, a few hundred feet from the main house in a farmer's cottage that was on the property when Fuller's grandmother bought it. It turned out that there was not enough room at the crowded table to use the bullhorn comfortably, so he soon gave up trying. The sound of many voices reflected off a low ceiling apparently made it almost impossible for Fuller to hear what anyone said, and, sitting at one end of the table watching the others but taking little part in the conversation, he looked, in the flickering light of kerosene lamps, a little sombre and withdrawn.

When dinner was over, though, he suggested to Professor Rosen and me that we stay on at the table and listen to a few things he had to tell us. As I knew from previous meetings, there is no such thing as an ordinary conversation with Fuller. One question is enough to set him talking for an hour or more, and often a question is not even necessary. His talk follows a process that the cyberneticists call "positive feedback," in that each idea sets off a whole flock of related ideas in something like geometric progression; Fuller seems never to have forgotten anything he ever knew, and his command of statistical detail is awe-inspiring. Perhaps the most amazing aspect of these monologues is that, no matter how long and labyrinthine the digressions that crop up along the way, he invariably returns sooner or later to the primary subject of his discourse, and everything turns out to have been relevant. On that particular evening, he talked for a little longer than three hours. His voice gathered strength and momentum as he went along, and he could clearly have continued for another three hours if his listeners had been up to it. The main subject was his own system of mathematics, which he has been evolving for nearly half a century, and which underlies all his work in other fields.

Fuller began by telling us about meeting C. P. Snow in England two years ago. He said he was sympathetic to Snow's view that there is a gap between the "two cultures"—the sciences and the humanities—but he did not agree that this gap had been caused by a spontaneous aversion to industrialization on the part of literary men. In Fuller's opinion, scientists had caused it. Soon after the discovery of electromagnetics, in the nineteenth century, he said, scientists had decided that because electrical energy was invisible, it could not be represented to the layman in the form of models, and so they had decided to stop trying to explain what they were doing in terms that the layman could understand. "That's really the great myth of the nineteenth century," he said. "I told Snow the basic reason for the split was that science gave up models."

Having made sure that this point was firmly established, Fuller set off on a survey of his self-education in mathematics. "At Milton Academy, in Massachusetts, where I went to school, I just loved mathematics," he said. "I found I could get A in it whether or not they liked my face. I was severely cross-eyed then, and not a favorite student ever, and I really believed I was getting bad marks in my other subjects because the teachers didn't like me. But they couldn't do that in mathematics. At the same time, there were certain things that the mathematics teacher was saying and doing that I didn't think were really valid, but it was a game you could learn to play, and you could do it right and get your A. For example, we'd been taught fractions, and one day the teacher—it was a woman—said, 'I am now going to teach you a better way. It's called decimals.' She didn't say why she hadn't shown us the better way to begin with. She showed us

that an eighth is point one two five, and a quarter is point two five, and a third is point three three three, and so on with threes, out the window and over the hill. I noticed that some of these numbers went out the window and others stayed in the classroom, and I didn't think she really knew what she was talking about. I thought she was very pretty and appealing, and if that's the way she wanted to play the game, I'd play it her way, because I'd been brought up to believe that adults knew all the answers and that you were just supposed to shut up and learn, but I also thought she wasn't on any very profound team.

"Later on, we came to geometry. The teacher made a point on the blackboard, then erased it and said, 'That doesn't exist.' She made a row of points, and said, 'That's a line, and it doesn't exist, either.' She made a number of parallel lines and put them together to form a plane, and said it didn't exist. And then she stacked the planes one on top of the other, so that they made a cube, and she said that existed. I wondered how you could get existence out of nonexistence to the third power. It seemed unreasonable. So I asked her, 'How old is it?' The teacher said I was just being facetious. I asked her what it weighed and I asked how hot it was, and she got angry. The cube just didn't have anything that I thought was existence, but I thought I was probably being unfriendly, and so I shut up. I got A's in all my science work, and when I got to Harvard I didn't go on with mathematics, because it was so easy—just a sort of game you played. I thought I'd take something really difficult, like government or English.

"I was kicked out of Harvard. I spent my whole year's allowance in one week, and I cut classes and went out quite deliberately to get into trouble, and so naturally I got kicked out. I was sent to work in a factory in Canada making cotton-mill machinery, and I did very well there. It was a very important phase of my life, for I met shop foremen and machinists, and got to know a lot about their tools and about metals in general. I did so well that Harvard decided I was really a good boy and took me back the following year, but obviously I couldn't stay at Harvard very long. [In his autobiography, Fuller wrote that what really bothered him at Harvard was the social institutions.] So I cut classes and got fired again. This time, I enlisted in the Navy, where again I began to do very well. Well, one day in 1917 I was standing on the deck of my ship looking back at the wake—it was all white because of the bubbles—and I began wondering idly how many bubbles there were back there. Millions, obviously. I'd learned at school that in order to make a sphere, which is what a bubble is, you employ pi, and I'd also learned that pi is an irrational number. To how many places, I wondered, did frustrated nature factor pi? And I reached the decision right at that moment that nature didn't use pi. I said to myself, 'I think nature has a different system, and it must be some sort of arithmetical-geometrical coördinate system, because nature has all kinds of models.' What we experience of nature is in models, and all of nature's models are so beautiful. It struck me that nature's system must be a real beauty, because in chemistry we find that the associations are always in beautiful whole numbers—there are no fractions. And if nature can accomplish all those associations in beautiful whole numbers to make all her basic structures, I thought, then the system will turn out to be a coördinate system and it will be very, very simple. And I decided then, in 1917, that what I'd like to do was to find nature's geometry."

Instead of using points and lines and planes, which had no objective existence, Fuller decided to see what would happen if he started with vectors, or lines of force, which had appealed to him very much when he studied Galileo's diagram of forces in school. He liked vectors tremendously, he said, because they were descriptions of actual physical events. "Your vector has a length that is proportionate to the product of the velocity times the mass," he explained. "Vectors represent energy events, and they are discrete. All my geometry would therefore be discrete geometry, and you wouldn't have to worry about infinity and things going out the window all the time. I was interested in exploring a geometry of vectors, which always represent energy events and actions in respect to other energy events and actions. The vector has velocity, and time is a function of velocity, so such a geometry would automatically have a time dimension. The qualities I had wanted in the Greek cube which the Greek cube didn't have—of heat and weight and age, and so forth—would be implicit in the velocity and the mass that would be translated into energy. . . . Can you fellows go on taking this, or are you getting too tired? You're going to get awfully sleepy in this Bear Island atmosphere."

"No, no," Professor Rosen said. "We're fine."

What followed was a detailed account of the mathematical steps by which Fuller, through his study of vectors, came to the conclusion that nature's geometry must be based on triangles. "The triangle is a set of three energy events getting into critical proximity, so that each one with minimum effort stabilizes the opposite angle," he said. "Now, I found that a quadrilateral—a square, for example—will not hold its shape. No rubber-jointed polygon holds its shape except one that is based on the triangle. So I said, 'I think all nature's structuring, associating, and patterning must be based on triangles, because there is no structural validity otherwise.' *This is nature's basic structure, and it is modellable.*"

Fuller had been picking up steam right along, and by this time he was talking very rapidly. Pausing to take a Japanese felt-tipped pen from his pocket, he proceeded to illustrate the next phase of the lecture with vigorous drawings on a white pad. "Now, if I'm going to subdivide the universe with triangles, how many triangles will it take to give me a system that will have both an inside and an outside?" he asked. "I found that two triangles just fall back on each other and become congruent. I found that it takes a minimum of three triangles around a point. When you put in three triangles, with three common sides, around a point, they form a fourth triangle at the base and what you get is a tetrahedron. We know that nature always does things in the simplest and most efficient way, and structures based on tetrahedrons are the structures that nature uses—these are the only babies that count. All the metals are made up of some form of tetrahedron. All the other shapes you find in nature are only transformable states of the tetrahedron. This is what nature is really *doing*.

"All right, getting back to Snow, then, I showed him how I could make a model of any of nature's structural relationships by using triangulation as the basis. Everything was now back in modellable form, I told him. And soon after that Snow said on the radio that he believed that the chasm between the

sciences and the humanities could be closed—that the conceptual bridge had been found."

A gust of wind buffeted the cottage, throwing open the doors on both sides and scattering the loose sheets of paper that Fuller had torn from the pad. It was eleven o'clock. When the doors had been secured again, Fuller poured himself a cup of tea from a large pot he had been working on ever since dinner. It was quite clear that the Bear Island atmosphere was not making *him* sleepy. He talked for a while about the immense changes that were taking place in the world, and how the really significant developments were going on quite independently of politics, and this brought him to the subject of the fourth Dartmouth Conference, held in Russia the previous summer, which he had attended.

"The Dartmouth Conference was instituted several years ago," he explained. "The first one was held at Dartmouth College, and this one, the fourth, was in Leningrad. It's supposed to be a meeting of prominent Soviet and American citizens, in a wide variety of different fields, to talk over any and all problems. There were twenty-one Russians at our last meeting and sixteen Americans, and that's the way it's been right along—the Russians have been more thorough in appointing people from all parts of their society, most of them the top men in their field. We had some very exciting people, though. We had Paul Dudley White—the Russians told me they considered White the world's greatest cardiologist, and that they trusted him more than any other American; the poor man is so trusted by both sides that he hardly has any time to himself anymore—and we had James Michener and John Kenneth Galbraith and David Rockefeller. One of the Russians got up during a seminar and said, 'Mr. Rockefeller, I'm an old Bolshevik, and I must say you're very different from what I'd always thought of as a capitalist.' They liked him very much. It was a wonderful meeting, and it was decided that it would end with a prognostication by a Russian and a prognostication by an American.

"We had talked very frankly and freely, and we were all somewhat aghast to find that whatever we wanted to do or thought should be done about the problems between us would inevitably be defeated by the bureaucracies on both sides. The Russians, though, were convinced that they had one fundamental advantage over us. They kept saying, 'We have a singleness of purpose in Russia, while in America you're completely competitive and you're always cancelling out each other's good effects.' They said it with such earnestness—they were really convinced it was true. And some of the Americans were not able to answer right away whether it was true or not.

"At any rate, I was chosen to give the American prognostication. The Russian one took up the whole morning, and I had the whole afternoon—fabulous. I always speak spontaneously, because I've found that it really is possible to think out loud. Although I seemingly go over and over the same inventory of thoughts and experiences, I find that each time I do, I learn something new, and that I have to change or rearrange what I've learned, and that I'm not allowed to carry out yesterday's myths. Anyway, I found myself standing up and talking in the following way. I said, 'I don't know why I'm talking to you here, because you're all so ignorant.' Well, they were surprised by that, and I was surprised, too. But then I had to make good on it, so I said, 'Many of you think of yourselves as scientists, and yet you go off on a picnic with your family, and you see a beautiful sunset, and you actually *see* the sun setting, going down. You've had four hundred years to adjust your senses since you learned from Copernicus and Galileo that the earth wasn't standing still with the sun going around it. I've made tests with children—you have to get them right away, before they take in too many myths. I've made a paper model of a man and glued him down with his feet to a globe of the world, and put a light at one side, and shown them how the man's shadow lengthens as the globe turns, until finally he's completely in the shadow. If you show that to children, they never see it any other way, and they can really understand how the earth revolves the sun out of sight. But you scientists still see the sun setting. And you talk about things being "up" or "down" in space, when what you really mean is *out* and *in* in respect to the earth's surface. And you say that the wind is blowing from the northwest, which means that there must be a place called northwest that it's blowing from—being blown, I suppose, by one of those little fat-cheeked zephyrs that used to be drawn on maps. When you scientists say the wind is blowing from the northwest, what's actually happening is that there's a low-pressure area sucking it toward the southeast, pulling the air past you. So why don't you say the wind is sucking southeast, which is what it's really doing?' Well, by this time the Russians were all laughing. They were off their high horse. Next, I told them that young people were always wondering what it was like to be on a spaceship, and that my answer was always, 'Well, what *does* it feel like? Because that's what you're on.' The earth is a very small spaceship. It's only eight thousand miles in diameter, and the nearest star is ninety-two million miles away, and the next star after that is billions of miles away. This spaceship is so superbly designed that we've had men on board here for about two million years, reproducing themselves, thanks to the ecological balance whereby all the vegetation is respiring all the gases needed by the mammals and the mammals are giving off all the gases needed by the vegetation, even though they may think they're just making hot air. The bees go after the honey, which is all they're interested in, and quite inadvertently their little tails knock off the pollen that fertilizes the vegetation. And so I said that in America we're all bees, and we're all after our honey, and inadvertently our little tails knock off quite a lot of pollen, and inadvertently we've made some contributions. Well, the Russians really had a good sense of humor. They realized they were all just after honey themselves, and that their whole argument about singleness of purpose was pretty silly, and that the whole thing was working quite independently of politics.

"And so I said, 'I don't know any man who really knows anything about himself. I don't think anybody in this room can stand up and tell me what he's doing with his luncheon. And no one can stand up and say that he's consciously pushing each of his hairs out of his head in preferred shapes and colors, and I doubt whether anyone even knows why he has hair. In fact, I don't know anybody who really knows anything. But it's very important to recognize what we don't know, and to realize that so far man has been moderately successful in his environment despite his ignorance.' Then I went into Hoyle's prediction that hundreds of millions of planets are going to be discovered, and that not all the human beings on all the planets will have lived to fulfill their functions, and I said, 'I think we have a very borderline case here, and it's about time we began to make some sense.' That's where I really started my talk. My main prognostication was based on the point that,

for the first time in the history of the world, man is just beginning to take conscious participation in some of his evolutionary formulations. And from this point on we're not going to be allowed to be innocent anymore. From ndw on, we're going to have to be very responsible, or the show is not going to work."

Fuller broke off and looked from Rosen to me and back, a sudden smile illuminating his face. "You must find it strange to sit here all this time and hear me talk about me," he said. "But the fact is I really am pure guinea pig to me. I set out many years ago to see what would happen if an individual did certain things. Back in 1927, just after our second child was born, I committed myself to as much of a fresh start as a human being can have—to try to go back to the fundamentals and see what nature was really up to. But I was all alone, and up against the massive corporation and the massive state. 'Can the unsupported individual really get anywhere?' I asked myself. Because I'm not impractical, I'm not a blind idealist. How could I work in the system without capital backing? And I came to the following conclusion: In the universe, everything is always in motion, and everything is always moving in the directions of least resistance. That's basic. So I said, 'If that's the case, then it should be possible to modify the shapes of things so that they follow *preferred* directions of least resistance.' I made up my mind at this point that I would never try to reform man—that's much too difficult. What I would do was to try to modify the environment in such a way as to get man moving in preferred directions. It's like the principle of a ship's rudder, which is something I thought a lot about as a boy here on Bear Island. The interesting thing about a rudder is that the ship has already gone by, all but the stern, and you throw the rudder over, and what you're really doing is to make a little longer distance for the water to go round; in other words, you're putting a low pressure on the other side, and the low pressure pulls the whole stern over and she takes a new direction. The same in an airplane—you have this great big rudder up there, with a little tiny trim tab on the trailing edge, and by moving that little trim tab to one side or the other you throw a low pressure that moves the whole airplane. The last thing, after the airplane has gone by, you just move that little tab. And so I said to myself, 'I'm just an individual, I don't have any capital to start things with, but I can learn how to throw those low pressures to one side or the other, and this should make things go in preferred directions, and while I can't reform man, I just may be able to improve his environment a little. But in order to build up those low pressures I'm going to have to really know the truth.' "

Fuller broke off again, and poured himself a last cup of cold tea. The wind made a sudden restless sound in the fireplace chimney. He leaned back and stared at the ceiling. "Of course, I know that you can't get to the truth," he said slowly. "Heisenberg was right about that—the act of measuring *does* alter what's being measured. But you can always get nearer to the truth. It's something you can get closer to, even though you never get to it. And today the young people really want to know about things, they want to get closer to the truth, and my job is to do all I can to help them. The child is really the trim tab of the future. At any rate, that's the sort of thinking that came out of Bear Island, and that's probably enough for tonight, isn't it?"

EXPOSURE to an hour or more of Fuller's conversation can give rise to extremely varied reactions. Not infrequently, people meeting him for the first time are so taken aback by what seems to them a torrential outpouring of ego that they hear nothing he says, and go away in a state of shock. Others are convinced that, having suffered for years at the hands of people who refused to take his ideas seriously, he is simply enjoying his revenge. Such reactions are rarely experienced by students, who pack lecture halls to hear him and often keep him talking long after the scheduled time. A Fuller lecture can easily run for six hours, and upon occasion he has talked, with only incidental breaks, from eight o'clock in the morning until past midnight. After the first hour, which is usually perplexing, students find themselves tuned in to the unique Fuller wave length, with its oddly necessary word coinings and its synergetic constructions. They dig his humor, which often appears as a sort of wry comment on his own verbal style—as, for example, when digressing to students at the University of London about bird ecology not long ago, he described how "the male birds fly off to sweep out areas of maximum anticipated metabolic advantage," then paused and added, reflectively, "Worms." What's more, students seem to feel that there is really very little ego involved in his monologues, that Fuller *is* pure guinea pig to Fuller, and that when he talks about himself and his experiences, his tone is that of an objective, if greatly interested, third party. Nothing irritates Fuller more than occasional implications by journalists that he is a non-stop talker who loves to hear himself hold forth; he never talks, he says, unless he is invited to do so, but he cannot limit himself to one or two aspects of a complex subject. Since 1927, which he looks back on as the critical year in his life, he has taken himself and his experiences as raw material for a series of experiments aimed at improving man's environment, and to anyone who is interested he will provide the results, in comprehensive form.

What happened in 1927 was that Fuller, at the low point of his career, gave serious consideration to the idea of committing suicide and then rejected it in favor of what he has called "a blind date with principle." For several years after he resigned from the Navy, in 1919, he had done rather well for himself. He had worked as assistant export manager for Armour & Co., and, in partnership with his father-in-law, a New York architect named James Monroe Hewlett (Fuller married Anne Hewlett in 1917), he had formed a company to exploit a building-block method of construction, patented by the two men, which was used in two hundred and forty houses and small commercial buildings over a five-year period. In 1922, the Fullers' daughter, Alexandra, had died, just before her fourth birthday, after a succession of illnesses culminating in spinal meningitis. Fuller began drinking heavily; he recalls that he used to stay up all night drinking, and still have enough energy to work twelve or fourteen hours the next day. When his father-in-law was obliged to sell his stock in the building-block company in 1927, Fuller, a minority stockholder, was informed by the new owners that his services were no longer needed. This blow came shortly after a second daughter, Allegra, was born to the Fullers. In the belief that he had made a complete mess of his life thus far, Fuller considered what seemed to him the only two courses open to him: he could do away with himself, thereby giving his wife and new baby a chance to find someone better equipped to take care of them, or he could devote the rest of his life to the service of something greater than he was, and try to get straightened out that way. In the light of his background—eight generations of Boston idealists, Unitarian min-

isters, and transcendental thinkers (Margaret Fuller was his great-aunt)—the answer was never really in much doubt. In his autobiography, Fuller tells how he stood on the shore of Lake Michigan in Chicago, where he was living at the time, and found himself saying, "You do not have the right to eliminate yourself, you do not belong to you. You belong to the universe."

Fuller moved his family into a slum neighborhood in Chicago, cut himself off from contact with everyone he had known before, and began, he says, to do his own thinking. It seemed to him that, purely by chance, he had already acquired a great deal of valuable experience, having repeatedly found himself working in areas that gave him an insight into the new world of accelerating technology. In the Navy, particularly, his exposure to the principles of ballistics, logistics, radio electronics, and naval aviation had given him a glimpse of future industrial developments that would make it possible—through the use of the new alloys, for example—to do more and more with less and less. This sort of technological movement seemed even then to promise, if carried far enough, a reversal of the old Malthusian concept of the economic forces at work in the world. Malthus had said that the world's population would always multiply more rapidly than the available food supply, and Darwin's theory of the survival of the fittest had seemed to provide a melancholy solution to this perennial problem, and also an ecological justification of war. But if technology could provide more and more goods from fewer and fewer resources, it was conceivable that man could convert himself from an inherent failure, as Malthus had depicted him, into a success in his environment. Technology, of course, is dependent on science, for it requires the discovery by science of certain basic patterns in nature that can be isolated and reproduced by industrial processes. In 1927, then, Fuller dedicated himself to a search not only for these patterns but also for ways in which they could be made to benefit his fellow-man. He is almost alone among twentieth-century scientists in having thus concerned himself at all times with the social implications of his discoveries.

Although society has not always been ready to accept what Fuller has come up with since then, he insists that not one of his inventions has been a failure. His first Dymaxion house, a circular dwelling unit suspended by cables from a central mast, was a successful exploitation of the discovery that the tensile strength of certain metals and alloys is far greater than the strength of the same materials when used in compression. (The term "Dymaxion," with its overtones of "dynamic" and "maximum," was coined by a pair of public-relations men for Marshall Field's, the Chicago department store, where the house was first exhibited, in 1929.) Fuller's Dymaxion three-wheeled automobile, of which three prototypes were built between 1933 and 1935, could turn in its own length; it could also develop a speed of a hundred and twenty miles per hour using a standard ninety-horsepower Ford engine. His 1943 Dymaxion Airocean World Map was the first cartographic system to receive a United States patent, and was one of the first Fuller inventions to arouse the serious interest of other scientists; it shows the whole surface of the earth in a single flat view with no visible distortion. In 1944, the government agreed to release high-priority aluminum alloys for Fuller's Wichita House, a new version of the Dymaxion circular unit. It was to sell for sixty-four hundred dollars, and was scheduled to go into mass production as an emergency solution to the postwar housing shortage, but with the end of the war and the end of rationing the arrangement fell apart. Like a die-stamped, mass-producible bathroom unit that Fuller had designed earlier, the Wichita House was ultimately the victim of caution and inertia in the building industry. Fuller had decided long before that housing was technologically the most backward of all the major industries, and he continued to concentrate his efforts in the field of shelter.

In 1947, Fuller produced the discovery that made him famous—the geodesic dome whose basic, patented formula comes straight from nature's geometry. For a while, all geodesic domes were manufactured by two companies Fuller set up for that purpose, Synergetics, Inc., and Geodesics, Inc. But now he has licensed about two hundred construction and other firms to do the actual manufacturing and building under his patent, and for every dome sold he receives a royalty of five per cent of the selling price. Fuller's domes are now spread throughout the world—more than three thousand of them, according to a recent count. They range in size from small living units to a huge maintenance and repair shed, three hundred and eighty-four feet in diameter, that was put up in 1958 for the Union Tank Car Company in Baton Rouge, and they are just as suitable in the Arctic, where geodesic Radomes house the listening devices of the Air Force's Distant Early Warning Line, as in Equatorial Africa, where Fuller has taught natives to make them out of bamboo, or on the top of Mount Washington, exposed to the highest wind velocities on the North American continent. The Marine Corps has adopted air-liftable geodesic domes as its advance-base shelters, and the Department of Commerce has been using them since 1956 to house its exhibits at international trade fairs. Fuller's domes are a product of his geometry of vectors, their prodigious strength arising from a patented formula that combines interlocking tetrahedrons and icosahedrons so as to balance the forces of tension and compression and thus distribute stresses evenly throughout the structure. Because their strength is all in the invisible mathematics, they can be made of almost any material, including paper, and because the basic structural formula is simple, they can be assembled by unskilled labor, using color-coded parts, in unbelievably short order; in Hawaii, for example, a hundred-and-forty-five-foot-in-diameter dome was assembled in one day by the Kaiser Aluminum company, in time for a symphony orchestra to give a concert inside it that same evening. Although Fuller has farmed out the production of his domes to individual licensees, he has more requests than he can handle to adapt the basic design for various purposes. Right now, he is designing several domes for the 1968 Olympics in Mexico City, a huge dome to cover the Mexico City Plaza de Toros, and a huge geodesic sphere to serve as the United States Pavilion at the 1967 Montreal World's Fair. (Fuller was named the official architect for the United States Pavilion in Montreal, although he has no architect's license and must have all building contracts signed by an associate, a young man named Shoji Sadao.) The domes have brought Fuller wealth and fame, but there are times when he grows a little tired of hearing about them. They are, after all, only one application of a lifetime's research. He once told his friend and biographer Robert W. Marks, "I

did not set out to design a house that hung from a pole, or to manufacture a new type of automobile, invent a new system of map projection, develop geodesic domes or Energetic Geometry. I started with the universe—as an organization of regenerative principles frequently manifest as energy systems of which all our experiences, and possible experiences, are only local instances. My objective was humanity's comprehensive success in the universe. I could have ended up with a pair of flying slippers."

ALTHOUGH, technically speaking, Fuller is not an architect, he has come to be recognized as a powerful force in contemporary architecture. Leading architects here and abroad often make a point of praising his contributions in their field, even though what he has done, in a sense, has been to challenge the whole basis of their aesthetic, pointing out that the supposedly modern and functional Bauhaus-derived architecture of our time is only superficially functional and not modern at all. It is almost as though the architectural profession had chosen to avoid Fuller's challenge by pretending to agree with what he says.

At breakfast the morning after the three-hour lecture on mathematics and other matters, Fuller, seeming not in the least winded, talked for quite a while about the deficiencies of contemporary architecture. He had come to breakfast in a bright-orange slicker, looking somewhat disconsolate, with the announcement that only about ten per cent of the runoff from a brief, hard rain that had taken place during the night had gone into the cisterns; he had been out checking the gutters and rainspouts, and had found most of them badly clogged. This bit of non-functionalism—the drinking water on Bear Island comes from a spring, but water for washing is collected as runoff—led him, by way of a chance remark, to a discussion of the Bauhaus idea and how it differed from his own work.

"You see, the very essence of the Bauhaus was what happened to Germany as a consequence of the First World War," Fuller said. "Having lost the war and suffered so much destruction, the Germans had the problem of rebuilding with very little money. Obviously, one of the things they could do without was decoration. Walter Gropius and those people looked at American industrial engineering about this time, and decided maybe they could turn that into an aesthetic. They didn't make any engineering contributions. These men simply used the hard edge that had been developed in engineering. They didn't invent a new window or a new structural principle, or anything like that; they didn't go in back of the walls and take a look at the plumbing, for example. Mies van der Rohe, who was the most perceptive of all of them, saw the glasswork in American stores and began making drawings of buildings that were all glass. Now, I was proposing something completely different at that time. I was saying that the same science that had gone into weaponry and the development of the advanced technology of the aircraft industry had also made it possible to make very much lighter and more powerful structures. I had come to the conclusion in 1927 that Malthus might be wrong, you see, because I'd realized that real wealth is *energy*, not gold, and that it is therefore without practical limit. Einstein and Max Planck demonstrated once again that energy could neither be created nor lost and that it left one system only to join another—the famous law of conservation of energy. And this meant that wealth was not only without practical limit but indestructible. Man's intellect, his ability to tap the cosmic resources of energy and make them work for him, had really caused wealth to be regenerative, or self-augmenting. The main thing, then, was to use this great energy-wealth to help man instead of to kill him—for example, in designing ways to house the third of humanity that was without adequate shelter. At any rate, that was very different from what Gropius taught his students. And now Mies tries to confuse me by saying 'Less is more'—meaning, I suppose, that less decoration is more effective. But that's hardly the same as doing more with less in making an airplane."

After a moment's reflection, Fuller continued, "Architects, engineers, and scientists are all what I call slave professions. They don't go to work unless they have a patron. But architects are the most slavish of all, and they work under a system that hasn't changed since the time of the Pharaohs. When you're an architect, the patron tells you where he's going to build, and just what he wants to do. And he says, 'My brother's in the hardware business, and my wife wants this, and here's the building code, and the labor laws, and here are the zoning regulations, and here's Sweet's catalogue. I don't want anything special outside of it.' So the architect is really just a tasteful purchasing agent. He discovers he's inherited a skeleton frame and guts, and all he can do is put in curtain walls—what I call exterior decorating. And for this you don't really need an architect at all. Only about four per cent of the building done in America involves architects, in fact. So who does design what you build? I've found that the real design initiative comes from way, way out, and gets into the prime contracts for hardware and so forth, and I've also found that the important hardware comes originally from those people who are producing the weaponry—battleships and airplanes. The first electric-light bulbs were developed for use on board battleships. The same thing with refrigeration and desalinization plants, which the Navy has had for half a century.

"You see, it surprises people when you tell them that since the last ice age three-quarters of the earth has been water, and that of the one-quarter that is land very little has been lived on. Ninety-nine per cent of humanity has lived on only about five per cent of the earth—a few little dry spots. Now, the law has always been applicable only to this five per cent of the earth, and anyone who went outside of it—the tiny minority that went to sea, for example—immediately found himself outside the law. And the whole development of technology has been in the outlaw area, where you're dealing with the toughness of nature. I find this fascinating and utterly true. All improvement has to be made in the outlaw area. You can't reform man, and you can't improve his situation where he is. But when you've made things so good out there in the outlaw area that they can't help being recognized, then gradually they get drawn in and assimilated. A good example of what I mean is going on right now in the space program. I'm on the advance-research team of NASA, on a consultant basis, working with some very good people on this problem of how to keep man in space. Now, the real purpose of the space programs at the present time is simply to get the highest weapons advantage, and the side that gets it will rule the universe. This is greatly hidden from people by all the talk of getting to the moon, but the space platform, the military advantage, is really *it*. In order to maintain advantage in space, though, where there's no atmosphere and no water and no sewer lines and no berries to eat, for the first time in history you have to look out for man. Not just for the weapon but for the individual. And this is really the most significant

part of the whole thing, as far as I'm concerned. Until now, making more effective weapons on earth never involved making life better for man. The little container that sustains man in space will actually be the first scientific house in history. Inadvertently, man is trying for the first time to learn how to make man a success: It's inadvertent, but it's being done."

The whole question of design initiative is central to Fuller's vision of utopia. The initiative must be wrested from the military strategists by comprehensive designers, he says, if we are to escape destruction. And where are the comprehensive designers to come from? Despite his reservations about most modern architects, Fuller is convinced that the leaders of the great new technological revolution will come from the architectural profession, which, in an over-specialized age, is almost the only profession that is trained to put things together and to think comprehensively. Architectural training must first be thoroughly overhauled and placed on a new footing, however, and Fuller has been doing quite a good deal lately, trim-tab fashion, toward that end. For some time, he has urged the creation of research centers at leading architectural schools, where students and professional architects can work together in anticipation of future needs, and within the last few years a number of universities in this country and abroad have set up such centers, which are often under Fuller's direct guidance. Fuller has visited a hundred and seventy-three colleges and universities, all told, and architectural students at a great many of them now exchange information and keep in touch with each other and with a "World Resources Inventory" that Fuller has set up at Southern Illinois University—a vast compilation of data on raw and organized resources, human trends, and projected human needs. These developments encourage Fuller to believe that the comprehensive design initiative is finally getting into the right hands. He devotes a large proportion of his time and energy now to coördinating this worldwide student movement, which remains, at his insistence, loosely organized and resolutely non-political. In Paris last June, at an assembly for architectural students held in conjunction with the International Union of Architects' Eighth Biennial World Congress, the students adopted a proposal by Fuller that the years from 1965 to 1975 be designated as a World Design Science Decade. The goal, simply stated, is "to render the total chemical and energy resources of the world, which are now exclusively preoccupied in serving only 44 per cent of humanity, adequate to the service of 100 per cent of humanity at higher standards of living and total enjoyment than any man has yet experienced."

BY the time Fuller had concluded his remarks on architecture and the design initiative, it was nearly one o'clock. The weather had cleared during the morning. A benign sun presided over the blue water and dark-green islands of the bay, and the seventy-five-mile sweepout left one's eyes feeling freshly washed. Following the custom of summer people in all latitudes, several members of the family came to lunch with the observation that it had turned into "a real Bear Island day."

Later that afternoon, I set off with Fuller for a tour of the island. The weather was magnificent and he took deep breaths as he walked, stopping short when he wanted to say something, then forging ahead rapidly with short, vigorous strides. He had his two-way bullhorn slung around his neck, but he scarcely ever bothered to use it. "I really feel quite wonderful," he announced at one point. "When I got here, three days ago, I was in terrible shape, and already I'm getting my energy back."

We crossed a long meadow sloping away from the main house and past the dining cottage, and headed toward the heavily wooded southern end of the island. On the way, Fuller stopped to show me a small graveyard—three headstones in a neatly fenced plot. "When my grandmother bought this island," he said, "the settlers were down to two families—the Parsons and the Eatons, both fishermen-farmers. They moved back to the mainland, and we agreed to keep up their little burial ground. We've found gravestones all over the island, you know, some of them going back a century and a half, and we've also found eleven cellar holes, which shows you how much life there's been here. These islands have been lived on for generations. The earliest settlers from England were massacred when they tried to build on the mainland, but islands were easier to defend. You'll find that the British charts of 1765, or thereabouts, show all the Penobscot Bay islands, many with the same names they have today. You must get my sister Rosie to tell you about the early history of the island sometime. She knows a lot about it. Get her to tell you about the time the Seventh-Day Adventists came here to wait for the end of the world." (I did ask Mrs. Kenison about the Adventists that evening, and she told me that in 1901, or thereabouts, all the members of this sect in Bangor had rowed over to Bear Island one day, climbed trees, and settled down to wait for the end of the world, which they expected momentarily. No one knew why they had picked Bear Island. When the scheduled event failed to take place, they climbed down and rowed back.)

We pushed on into the woods. Fuller paused at frequent intervals to sniff the wild raspberry and balsam and other forest scents, which he said were especially delicious just after a rain. His hearing and eyesight were not all they might be, he said, but his sense of smell had always been very good. Our path, which had followed the edge of the high bluff at the northern end of the island for a while, now descended until we were only a few feet above the sea, which sparkled brightly through a green curtain of spruce. We passed a rocky beach and continued around a point, until Fuller led the way down to a smaller beach consecrated to nude male bathing (the ladies' beach is nearer to the main house and similarly secluded). Fuller stood facing the water, smiling his toothy smile. "Everything I can really remember begins here," he said happily. "There's Eagle Island, where I used to row for the mail every day. And there's Butter, and Fling, and Burnt, and Dagger, and Sheep, and Oak, and around there is Horse Head and Colt Head. Time and time again, the views of this bay are in my mind as I go around the world. And the atmospheric conditions, the sudden changes you get. That northwest wind that came in last night and pushed the doors open—it always comes suddenly that way. It just cleans everything out. You can understand how it was on an island, can't you, old man? All the things that had to be done, all the chores. And then I often felt like being by myself, so I started making experimental houses on different parts of the island. I didn't have any regular allowance, but I'd have money left over from birthdays and things, and I'd buy a hammer and some nails and start making a house. . . . Well, I think if we're going to swim we'd better do it now."

Fuller started to remove his clothes, laying them out carefully on the warm, jagged rocks, which he identified for me as the top of the Allegheny range and probably among the oldest geological formations in existence anywhere. As he was untying his sneakers, he reached down and picked up a pebble that was

almost a perfect tetrahedron. A moment later, he found another, and then another. It was amazing, he said, how often you came across this shape on the beach. Fuller took off his socks and then put his sneakers back on, and warned me to do the same; the tide was out, and the bottom would be strewn with sea urchins. His next bit of instruction concerned the art of swimming in Maine water. By going in and out very quickly several times, he said, and warming up between plunges, one could build up a tolerance to the cold. On our fourth entry, the crystalline water actually did seem a trifle less numbing, and I was prepared to believe that after a while it might become almost comfortable. Fuller warmed up between plunges by skipping stones on the water. He claimed he could skip any stone I found, whether it was flat or not, and he had no failures. Just as we were coming out of the water for the last time, a big seal surfaced near the rocky point some twenty yards away; he gave us a long, incredulous look and then vanished silently.

I had asked earlier to see Fuller's new dome. We went there directly from the beach, retracing our path through the woods and then cutting in back of the dining cottage. The dome stands above the harbor on a high point of land, looking out toward one of the other two Fuller-owned islands, Compass, and, beyond that, to the Camden Hills, on the mainland. Put up two summers ago to replace an earlier, paperboard dome that had been destroyed by a falling tree in a storm, this one is what Fuller terms a "tensegrity" structure—meaning, he said, that the forces of discontinuous compression and continuous tension that hold it together are entirely differentiated, or separate. The compression members are two-by-four timbers. They are held apart—not joined together—by the tension members, light Dacron cords, in such a manner that a stress exerted anywhere on the surface is immediately distributed throughout the entire structure, rendering the whole construction immensely strong. As I stood inside the dome, which Fuller had not yet got around to covering with a plastic skin, the sense of lightness, grace, elegance, and unseen strength was strangely exhilarating. It was easy to understand why Fuller, throughout his career, has had the immediate and enthusiastic support of artists, if not of engineers and architects. While he greatly appreciates this sort of recognition, and values highly his long and close friendships with such artists as Isamu Noguchi and Alexander Calder, he makes it clear that in his own work aesthetics plays only an incidental role. "I never work with aesthetic considerations in mind," he told me that afternoon. "But I have a test: If something isn't beautiful when I get finished with it, it's no good."

Our path back to the main house led past a sturdy little farmer's cottage, which Mr. and Mrs. Kenison and their children now occupy each summer. Mrs. Kenison asked us in to have a cup of tea and to inspect a new room that Mr. Hardie had nearly finished building for them, and a little later I left Fuller there, chatting contentedly in his sister's parlor. His affection for every member of the family is apparent at all times, but it had struck me that he reserves a special fondness for Mrs. Kenison, as she does for him. "Bucky really became the head of our family after our father died, in 1910," Mrs. Kenison told me that evening, after she had filled me in on the Seventh-Day Adventists. "He was both father and brother to me, and I just adored him always. Of course, he did worry Mother. Mother was left with four children and very little money when Father died, and Bucky's improvidence was her despair. I can remember how night after night she used to bawl him out and I'd sit in the next room just shivering. And then she would get the husbands of her friends to bawl him out. He had a terrible time in school, you know, although he always got good marks. He couldn't play games, because of his glasses, and he was almost always in trouble. Mother so wanted him to be a success, and I'm afraid she died without knowing that he ever would be."

Actually, Fuller came rather close to a major success in 1933, the year before his mother died. His first three-wheeled Dymaxion car, built by a team of hand-picked mechanics in Bridgeport, had stopped traffic in New York and other cities and drawn considerable publicity nationally, and some engineers believe that it might very well have revolutionized the automobile industry if it had not suffered a stroke of exceptionally bad luck. Just outside the main gate of the Chicago World's Fair, the Dymaxion car was rammed by a conventional vehicle, which happened to belong to a city official. The Dymaxion was overturned and its driver was killed. The other car was immediately towed away from the scene, and its involvement completely escaped the notice of reporters, who subsequently ascribed the accident to the Dymaxion car's "freak" design. ("THREE-WHEELED CAR KILLS DRIVER," ran a headline in one paper.) A later investigation disclosed the true facts, but the stigma remained, and in order to erase it, Fuller put his whole inheritance from his mother's estate into the production of two more automobile prototypes. Unfortunately, when the two new Dymaxion cars had been completed and sold—one to a racing driver, the other to Leopold Stokowski—two of the subcontractors whom Fuller had engaged presented a bill for a great deal more than the sum he thought they had originally agreed on, and then sued for the difference. Fuller, dead broke, was unable to pay. He held a one-eighth interest in Bear Island, and the two men then came to Maine and pressed a claim to it. A local judge awarded it to them. Several years later, Mrs. Kenison managed to buy back her brother's share, and Fuller paid her back as soon as he could.

During my talk with Mrs. Kenison after dinner, the whole family gathered in the living room of the main house to watch Fuller put on a visual demonstration of his mathematics. He went upstairs to his room and returned with a bag full of bright-colored plastic rods and rubber elbow joints, which he had had a toy manufacturer make up for him, and proceeded to construct out of them five geometrical shapes—a dodecahedron, a cube, a tetrahedron, an octahedron, and an icosahedron. Seated gnomically on a bench by a window, with his audience gathered in a half circle around him, he took up each shape in turn and showed us that the cube and the dodecahedron, no matter how you tried to prop them up, invariably collapsed, while the other three, whose structural basis was the triangle, held their shape. The accompanying explanation was rather complex, and it was close to midnight by the time he had finished it. He was then prevailed upon to sing, in a faltering but dogged tenor, some lyrics he had once written to the tune of "Home on the Range." They began like this:

There once was a square, with a romantic flair,
Pure Beaux-Arts, McKim, Mead & White,
Then modern ensued; it went factory-nude—
Mies, Gropius, Corbu, and Wright.

Roam, home to a dome, where
Gothic and Roman once stood.
Now chemical bonds alone guard
our blonds,
And even the plumbing looks good.

Let architects sing of aesthetics
that bring
Rich clients in hordes to their knees;
Just give me a home in a great circle
dome
Where the stresses and strains are
at ease. . . .

Several of Fuller's listeners took the end of his song as an opportunity to retire. The rest of us followed him outdoors to look at the full moon and feel the earth's rotation. If you stood with your feet wide apart and faced the North Star, he explained, you would, after a certain length of time, begin to sense the motion of the earth in the night sky as it turned with you aboard. You could actually feel it, he said, as a pressure on your left foot. After about fifteen minutes, several of us said that we were beginning to get something like the sensation he meant, and this pleased him enormously. When I finally left to go to bed, Fuller was explaining triangulation more fully to one of his nieces, out there under the great dome of the stars.

DURING the four days that I spent on Bear Island, it often occurred to me that the highly stimulating and occasionally exhausting "Bear Island atmosphere" that Fuller had talked about the first night was more or less directly the product of his own presence there. He never seemed to tire, although he seldom went to bed before two in the morning—four hours' sleep, he said, was his usual quota. When the rest of the family got together for cocktails in the late afternoon, Fuller might go upstairs to his room to work on one of several articles or books he was writing; he gave up alcohol during the Second World War, he told me, not because he could not handle it but because he had decided that people who did not want to take his ideas seriously often ascribed them to his drinking habits. One of the writing projects that occupied him during my visit was a personal summing up of what he had learned from life, which had been commissioned by the editor of the *Saturday Review*, Norman Cousins. Fuller had decided to cast it in a unique quasi-poetic form that he refers to as "mental mouthfuls and ventilated prose." He has written a number of things in this form, including an unfinished "Epic Poem on the History of Industrialization." It all began in 1936, when he was asked to write a technical paper for the Phelps Dodge Corporation. A director of the company found the paper totally incomprehensible, and said so. Somewhat miffed, Fuller gained an audience with the man and proceeded to read the paper aloud to him in carefully metered doses, watching his face to make sure that each portion was understood before he went on to the next. "Why don't you write it that way?" the director asked when he had finished reading. Fuller went home, rewrote the paper in metered doses, and resubmitted it. "This is lucid," the director said. "But it is poetry, and I cannot possibly hand it to the president of the corporation for submission to the board of directors." Fuller insisted that it wasn't poetry at all but simply a chopped-up version of the original prose report. The director said he was having two poets to dinner at his house that night, and would show the paper to them and ask their opinion. The following morning, he called Fuller into his office again, and said, "It's too bad—they say it's poetry." The report was finally put back into prose form, though with a great many dots, dashes, and asterisks to separate the mental mouthfuls. Ever since that time, however, Fuller has frequently found himself putting down his thoughts in the ventilated form. He showed me the rough draft of his article for the *Saturday Review*, and I saw that it contained a number of the ideas he had been discussing at somewhat greater length during the last few days. At one point, I read:

Fission verified Einstein's hypothesis
Change is normal
Thank you Albert!

And, a little farther on:

Nature never "fails."
Nature complies with her own laws.
Nature is the law.

Nature as it presented itself on Bear Island certainly offered unlimited stimulation to Fuller's thought processes. I was constantly fascinated to see how, his interest having been piqued by some bit of flora or fauna, he could suddenly take off on long and adventurous flights of erudition. The simple act of cutting out a spruce sapling that had elected to seed itself in a stone retaining wall started Fuller thinking about pruning as an art—the art, he said, of "killing without killing." This led him, by a lightning transition, to a discussion of the whales that came up through the Bering Strait each year, and of the Eskimos who spoke of the whale with love as their great brother and said that the great brother asked them to kill him very expertly, so that he would return in great numbers the following year. "And all this, by the way, is very close to the ancient bull worship in Crete," Fuller added. "The bull is, of course, the male fertility, and the killing of the bull in Crete was something that had to be done very beautifully and expertly, which is really what goes on today in the bull ring, although in a debased form. The Cretans played games of jumping over the horns and doing acrobatics on the back of the bull and dancing around him all day long." Fuller went on to describe the clothing worn by the Cretans at these ancient bull festivals, and then said that it had been taken over by gypsies from northwestern India on their way to Spain, and this brought him, quite naturally, to the true history of flamenco dancing, which, he said, the gypsies had also taken over from the Cretans. Flamenco, he explained, had originated on shipboard. It had grown out of the sounds made on the hard decks of Cretan ships—sounds echoed in the staccato clatter of the dancer's heels in the classical flamenco. Fuller demonstrated a flamencolike dance step, which he had learned, he said, from a South American Indian.

Once Fuller has embarked on one of his verbal flights, I found, he is virtually impervious to distraction or discomfort. As we were coming out of the water rather late one afternoon, while the last rays of the sun lingered on the men's beach, the subject of New Zealand came up, and in short order he was well launched on the story of his visit to the Maori anthropologist who was also Keeper of the Chants, and his theory of how the Maori navigators had discovered the prevailing wind patterns in the southern latitudes known as the roaring forties, and had used them in sailing around the world as long as ten thousand years ago. It was an interesting story, but by the time he had come to the end of it, the sun was well down behind the trees and a cool breeze was blowing from the northeast (or sucking, rather, from the southwest). Suddenly noticing that I looked a little chilly—I had felt that it would somehow be in poor taste to get dressed before Fuller did, and while he was talking—he

quickly put his clothes back on and then led the way to the house at a fast trot, pausing only to pick up an exceptionally good example of "our friend tetrahedron." Fuller himself was not a bit cold.

THE whole story, as Fuller sees it, of the tie-in between the earliest history of navigation and the development of mathematics emerged the next morning. Fuller rowed me over in his dinghy to Little Spruce Head—a thickly wooded island, which he now owns outright, having bought out the rest of the family's shares in it—and we spent the morning exploring it. On the way over, he talked nostalgically about the Swedish-built Nagala, a thirty-metre sloop he had owned, describing her as the most beautiful boat ever designed. He had sold her the year before (retaining the dinghy, in which we were at that moment afloat), because he used her seldom, but he still dreamed about the boat and often thought of buying her back. She was a needle, a wraith, he said, and the emotions you felt about her were of the same kind as the emotions you felt about a beautiful woman. I asked how she had come by her name. He explained that in most languages "na" was the ancient word for the sea—the root of all marine words like "navigation" and "navy" and "nautical"—and that Naga had been the great serpent god of the sea in prehistoric times. When man took the tremendous risk of going to sea in boats, Fuller said, he gradually learned that by making a snake's path in the water—that is, tacking—he could navigate against the wind, and this was really the beginning of science and technology, and the beginning of the idea, which we now associate with the Western cultural tradition, though it was born in the South Seas of the Pacific, that nature could be studied and made to serve man's needs and desires. "Nagala," of course, was simply the feminine form of "Naga."

On the way back to Bear Island, I took the oars and asked Fuller to go on talking about the early history of navigation, and he outlined his theory on the subject, which is nothing less than comprehensive. At the beginning, he said, when men first put to sea, on rafts, they just drifted away from the mainland of Asia on the Japan Current, going where God seemed to will. Much of the philosophy of the Orient may have stemmed from this willing submission to fate as sensed in nature, he said—this drifting away and never coming back. Then, after many centuries, successors of these earliest seagoing drifters who had found their way to the South Seas, and who may very well have been Maoris, learned how to steer their rafts with crude log rudders and, eventually, how to put up masts in the form of live trees, whose leaves caught the wind, and gradually there evolved the proa, with a mast and sail that could be moved from one end of the boat to the other, and this led, in turn, to the philosophically and technically enormous step of into-the-wind sailing. The men who dared go against God's will and sail into the wind, Fuller said, also wanted to be able to come back where they had started from, and this was the real beginning of navigation. The sailors of the South Seas made the world's first navigating devices, which were crude combinations of notched sticks that could be used to plot the position of a boat between two fixed stars—the only visible points of reference. And this early three-point navigation, Fuller said, was the beginning of mathematics—the first system of true calculation, as opposed to the simple scratchings on rock that landlubbers used in counting their livestock.

Gathering verbal momentum but still managing to direct my own somewhat serpentine rowing efforts, Fuller described how the earliest navigators gradually spread throughout the island world of Micronesia, and how they had gained great influence, because of their seemingly magic power to go great distances and return with treasure from no one knew where; they guarded the secrets of navigation, he said, and even lived apart from the other members of their tribe while they were onshore. They became the high priests and witch doctors and spiritual leaders of their people, and they continued to develop their secret mathematical knowledge, and their successors grew more and more proficient at mathematics and astronomy, and more and more daring in their navigation. They reached India, where they built tall star-sighting towers on the mainland, and they learned how to ride the monsoons across the Indian Ocean in dhows until eventually they went overland to the Mediterranean. The descendants of these navigators formed the priesthood of the Babylonian and Egyptian civilizations, became famous as Phoenician navigators, and established the brilliant and powerful Minoan civilization on Crete, still without relinquishing the secrets of the mathematical knowledge that was the source of their power, and *their* descendants, in turn, pushed on, in bigger and more seaworthy boats, all the way up the Atlantic coast of Europe to England and Scandinavia, where they became known as Vikings, and down the rivers of Russia and out across the North Atlantic to Greenland and America. When the Ionian Greeks overwhelmed the Minoan civilization at Knossos, on Crete, however, the secret mathematical code was finally broken, and immediately afterward, to the amazement of all subsequent historians unacquainted with Fuller's theory, Greek science suddenly blossomed forth with quadratic equations and other highly advanced methods of calculation. "And now," Fuller said, "we come to the Garden of Eden story in the Old Testament, and we find that Eve was created out of Adam's rib, and I am going to tell you that Eve was not a woman at all—she was the boat. Boats have been feminine from the beginning, and Eve was the ribbed, deep-sea ship that took the man Adam into the great globe-girdling experience that proved to him the earth was round and therefore finite. And the apple from the tree of knowledge represented the earth, and the serpent was Naga, the great god of the sea, and this is really the very, very long-hidden story."

As Fuller told it, the whole rousing saga sounded absolutely irrefutable. He expects to write a book about it within the next year or so—one of five books by him that the Macmillan Company has contracted to publish—and the film director John Huston, a friend of his, has said he wants to make it into a motion picture.

There is no doubt whatever in Fuller's mind that the whole development of modern science and technology has resulted from a willingness on the part of a very few men to sail into the wind of tradition, to trust in their own intellect, and to take advantage of their natural mobility. According to Fuller, the influence of this tiny minority, the navigator-priests of pre-history who ventured into the outlaw area and returned with the new wealth that was knowledge, was always far greater than that of the kings or other rulers to whom they were officially subject, and the situation is no different today; it is modern technology, rather than political leadership, that directs the real movement of contemporary history. "Take away the energy-distributing networks and the industrial machinery from America, Russia, and all the world's industrialized countries, and within six months over two billion swiftly and painfully deteriorating people will starve to death," he has written. "Take away the politicians, all the

ideologies and their professional protagonists from those same countries and leave them their present energy networks, industrial machinery, routine production, and distribution personnel, and no more humans will starve nor be afflicted in health than at present."

The colossal irony of our time, of course, is that the scientific knowledge that has made utopia possible has also made world suicide a distinctly plausible alternative. As Fuller once put it, "Either war is obsolete or men are." The issue will be decided one way or another within the next thirty years, he believes—but not by the politicians. Much as the political leaders in Russia and America might like to divert science and technology from weaponry to livingry, they are prevented from doing so by the opposition leaders within their own systems, who would use any relaxation of the national military posture as evidence of weakness or treason. "It comes to those who discover it, all round the world, as a dismaying shock, to realize that continuation of the weapons race and of cold and hot warring are motivated only by intramural party fears of local political disasters," Fuller wrote last spring. "The world's political fate does not rest with leaders at the summit, expressing the will of world people, but with the local ambitions and fears of lower-echelon political machines, within the major weapons-possessing nations, whose vacillation is accompanied by an increasing spread of the atomic weapons-possessing nations. . . . All political machine professionals of all political states will always oppose loss of sovereignty for their own state. Solution of the impasse, if it comes at all, must clearly come from other than political initiative."

Fuller is sure that the solution can come only from a design revolution to be carried out by today's students. Time after time during my stay on Bear Island, he returned to the subject of the student movement, on which he pins all his hopes for the future, and he returned to it once more in the last conversation I had with him before leaving. We had gone for a swim that morning, and were thawing out on the warm rocks and talking about automation. Fuller has a lot of thoughts about automation (which he prophesied many years ago), and he has recently published a little book called "Education Automation" (Southern Illinois University Press), about coming changes in the educational process, that is creating quite a stir in academic circles. The essence of his theory is that education will be the major industry of the future, for automation increasingly will make the old concept of work obsolete and everyone will spend more and more of his nonleisure time in research and reëducation to keep up with a constantly accelerating technology. "Everybody will be going back to school periodically," he told me. "But, of course, the university itself won't be anything like what it is now. We'll get rid of all the teachers who are just holding on to their jobs in order to eat—all the deadwood, which is the biggest problem in a university anyhow. The deadwood will get fellowships to study or work on their own, and TV will come in to take over most of the actual teaching. There will be a large technical staff making documentary movies. The university is going to become a really marvellous industry, with tools like individually selected and articulated two-way TV that will permit any student anywhere in the world to select from a vast stockpile of documentaries on any subject and watch it over his own TV set at home. The individual is going to study mainly at home. And the great teachers won't have to spend their time delivering the same lectures over and over, because they'll put them on film. The teachers and scholars will be free to spend their time developing more and more knowledge about man's whole experience—past, present, and future."

"But what about the students?" I asked. "How will they react to being cast adrift in a world of impersonal educational machinery? Isn't part of the answer implied in the recent disorders at modern multiversities such as U.C.L.A.?"

Fuller considered the question. "You know, young people sometimes have an infallible sense about these things," he said, at last. "In my youth, we used to talk about 'square shooters.' Today, when a student calls somebody a 'square' he means something entirely different. It doesn't imply that he's lost respect for integrity, or anything like that. A 'square' these days is somebody who's static, immobilized, obsolete—as obsolete as the square box in architecture. Today's student knows instinctively that his world is dynamic, not static, and that the normal state of affairs is constant change and evolution. He also knows that a great many of our venerated institutions, educational and otherwise, are obsolete, and these are what he's reacting against all over the world, sometimes rather violently. Look here, old man, the present crop of university students are the Second World War's babies, and they're astonishingly different from any previous generation. A lot of them were born when their fathers were away at war, and a lot of them were looked after by baby-sitters while their mothers worked in munitions factories. Besides which, they are the first humans to be reared by what I call the third parent—television—which helped them from the very beginning to think 'world.' And look what's happened in the world since they were born. First off, the atomic bomb. When they were about four years old, the giant computers began commercial operation. When they were eight, men climbed Mount Everest. When they were ten, they were immunized against polio. When they were twelve, Sputnik went up and the first civilian nuclear reactor went into operation. When they were thirteen, the atomic submarine Nautilus crossed from the Pacific to the Atlantic under the North Polar ice. When they were fourteen, a Russian rocket photographed the far side of the moon and returned to earth. When they were fifteen, the bathyscaphe took men down to photograph the bottom of the Pacific Ocean's deepest hole. When they were sixteen, a Russian orbited the earth in a rocket. When they were seventeen, the DNA genetic code for the control of the design of all life was discovered. This generation *knows* that man can do anything he wants, you see. These people know that wealth is not money—that it's a combination of physical energy and human intellect—and they know that energy can be neither created nor destroyed and that intellectual knowledge can only increase, and that therefore total wealth cannot help but increase. They also know that they can generate far more wealth by coöperation on a global scale than by competition with each other. And they realize—or at least they sense—that utopia is possible now, for the first time in history. All past ideas of utopia were unrealistic, because it was assumed that Malthus was right and there would never be enough physical resources for more than a tiny proportion of humanity to live in comfort. No one ever thought of invisible technology doing more with less. Previous utopians didn't think in terms of airplanes getting to increase their power thousands of times over while reducing their engine and airframe weights per horsepower by ninety-nine per cent. No one thought of communications going from wire to wireless. No one thought of a communications satellite weighing a tenth of a ton and out-

performing seventy-five thousand tons of transatlantic cables. For the present generation of students, though, these are the facts of life. And yet they see their political leaders locked in the same old static mentality, still putting everything into weaponry, although it's perfectly obvious where that's taking us."

Fuller fell silent. After a moment or so, he got up and walked to the edge of the water and stood there, looking across at Eagle Island, and then, with a quick motion, he stooped to pick up a stone and send it skipping fifty feet out into the bay. I looked at my watch and saw that it was nearly two o'clock. The boat taking me over to Sunset was to leave at two-thirty, so we headed back toward the main house. On the way, I asked Fuller whether he felt that there was anyone in his own generation working in the same direction he was. He stopped to ponder the question. He stood stock-still, his eyes raised reflectively, and then said, "No, not really. I've been hopeful at times, but I find they don't really take the fundamental initiative. I just seem to be a maverick in that respect. And I didn't decide to take the initiative because I thought I was so good, either—it was only because no one else was doing it."

We walked on up the path, and came out into the meadow below the main house. As I caught up with Fuller, I saw that he was smiling his chip-toothed smile. "You know, in Greece last month, Doxiadis gave a big dinner party, at which he asked me to make a speech," he said. "And when it got to be time for the speech, Doxiadis got up from the table and said that he was not going to introduce me—he was going to leave that to a member of my own generation. And up to the platform stepped his daughter, who graduated two years ago from Swarthmore. Lovely girl. Well, I sort of liked that. And then, after dinner, this same girl asked me if I would speak to a group of young postgraduate-student friends of hers from the university in Athens—young scientists and mathematicians—and naturally I said I'd be glad to. It turned out to be one of the most fascinating evenings of my life. I found that all these young people were really *thinking*. Their questions were brilliant, and they had such a clear grasp of the important issues, and their interest and their enthusiasm were so great—it was a strange thing, but I felt as though all the centuries had rolled back and I was really talking to the young thinkers of ancient Greece. We didn't break up until three-thirty in the morning. I don't believe I've ever felt such a spirit as I did that night, just two weeks ago. It's this sort of thing that makes me so sure we're going to come through. Everything centers more and more on the young people, but they're up to it. World is going to work for world, that's all."

After I had said my goodbyes at the main house, Fuller insisted on walking down to the dock with me. On the way, he invited me to join a contest he was sponsoring, with a substantial prize for the person who came up with the best substitute for the word "sunset." It bothers him quite a bit that his summer mailing address—% Sunset Post Office, Maine—happens to involve a term of which he disapproves on scientific grounds, although he ruefully admits that it will not be easy to hit on a satisfactory replacement for "sunset," with its entrenched poetic associations. I said I would do my best.

Mr. Hardie had the engine of the launch warming up when we arrived. I put my suitcase aboard, and turned around to find that Fuller had gone off to look for something on the little strip of beach near the dock. He returned in a few moments, smiling broadly, and handed me a rather lumpy but undeniably tetrahedron-shaped stone. "Goodbye, old man," he said, raising his voice above the noise of the engine. We shook hands, and I climbed aboard. He stood at the end of the dock until the launch was far out in the bay, waving energetically from time to time, and looking, for the moment, as though there were absolutely nothing in the world that he had to do.

—Calvin Tomkins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TIME ESSAY

THE FUTURISTS: Looking Toward A.D. 2000

THE U.S. has always been a country in love with the future. Americans have never quite shared the traditional notion that prying into tomorrow is suspect if not downright dangerous—the sort of feeling that made Dante consign soothsayers to the fourth chasm of the Inferno. On the contrary, the U.S. readily accepted the fact that modern science established progress as a faith and the future as an earthly Eden. Yet recently, the American passion for the future has taken a new turn. Leaving utopians and science-fiction writers far behind, a growing number of professionals have made prophecy a serious and highly organized enterprise.

They were forced into it by the fact that technology has advanced more rapidly in the past 50 years than in the previous 5,000. Men in business, government, education and science itself realize that they must look at least two decades ahead just to keep abreast, must learn to survive under totally different conditions. The new futurists, as they sometimes call themselves, are well aware of past failures of vision. Soon after World War II, top U.S. scientists dismissed and derided the notion of an accurate intercontinental ballistic missile, and as late as 1956, Britain's Astronomer Royal called the prospect of space travel "utter bilge." Relying on the atom's almost limitless energy, the computer's almost limitless "intellect," the futurists predict an era of almost limitless change. With remarkable confidence, and in considerable detail, they present a view of man not only in total control of his environment but of his own brain and his own evolution.

New Skill & Time

The exploration of the future has become a sizable business. General Electric has set up Tempo (Technical Management Planning Organization) in Santa Barbara, where 200 physical scientists, sociologists, economists and engineers contemplate the future on a budget that tops $7,000,000 a year. The armed forces have long been in the future business. The Air Force, at Wright-Patterson A.F.B., conducts studies of the whole problem of scientific prediction, also contributes $15 million a year to Santa Monica's Rand Corp. to think—and not necessarily about weapons systems. The nonprofit Hudson Institute investigates the possibilities of war and peace along with the future in general. At the University of Illinois, Dr. Charles Osgood is conducting a "computerized exploration of the year 2000," and the Southern Illinois University is providing money and facilities for Buckminster Fuller's World Resources Inventory. The American Academy of Arts and Sciences helps to support the Commission on the Year 2000, headed by Columbia Sociologist Daniel Bell. The Ford Foundation has allocated $1,400,000 this year to a group called Resources for the Future, also supports a Paris-based organization, headed by Veteran Futurist Bertrand de Jouvenel, whose studies are known as "Les Futuribles."

Forecasting is an art that still has few textbooks. Its basic tool is extrapolation from yesterday and today. As John McHale, executive director of World Resources Inventory, puts it: "The future of the future is in the present." Some other methods seem fairly arcane. Defense Expert Herman Kahn, for instance, uses "scenario writing," in which various alternative future situations are dramatized. Some forecasters use computers to produce a symbolic "model" of particular social or economic structures—including whole industries or nations—and then simulate the interaction of variables. Rand uses the "Delphi" method, in which a wide range of experts are queried and re-queried for their forecasts, arriving finally at a near-consensus. Prognosticators concede that the timing and nature of pure inventions or basic breakthroughs—such as the achievement of atomic fission—are not predictable. In many cases, they must still rely on "imaginings."

In the recent flood of forecasts, what are the futurists saying? By no means are all their predictions new, but taken together, they present a remarkable vision. Most convenient benchmark for that vision is the year 2000, a rounded and romantic date that is nearer than is generally realized—only 34 years away, it is nearly as close as the election of Franklin D. Roosevelt.

People & Weather

By A.D. 2000, the U.S. population will have risen to about 330 million, and nine out of ten Americans will be living in supercities or their suburbs. But cities, like industry, will tend to decentralize; with instant communications, it will no longer be necessary for business enterprises to cluster together. Futurist Marshall McLuhan even foresees the possibility that many people will stay at home, doing their work via countrywide telecommunication.

None of the forecasters seem to have any good solution for the traffic problem, though they count on automated, and possibly underground, highways. McLuhan and others predict that both the wheel and the highway will be obsolete, giving way to hovercraft that ride on air. Planes carrying 1,000 passengers and flying just under the speed of sound will of course be old hat. The new thing will be transport by ballistic rocket, capable of reaching any place on earth in 40 minutes. In Rand's Delphi study, 82 scientists agreed that a permanent lunar base will have been established long before A.D. 2000 and that men will have flown past Venus and landed on Mars.

That closer inner space, the ocean, will be even more radically transformed. Rand experts visualize fish herded and raised in offshore pens as cattle are today. Huge fields of kelp and other kinds of seaweed will be tended by undersea "farmers"—frogmen who will live for months at a time in submerged bunkhouses. The protein-rich underseas crop will probably be ground up to produce a dull-tasting cereal that eventually, however, could be regenerated chemically to taste like anything from steak to bourbon. This will provide at least a partial answer to the doom-sayers who worry about the prospect of starvation for a burgeoning world population. Actually, the problem could be manageable before any frogman wets a foot; Oxford Agronomist Colin Clark calculates that if all the presently arable land were farmed as the Dutch do it, it could support a population of 28 billion. Even the gloomiest forecasts assume a world population of not more than twice the present size, or 6 billion by the year 2000.

One of the more dramatic changes will be climate control. Tempo scientists estimate that the entire electrical energy needs of the U.S. could be supplied by a dozen nuclear generating stations spotted around the country, each with a capacity on the order of 60,000 megawatts (*v.* 1,974 megawatts for Grand Coulee). If one such station were built on Mount Wilson above Los Angeles, the heat produced as a byproduct could be guided into the atmosphere, raising the inversion layer that hangs over Los Angeles to 19,000 feet, thus ridding the city of smog. A sea breeze could be drawn into the space beneath, bringing rain that would transform the high desert between Los Angeles and Las Vegas into a flowering land.

Medicine is in a similar state of exhilarated anticipation. Already widely discussed today, artificial organs—hearts, lungs, stomachs—will be commonly available by the year 2000. An expected development in immunology will make possible the widespread transplanting of organs from either live donors or the recently dead.

The blind and the deaf will have new sight and new hear-

ing. A pocket radar will scan a blind man's surroundings, relay the information either through sounds or through vibrations. A comparable device will let the deaf "hear." Artificial arms and legs could be motorized and computerized, perhaps linked to the brain, so that the wearer will find his impulse translated into action. Medical men foresee fetuses grown outside the uterus (in case women want to be spared the burdens of pregnancy) and human tissues grown to specifications. The Cleveland Clinic's Dr. Willem J. Kolff prophesies "artificial skin with all the appendages built in, such as ears and nose." How they would look is a cosmetic problem that the doctors dismiss with a shrug.

Nearly all experts agree that bacterial and viral diseases will have been virtually wiped out. Probably arteriosclerotic heart disease will also have been eliminated. Cells have only a few secrets still hidden from probers, who are confident that before the year 2000 they will have found the secret that causes cancer. The most exciting, and to some the most frightening, prospect is the chemical and electrical treatment of the brain. Dr. David Krech, psychology professor at the University of California, believes that retarded infants will be diagnosed at birth, and chemical therapy will permit them to function as normal people. The memory loss accompanying senility will be eliminated.

In general, drug control of personality will be widely accepted well before the year 2000. If a wife or husband seems to be unusually grouchy on a given evening, says Rand's Olaf Helmer, a spouse will be able to pop down to the corner drugstore, buy some anti-grouch pills, and slip them into the coffee. Or a lackadaisical person could be dosed into a sense of ambition. Electrical stimulus of brain areas has been shown to produce responses of fear, affection, laughter or sex arousal; such techniques, says Yale's Dr. José Delgado, "will certainly increase man's ability to influence the behavior of man." By the year 2000, a symbiotic link between the brain and a computer-memory may also be in the experimental stage.

An even more momentous prospect is offered by DNA, the complicated molecule that contains the elements of heredity. Biologists think that before the century is out, they will have succeeded in changing the "information" contained in DNA. If so, it will become possible eventually to control the shape—or color—of men to come. Genetic "intervention" could improve learning capacity. Hudson Hoaglund, executive director of the Worcester Foundation for Experimental Biology, believes that thus "man will become the only animal that can direct his own evolution."

Some futurists are less sanguine; they worry not only about the social problem of who would supervise this man-made evolution, but also about unforeseen side effects, such as genetic mutations. Medical optimism is also limited by the notion that there may be an increase of accidents and the general wear and tear of urbanization. Great population density will create the "encounter problem," the fact that the effect of any event, from an accident to a riot, may be multiplied beyond control when masses of people are involved. Even the most optimistic experts see no real sign that they can learn enough about the process of aging to dramatically prolong life beyond 70 to 80 years average.

Food & Work

Some futurists like to make predictions about homey details of living. The kitchen, of course, will be automated. An A.D. 2000 housewife may well make out her menu for the week, put the necessary food into the proper storage spaces, and feed her program to a small computer. The experts at Stanford Research Institute visualize mechanical arms getting out the preselected food, cooking and serving it. Similarly programmed household robots would wash dishes, dispose of the garbage (onto a conveyer belt moving under the street), vacuum rugs, wash windows, cut the grass. Edward Fredkin, founder of Cambridge's Information International Inc., has already developed a computer-cum-mechanical-arm that can "see" a ball thrown its way and catch it. Soon, Fredkin expects his gadget to be able to play a mean game of pingpong.

As for shopping, the housewife should be able to switch on to the local supermarket on the video phone, examine grapefruit and price them, all without stirring from her living room. But among the futurists, fortunately, are skeptics, and they are sure that remote shopping, while entirely feasible, will flop—because women like to get out of the house, like to handle the merchandise, like to be able to change their minds. Not everything that is possible will happen—unless people want it. One thing they almost certainly will want is electronic "information retrieval": the contents of libraries and other forms of information or education will be stored in a computer and will be instantly obtainable at home by dialing a code.

In automated industry, not only manual workers, but also secretaries and most middle-level managers will have been replaced by computers. The remaining executives will be responsible for major decisions and long-range policy. Thus, society will seem idle, by present standards. According to one estimate, only 10% of the population will be working, and the rest will, in effect, have to be paid to be idle. This is not as radical a notion as it sounds. Even today, only 40% of the population works, not counting the labor performed by housewives or students. Already, says Tempo's John Fisher, "we are rationing work. By 1984, man will spend the first third of his life, or 25 years, getting an education, only the second one-third working, and the final third enjoying the fruits of his labor. There just won't be enough work to go around. Moonlighting will become as socially unacceptable as bigamy."

By 2000, the machines will be producing so much that everyone in the U.S. will, in effect, be independently wealthy. With Government benefits, even nonworking families will have, by one estimate, an annual income of $30,000-$40,000 (in 1966 dollars). How to use leisure meaningfully will be a major problem, and Herman Kahn foresees a pleasure-oriented society full of "wholesome degeneracy."

There are some who gloomily expect a society run by a small elected elite, presiding over a mindless multitude kept happy by drugs and circuses, much as in Huxley's *Brave New World*. But most futurists believe that work will still be the only way to gain responsibility and power.

Fear & Bliss

Social and political changes are far harder to forecast than technological ones. Futurists are earnestly considering all kinds of worries: the possible failure of underdeveloped countries to catch up with the dazzling future, the threat of war, the prospect of supergovernment. Today's "New Left" predicts the need for political movements to break up big organization. But the skeptics are plainly in the minority. Some futurists, like Buckminster Fuller, believe that amid general plenty, politics will simply fade away. Others predict that an increasingly homogenized world culture—it has been called "the culture bomb"—will increase international amity, although Rand's experts rate the probability of major war before the end of the century at 20%.

Certain prophets are in a positively millennial mood. Harvard's Emmanuel Mesthene, executive director of a ten-year, $5,000,000 program on Technology and Society commissioned by IBM., believes that for the first time since the golden age of Greece, Western man "has regained his nerve" and has come to believe, rightly, that he can accomplish anything. "My hunch," says Mesthene, "is that man may have finally expiated his original sin, and might now aspire to bliss."

This may be a rather naive form of *hubris*. But even the more cautious futurists are caught up in a renewed sense of human freedom. "The function of prediction," says Columbia's Daniel Bell, "is not, as often stated, to aid social control, but to widen the spheres of moral choice." And Bertrand de Jouvenel has suggested that various types of future should be portrayed on TV, allowing the public to vote in a referendum on "the future of your choice." The chief message of the futurists is that man is not trapped in an absurd fate but that he can and must choose his destiny—a technological reassertion of free will.

BOOKS ABOUT BUCKMINSTER FULLER

Marks, Robert W., Ph.D. Dr. Sc.: The Dymaxion World of Buckminster Fuller, S.I.U. Press, C'dale Ill. $12.

McHale, John: Buckminster Fuller, George Braziller, Inc. (215 Park Ave., S., N.Y.). $6. c1962.

BOOKS BY BUCKMINSTER FULLER, ALREADY PUBLISHED

Education Automation, Southern Illinois Univ. Press, Carbondale, Ill., c1963. $2.

No More Second Hand God, Southern Illinois Univ. Press, Carbondale, Illinois, c1963. $4.

Ideas and Integrities, Prentice Hall, Englewood Cliffs, N.J., c1963.

The Unfinished Epic of Industrialization, Jargon Press of Jonathon Williams' Nanthala Foundation, c1963. $3.50. Obtain from Heritage Press, 510 W. 4th Street, Charlotte, N.C.

Nine Chains to the Moon, Southern Illinois Univ. Press, Arcturus Books Div. $2.45. c1963.

BOOKS BY FULLER SOON TO BE PUBLISHED

Charles Eliot Norton 1961-62 Lectures at Harvard University, Harvard Univ. Press, Publ. date, 19??.

Synergetic (Formerly En/Syn Geom.) Comprehensive mathematical system apparently employed by nature. Worked on by BF for a quarter of a century. Co-editors: Prof. Arthur L. Loeb, Math-physicist and Shoji Sadao, Illustrations.

Naga to Eden. A new theoretical maritime reconstruction of prehistory.

Past Masters of World Economic Patterns. The evolution of human ecology.

Design Science -- by means of which democratic man will become a total economic success on earth.

N.B.: All of the books listed above as published may be obtained from the Gotham Book Mart, 41 W. 47th St., N.Y.C., N.Y. If any of these are temporarily or permanently out of print, Gotham Book Mart makes a practice of advertising for second-hand copies and can usually obtain them at a small premium.

"WORLD DESIGN SCIENCE DECADE" PUBLICATIONS

Phase I (1963) Document One: Inventory of World Resources, Human Trends and Needs, by R. Buckminster Fuller and John McHale.

Phase I (1964) Document Two: The Design Initiative, by R. Buckminster Fuller.

Phase I (1965) Document Three: Comprehensive Thinking, by R. Buckminster Fuller.

Phase I (1965) Document Four: The Ten Year Program by John McHale.

* Copies of the documents, and other materials, prepared for the "World Design Science Decade 1965-1975" program, may be obtained from: World Resources Inventory, 715 S. University Avenue, P.O. Box 909, Southern Illinois University, Carbondale, Illinois 62901 U.S.A.

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SCIENCE & HUMANITY

IS MAN CHANGING THE CLIMATE OF EARTH By Reid A. Bryson

FRED W. FRIENDLY'S "DUE TO CIRCUMSTANCES BEYOND OUR CONTROL" Reviewed by Robert J. Landry

Buckminster Fuller, Citizen of the Twenty-first Century (See page 14)

Saturday Review

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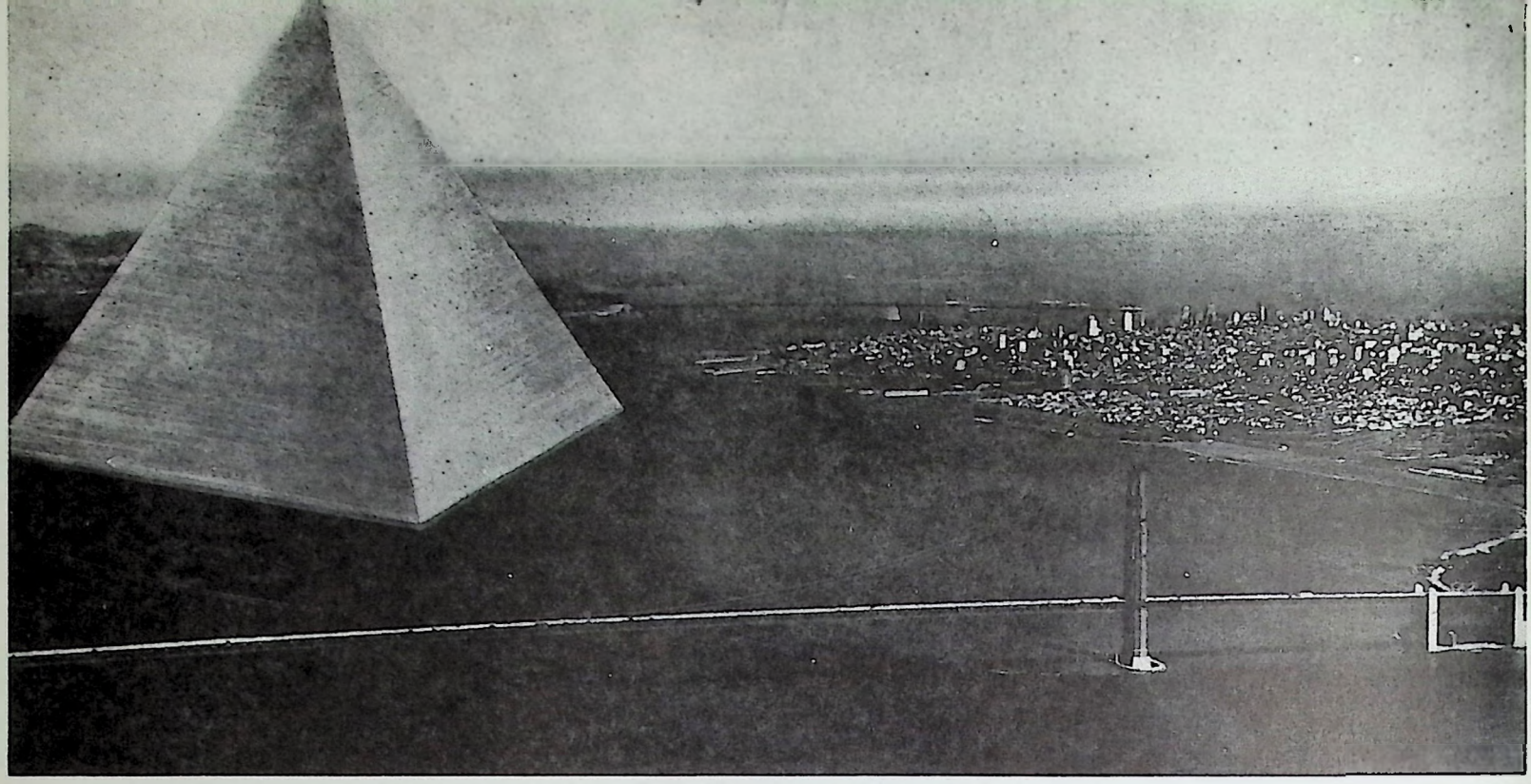


—*Illustrations courtesy Fuller Research Associates.*

Buckminster Fuller's design for a floating tetrahedronal city (shown superimposed on San Francisco Bay)—In sizes up to two-and-a-half miles high, it could make possible habitation of the earth's water surfaces (see description, page 16).

MAN WITH A CHRONOFILE

A citizen of the twenty-first century looks back the better to see ahead.

By BUCKMINSTER FULLER

R. Buckminster Fuller has led a consistently productive life but most of the recognition he has received has come only in the past five years. In that recent period, he calculates, he has been granted 45 per cent of his 145 patents in fifty-six countries; he has licensed the construction of 60 per cent of all the structures built under his patents; and five of his six books released by major publishers have been marketed.

Why has interest in Mr. Fuller and his ideas only recently reached a crescendo? One reason, he suggests whimsically, is that he was born cross-eyed—and that being born cross-eyed can be an advantage in the sense that the concomitant can be farsightedness. People who know him say that his most conspicuous trait long has been his depth vision—and, they are happy to report, as a mental habit it appears to be incurable.

I WAS BORN cross-eyed. Not until I was four years old was it discovered that this was caused by my being abnormally farsighted. My vision was thereafter fully corrected with lenses. Until four I could see only large patterns, houses, trees, outlines of people with blurred coloring. While I saw two dark areas on human faces, I did not see a human eye or a teardrop or a human hair until I was four. Despite my new ability to apprehend details, my childhood's spontaneous dependence only upon big pattern clues has persisted.

Most children like to collect things. At four I started to collect documents of my own development as correlated with world patterns of developing technology. Beginning in 1917, I determined to employ my already rich case history, as objectively as possible, in documenting the life of a suburban New Englander, born in the Gay Nineties (1895)—the year automobiles were introduced, the wireless telegraph and the automatic screw machine were invented and X-rays were discovered; having his boyhood in the Turn of the Century; and maturing during humanity's epochal graduation from the inert, materialistic nineteenth into the dynamic, abstract twentieth century. I named my documentation the Chronofile.

As the era of this case history loomed into greater perspective for me, as readable in the Chronofile, it became more accurately identifiable as that which, on the one hand, terminated Sir Isaac Newton's normally "at rest" world of myriadly and remotely isolated, hybrid cultures, to which change was anathema; and, on the other, opened Einstein's normally "dynamic," omni-integrating world culture to which change has come to seem evolutionarily inevitable. By 1917 I was convinced that, unannounced by any authority, a much greater environmental transformation was beginning to take place in our generation's unfolding experience than had occurred, for instance, between my father's, grandfather's, great-grandfather's, and great-great-grandfather's successive generations. Their writings contain glimpses of their lives in their successive undergraduate days in the classes of 1760, 1801, 1840, and 1883 at Harvard. They tell of day-long trips walking or driving from

"Sky-floating geodesic spheres," which Buckminster Fuller predicts may become future dwelling places, along with floating tetrahedrons, submarine islands, and other new sites.

Cambridge to Boston via Watertown Bridge.

As in 1913, in Fair Harvard's "Age that is past/surrendered her o'er [once more]/to the age that" was "waiting before," I felt intuitively in our freshman year that the subway, which then opened to connect Cambridge and Boston by a seven-minute ride, was harbinger of an entirely new distance-time relationship of humanity and its transforming environment. It seemed to me that *the* science-quaking fact of our boyhood was that light has a speed. Though fantastically fast, its 700 million miles per hour is not as absolutely fast as Newton's "instant universe." Newton's foundation was experimentally unrealistic. Light was real—but 99 per cent of reality's electromagnetic spectrum was invisible. We could no longer pilot with our physical senses. We had henceforth to rely upon intellect and its power to invent and navigate with the instruments which could tune and scan the vast ranges of nonsensorially tunable reality. This called for intellectual confidence in the fundamental but nonobvious trends, and disregard for the only momentarily spectacular news.

AVERAGE life-span expectancy for our classmates born *circa* 1895, as then calculated by the life insurance actuaries, was forty-two years. During our lifetime, the average life expectancy in the United States has increased to seventy years. Up to the time we were born, the average total distance covered by a member of humanity in his all-time, average life span of twenty-seven years, was 30,000 miles. My total travel to date, by land, sea, and air, is a hundredfold that distance. It aggregates more than 3,000,000 miles and now, at seventy-two years, I find my work often taking me annually several times around the world with many lesser to-and-fro-ings. This is in no wise a unique record. It is average for ever increasing millions of humans who have responsibilities in the vast frontiers of technology, business, and statecraft of a swiftly emerging spherical world city. Today's air hostesses far outtravel me, and Gemini astronauts outdistanced my 3,000,000 miles in one week's orbiting. Quite clearly, a complete transformation of human ecology in universe is occurring. It is not surprising that man, burdened with obsolete "knowledge" — his spontaneous reflexing conditioned only by past experience, and as yet unable to realize himself as being already a world man—fails to comprehend and cope logically with the birth of Universe Man.

By 1927 I felt that three big questions were posed by what the Chronofile as then made visible by the foregoing type of information.

► First, what could society, backing up into its future, with eyes fixed only on the ever receding and less adequate securities of yesterday, do to make this evolutionary process a gratifying rather than a painful experience?

► Second, what could the average intelligent and healthy, moneyless individual best contribute, singlehandedly, toward bringing the earliest and happiest realization of advantage for society in general through taking and maintaining the comprehensive, anticipatory design-science initiative—in the face of the formidable axiomatic errors and inertias of academic authority as well as the formidable economic advantage of the massive corporations and their governments and mutually shortsighted foci of resource and capabilities exploitation?

► Third, assuming that by competently reforming only the environment instead of trying to reform man, a favorably designed environment can be realized which will both permit and induce man to accomplish the same logical degree of physical success in universe as is manifest, for instance, by the hydrogen atom, how then can the economic and technological capability of all humanity to enjoy freely all of its world be accomplished exclusively by design science, without any individual interfering with another and without any individual being advantaged at the expense of another, with a design that will also induce its spontaneous adoption by world industrialization's managers?

In 1917, in the U.S. Navy, as I studied these questions the Chronofile disclosed a technological-environment-regenerated *acceleration* of technical evolution. This concept of *accelerating acceleration*, which had been discovered by Galileo and was later identified with gravity by Newton, had not been con-

ceived of as accelerating social evolution. During 1922-1927 the Chronofile also disclosed a trend of *comprehensive ephemeralization*—i.e., the doing of ever more with ever less, per given resource units of pounds, time, and energy. Ephemeralization was vastly augmenting the standards of living of ever increasing numbers, but only inadvertently, as fallout from the defense-subsidized preoccupation of science with a weaponry supporting industrialization.

Ephemeralization was also accelerated by ever increasing quantities of invisible energy events of universe, detoured by human intellect from their previously only cosmically flowing patterns to flow through engineered channels and impinge upon intellect-invented levers and thereby to vastly augment the work accomplishable by mankind's muscles in rearranging the energetic environment events to more effectively sustain the metabolic regeneration of human life.

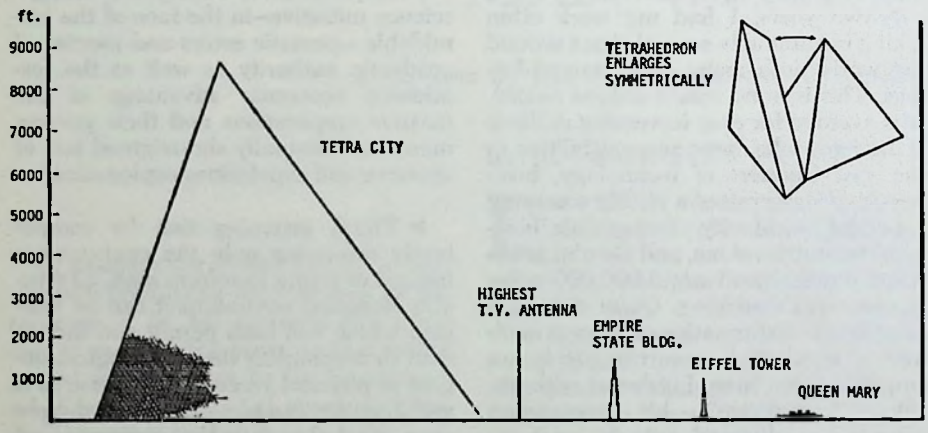
Ephemeralization, which constantly does more with visibly less—as does, for instance, the one-quarter-ton communications satellite outperform 150,000 tons of transoceanic cables—has not as yet been formally isolated, recognized, and discussed in print as such by any economists. Until economists recognize it, ephemeralization cannot be popularly comprehended and be adopted in public policy formulations.

However, as the years have gone by the combined effects of accelerating-acceleration and ephemeralization account primarily for the technical and economic augmentations which are now overwhelming man—trying to make him a success in universe despite his age-old Malthus-supported conviction that humanity, regardless of its composite significance and fate, is, with but a few exceptions, destined to demonstrate personal economic failure and premature death. Public policy the world around as yet assumes that Malthus was right—*ergo*, the vital necessity of Defense in view of the inexorability of the next Great War.

My Chronofile gradually disclosed the invalidity of that great superstition. It showed, for instance, that the metals in 80 per cent of all of yesterday's obsolete mechanics and structures, contrary to popular conception of their "exhaustion," have been recovered, refined as "pure metals," and put to work again. Eventually, 99 per cent of the all-time mined metals will be recovered and put into the recirculating-metals bloodstream of world industrialization as we go competently into the sea to recover all of yesterday's lost ships and cargoes—in particular, the war-sunken munitions vessels. But the rate of discovery of additional metal ores is slower than human population increase.

Throughout the twentieth century, therefore, the metals mined or unmined and materials in general have continually decreased in ratio to each individual. At this moment the cumulative total of metals—mined and refined by man throughout history—is wholly employed in machines or structures which, operating at full design-limit capacity, can successfully support only 44 per cent of living humanity. Therefore, no exclusively political act of any political system can make the world's resources take care of more than 44 per cent of humanity. But the over-all mechanical efficiency of the extant machinery and structures is only 4 per cent. An over-all efficiency of 20 per cent is engineeringly feasible at present. It could go to 80 per cent someday. A design-science revolution could solve the problem.

DESPITE the constant increase in human population and constant decrease of materials per person, between 1900 and 1965 the number of people attaining economic and physical success—by full participation in the highest standard of living progressively developed by world



Formula for a Floating City: To Buckminster Fuller's previous ingenious shelter concepts such as the Dymaxion House and the Geodesic Dome now must be added an even more ambitious design—a floating tetrahedronal city.

"We have learned that the most stable structure is the tetrahedron," he says. "Following this design-science clue, we find that a tetrahedronal city, to house a million people, is both economically and technologically feasible. Such a vertical tetrahedronal city can be constructed so that all of its 300,000 families have balconied 'outside' apartments. All of the organic operative machinery can be housed within the tetrahedron.

"Programed for 1,000,000 occupants, a tetrahedronal floating city would measure two miles long for each of its base edges. Such a city is so structurally efficient and therefore so relatively light that, together with its hollow box-sectioned reinforced concrete foundations, it can float. The city could be anchored in triangularly patterned canals or floated out into the ocean at any point and anchored. It would be earthquake-proof and, because the depth of the tetrahedron's foundation would be below the turbulence level of the seas, it would be a floating triangular atoll with a harbor that is always calm and protected. The cities will generate their own energy requirements using atomic reactors. The by-product of heat from these reactors will be used to desalinate water supplies."

Tetrahedrons are unique geometrically, he explains, in that they may be added to on every one of their four equilateral triangle faces and increased symmetrically in size by additions to any one of the faces. Thus the cities can begin with a program for a thousand occupants and grow to hold millions without changing their shape.

"Salvage of materials from obsolete buildings on the land can produce enough of these floating cities to have relays of them in various sizes around the oceans of the earth, at distances negotiable by relatively small boats such as those that operate between the Florida coast and the Bahamas. This will allow new habitation possibilities on that three-fourths of the earth's surface that is covered by water. It also will permit mid-ocean cargo transfer within the cities' calm harbors, extraordinarily increasing the efficiency of distribution of the world's raw and finished materials as well as aiding passenger traffic."

Is a tetrahedronal city, like many other Buckminster Fuller concepts, too advanced to win adherents in our time? The Japanese, he reports, already are interested in trying the concept, and a pilot-scale model may be built in Japan.

industrialization—rose steadily from less than 1 per cent to 40 per cent of all living humanity. This is a personal standard of living and health superior to that ever enjoyed by a pre-twentieth-century monarch. The 40 per cent of humanity thus surprisingly grown successful, despite constantly diminishing material resources per capita, can be explained only by accelerating ephemeralization.

Paradoxically, the self-accelerating doing-more-with-less invention revolution has been generated thus far almost exclusively by the technology of the world's weaponry race, whose ultimate objective has always been to deliver the greatest blows the farthest, most accurately, and most swiftly with the least effort. Evolution seems intent upon making man a success despite his negative fixations. The doing-more-with-less economic success of 40 per cent of humanity, accomplished in only half a century, cannot be attributed to any political doctrine. Technology has flourished equally under exactly opposed ideologies.

Take away the energy distributing networks and the industrial machinery from America, Russia, and all the world's industrialized countries, and within six months more than two billion swiftly and painfully deteriorating people will starve to death. Take away all the world's politicians, all the ideologies and their professional protagonists from those same countries, and send them off on a rocket trip around the sun and leave all the countries their present energy networks, industrial machinery, routine production and distribution personnel, and no more humans will starve nor be afflicted in health than at present.

FORTUNATELY, the do-more-with-less invention initiative does not derive from political debate, bureaucratic licensing, or private economic patronage. The license comes only from the blue sky of the inventor's intellect. No one licensed the inventors of the airplane, telephone, electric light, and radio to go to work. It took only the personally dedicated initiative of five men to invent those world-transforming and world-shrinking developments. Herein lies the unexpectedly swift effectiveness of the invisibly generated and inexorable design-science revolution. Politics is, inherently, only an accessory after the fact of the design-science revolution. Despite this historically demonstrable fact, world society as yet persists in looking exclusively to its politicians and their ideologies for world problem-solving.

Within all the foregoing concepts and in view of the low technical advance in everyday dwelling facilities as compared to transport and communication developments, my 1927 Dymaxion House was invented to function in due course as a prime instrument in an air-deliverable, mass producible, world around, new human life-protecting and nurturing, scientific dwelling service industry as the preferred means of transferring the scientific do-more-with-less capability from a weaponry to a livingry focus. I saw that a technology which produced total economic success for humanity could eliminate the fundamental causes of war, i.e., "you or me to the death—on behalf of yours or mine—for there is not enough to sustain us both": the seemingly scientific fact established by Thomas Malthus and later fortified by Darwin's survival-only-of-the-fittest. All else that I have done since then has related to these design-science considerations.

Thus in 1927 I embarked on a lifelong undertaking whose earliest possible realization lay a quarter of a century ahead, i.e., in 1952 (the year the Ford Motor Company acquired my first large Geodesic Dome) with full-scale, world-around industrialization of the livingry service industry to be realized only half a century ahead in 1977. I predicated the economics of my grand strategy upon my own superstition-free concept of wealth as consisting exclusively of integrated intellect and energy. Since science's Law of Conservation of Energy states that energy may neither be created nor lost and experience shows that every time intellect experiments with energy it learns more, wealth can only increase.

Despite their negatively accounted cost and theoretically incurred debt and wastage of more than a trillion dollars, World Wars I and II and subsequent cold warring have rendered the United States ever more vastly wealthy, despite the additional hundreds of billions of dollars lend-leased or given away. Why? Because those wars required ever more automated tool-up to harness more universe energy to do ever more continuous work on an earth whose total industrialization's percentage of strictly killing tools has become a progressively negligible minor fraction. The harnessed energy, production, distribution, communication tools, and techno-scientific literacy thus inadvertently established—all of which can produce peace-supporting prosperity—*is* the wealth.

There are two prime sources of energy to be harnessed and expended to do work. One is the capital energy-saving and storage account; the other is the energy-income account. The fossil fuels took multimillions of years of complex reduction and conservation, progressing from vegetational impoundment of sun radiation by photosynthesis to deep-well storage of the energy concentrated below the earth's surface. There is vast overabundance of income energy at more places around the world, at more times to produce billions-fold the energy now employed by man, if he only knew how to store it when it *is* available, for use when it was *not* available. There are gargantuan energy-income sources available which do not stay the processes of nature's own conservation of energy within the earth crust "against a rainy day." These are in water, tidal, wind, and desert-impinging sun radiation power. The exploiters of the fossil fuels, coal and oil, say it costs less to produce and burn the savings account. This is analogous to saying it takes less effort to rob a bank than to do the work which the money deposited in the bank represents. The question is cost to whom? To our great-great-grandchildren, who will have no fossil fuels to turn the machines? I find that the ignorant acceptance by world society's presently deputized leaders of the momentarily expedient and the lack of constructive, long-distance thinking—let alone comprehensive thinking—would render dubious the case for humanity's earthian future could we not recognize plausible overriding trends.

The only visible means of converting the momentum of negative employment of the physical principles operative in universe into making man a lasting success is in the design-science invention revolution, which fortunately may be joined by individual initiative founded on comprehensive intellectual integrity.

Whether all of my assessment of our historical position is correct and whether my grand strategy may be winning or not may possibly be readable in statistics that reflect the sudden surge of attention to and application of my ideas in the past five years. Though for more than half a century I have been purposefully disregarding the "earning of a living" or "money-making" in my occupational deliberations, my efforts sustaining but only incidentally accruing income, the income—low and slow at first—has steadily increased to ever more effective magnitude.

What, if any, is the significance of this upsurge? It seems to say that the generalized principles governing world industrialization which I seemed to discern, and the evolutionary events which they seemed to make predictable, are now tending to be confirmed by unfolding events. My activities' upsurge also probably reflects the fact that my world-around buildings are enclosing thirty-fold the clear-span interior space per pounds of material of any known alternative clear-span engineering systems designed to withstand the same hurricanes, snow loads, and earthquakes. It also reflects the recent years' experimental confirmation in various regions of science of nature's use of the mathematical coordinate system which I long ago discovered and developed.

The upsurge probably further reflects the growing realization by world youth

that its desire for success for all humanity can never be accomplished by politics, which is inherently divisive and biased and, to be effective, must eventually have recourse to its ultimate tools of war-making; and that fundamental world peace probably can be accomplished only by a design-science revolution which can and may realize the feasible potential by upgrading the performance per units of resources to provide 100 per cent of humanity with an ever higher standard of living.

The upsurge probably reflects as well the realization of increasing numbers of the world's youth that world peace probably can be accomplished twenty years faster by a deliberate design-science revolution than by waiting for the inadvertent twenty-years-later-fallout into the standard-of-living-advancing-commerce of the accelerating ephemeralization, as originally promulgated by only a wide variety of basic fear motivations, all of which result in the self-protective world-munitions racing. The world youth intuit that the twenty-year difference could be the difference between humanity's success or extinction.

The upsurge also probably reflects the support I am receiving from industry and the National Aeronautical and Space Administration in my answer to those who say, "Why don't we stop spending billions for going to the *moon* and spend the money solving the *world's* housing problems!" My answer is that we will not have developed the high level of technology with which to successfully sustain all of the games-preoccupied human passengers on the promenade deck of the Good Ship Earth until we give total chemical, physical, and medical science and technology the task of understanding and successfully supporting humans as regenerative metabolic processes anywhere in universe for protracted periods, remote from the complex, regenerative, life-sustaining conditions unique to the biosphere surrounding earth, with the total scientific information translated into the mechanisms and content of a little black box weighing about 500 pounds and requiring replenishment only yearly. Only by the stark, resourceless conditions thus imposed upon experimental science will humanity be forced to transcend its erroneously conditioned earthian reflexes which would otherwise continue to frustrate it with worthless opinions, politics, and war after war.

The upsurge in the accrediting of my functioning is also probably related to my forty years' earlier forecast of the last decades' admission by world-around science that Malthus is wrong and, granted removal of all political boundary restrictions, that the physical resources of earth can support all of a multiplying humanity at higher standards of living than anyone has ever experienced or dreamed.

The upsurge further reflects the recent enthusiasm of scholars and natural scientists for my definition of universe as the cumulative aggregate of all humanity's nonsimultaneous experiences, all of which are finite and include both the ponderable physical and the imponderable metaphysical; with the entropic, increasingly disorderly expansion of physical universe counterbalanced by the increasingly orderly contraction of anti-entropic, metaphysical universe.

The scholars have also commented favorably on my philosophic observations that the omni-interacting, weightless, generalized principles apparently governing universe—discovered only experimentally and progressively by human-intellect-directed science – disclose an *a priori*, anticipatory, amorphous, and only intellectually conceivable, omni-integrity of universe. By virtue of this integrity the generalized intellectual principles governing physical universe interactions and transformations never fail to provide an orderly set of consequences for any of its interacting events or for our own arbitrary or accidental experiments. We are thus confronted by a universe in which an intellect such as Einstein's could hypothetically take the measure of the physical energy universe, a measure which atomic fission later verified experimentally, thus demonstrating intellect's embracing and equating the integrated and differentiated energy of physical universe as $E=mc^2$. There has not been, however, either experimental evidence or intuitive suggestion of the reversibility of those conditions and results whereby physical energy might take the measure of intellect, equate and inscribe the integral and differential equation of intellect and the metaphysical universe.

No scholars have published refutations of my widely publicized conclusion that all of the foregoing brain-recorded, mind-sorted, and comprehended experiences clearly disclose an infinitely greater *a priori*, omni-anticipatory, intellectual integrity embracing and permeating universe than that demonstrable or suggested by any known capability of any individual human intellect—nor of the integrated, cumulative capabilities of all of history's human intellects—to control total universe in such a manner as to account for all the foregoing experimentally evidenced, omni-integrated, complex behaviors of universe. Wherefore the comprehensive, superhuman, nonanthropomorphic, Universal Intellectual Integrity thus altogether manifest to man by the integrated discoveries of experimental science may be spoken of as God, for that is the most economical term thus far intuitively formulated by humanity to identify such a macro-micro, human-capability-transcending, anticipatory, embracing, and inspiring relationship.

What intellect invented the integral of all the only intellectually conceivable, weightless, generalized principles discovered by science to be omni-operative as governing every physical experiment? Until man can answer that question he will have to accept an *a priori* intellect greater than his own.

I am convinced that neither I nor any other human, past or present, was or is a genius. I am convinced that what I have every physically normal child also has at birth. We could, of course, hypothesize that all babies are born geniuses and get swiftly degenuised. Unfavorable circumstances, shortsightedness, frayed nervous systems, and ignorantly articulated love and fear of elders tend to shut off many of the child's brain capability valves. I was lucky in avoiding too many disconnects.

There is luck in everything. My luck is that I was born cross-eyed, was ejected so frequently from the establishment that I was finally forced either to perish or to employ some of those faculties with which we are all endowed—the use of which circumstances had previously so frustrated as to have put them in the deep freezer, whence only hellishly hot situations could provide enough heat to melt them back into usability.

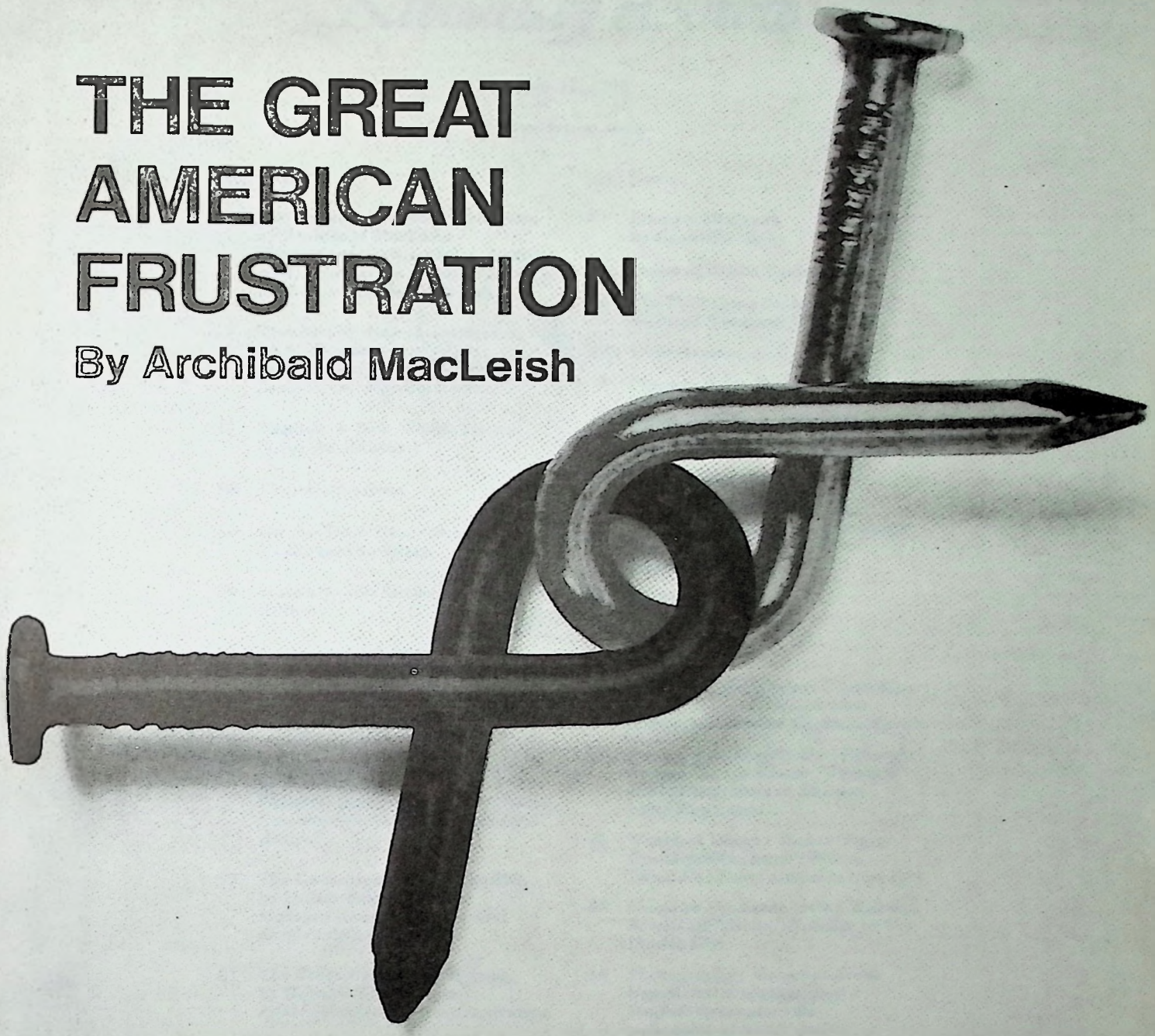
This article is adapted from a paper Mr. Fuller is contributing to the 50th anniversary book of the Harvard class of 1917.

Saturday Review

July 13, 1968 35c

THE GREAT AMERICAN FRUSTRATION

By Archibald MacLeish



THE AGE OF ASTRO ARCHITECTURE

By R. Buckminster Fuller

Saturday Review

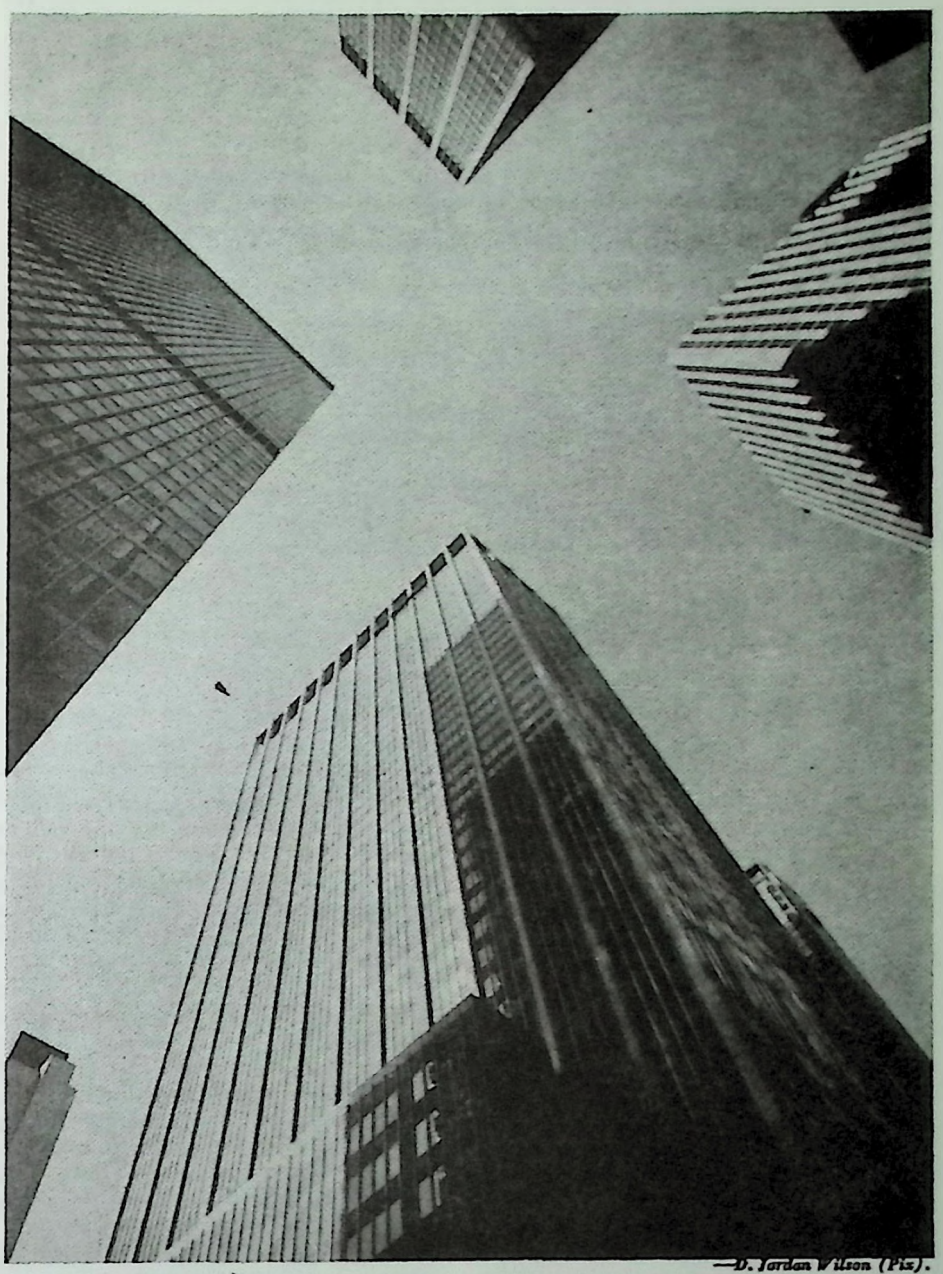
July 13, 1968

Cover: Pageant Studio

The Age of Astro-Architecture

Design by computer may be the path to more stately mansions.

By R. BUCKMINSTER FULLER



—D. Jordan Wilson (Pix).

New York's Sixth Avenue—"canyon-bottom living."

DESPITE the novel structures exhibited at Montreal's Expo 67, many of which may never reappear, the most notable aspect of contemporary architecture is its world-around sameness.

Although sameness does not necessarily mean monotony, the historical architecture, dramatically differentiating yesterday's ways of life about our planet, is being hidden or completely replaced.

While the giant graveyard-like clusters of fireproof monoliths cannot rate the verdict of "beautiful," it would be the affected dishonesty of a social poseur to say that the rhythmically surfaced verticality of such buildings is "uninteresting." They are as dramatic and intellectually challenging as are the undersea coral mountains which constitute mass housing on a far vaster scale for microcreatures of the sea. (A small sample of human housing on the coral-reef building principle was manifest in Moishe Safdie's "Habitat" at Expo 67.)

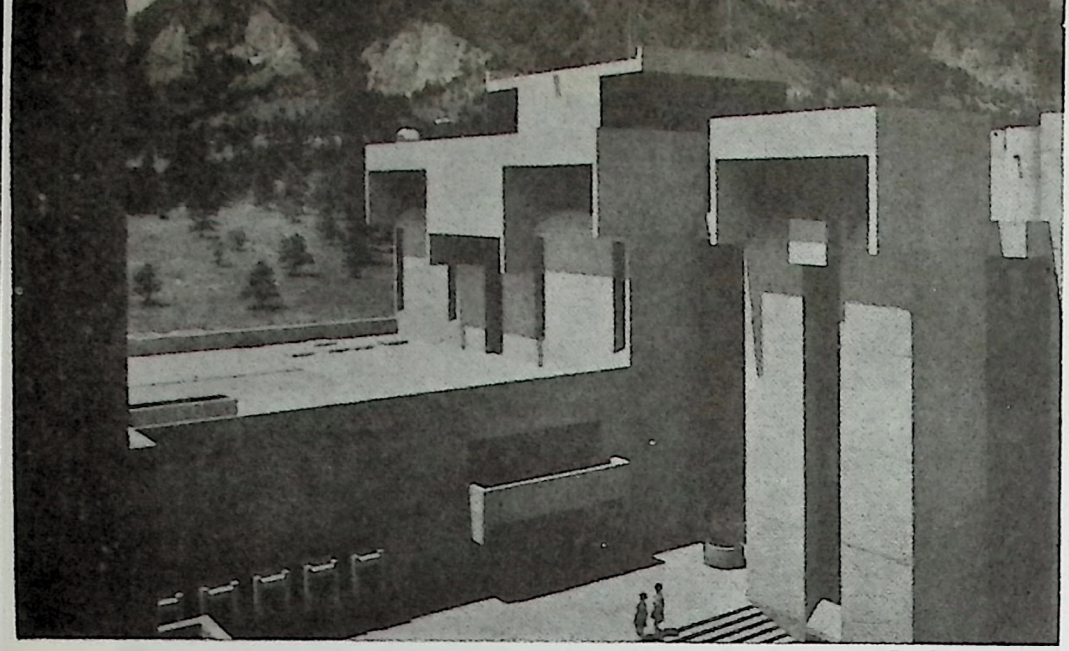
Ambitious to be known as originators, European architects in 1930 classified the early prototype of today's world-around-sameness type of building as the International style. It is, however, strictly the New York *skyscraper* style (Nysky). Prior to World War I, it existed only on New York City's Manhattan Island. So personally belittling is canyon-bottom living amongst the world-deployed phalanxes of Nysky buildings that vast numbers of humans bereft of visual horizons have also lost their long-distance insights.

The architecture of the electromagnetic air age should be viewed from the Nysky-belittling airliner's night-sky altitudes. Only from such heights can the historically unique aspect of present urbanism be seen. As with the exclusively night-fragrancing jasmine, the Nysky architecture with its myriads of windows ablaze, silhouetted against the westward twilight, unleashes its most powerful allure only when viewed from a thousand-feet altitude.

The specific behavioral characteristics of the present decade's crop of Nysky buildings are designed primarily by the computerized "Landlords' Optimum Occupancy and Earnings Analysis" for a given spot in a given city. The engineering departments of the elevator manufacturers design the main stacks to get the mortgaging bank's computer-specified number of occupants and their customers aloft on that much real estate. To serve that many people on that many vertically superimposed decks, the air conditioners surround the elevator shafts with their ducting and cap the giant skeleton structures with their large cooling towers crowded alongside the elevators' roof-top motor housing.

Next, the electrical and hydraulic en-

R. Buckminster Fuller—scientist, mathematician, writer, philosopher, inventor of the geodesic dome and other design-science innovations—is on the faculty of Southern Illinois University, Carbondale, Illinois.



—Ezra Stoller Associates.

—Stuart Smith.

National Center for Atmospheric Research, Boulder, Colorado (left), by I. M. Pei (above)—"Regimental."

gineers design the enormous networks and manifolds of power, light, and telephone wires, organic plumbing, and fireproof sprinkler systems which rise from the city's mains and return the wastes to the city's sewers. Next, the engineers of the steel-producing companies design the structural skeleton that will support and accommodate the weight and configuration of those main vertical transport stacks and organic systems. In the next-to-last design phase the exterior decorators play with the few permitted esthetic variables in the choice of materials and in the mechanical and structural componentation of the buildings' exterior. Among them are windows, embracing prefabricated modules, lobby lighting fixtures, and elevator-car décor. Lastly come the interior decorators employed by the individual tenants.

THE client who retains the architect tells him that he has already determined to produce a mortgage-bank prelogisticated building for a specific purpose on a specific site for a specific sum of money. The architect has no original design initiative, for he must design the kind of building the client already has in mind. Usually he must please not only the client, but the client's wife, business partners, lawyers, bankers, real-estate agents, and their respective committees of "experts."

By and large the architect has to work with what is available in the industry's architectural and engineering building-components catalogues. Furthermore, he must design within the already preconceived building codes, the zoning laws, and the restrictions set up by various labor unions. The architect also is greatly controlled by what the organized contractors can do, the kinds of tools they have, and the price that they bid to do the work. The architect is, finally, just an esthetical, good-taste purchasing agent and ways-and-means detailer—who is practiced in finding and organizing the usable space amongst the columns, pipes, and elevator stacks.

No longer does the architect develop and calculate the structural system or the water-tightening of the windows or any of the other building function tasks with which all architects once had to cope. If the client agrees, the architect can be sculpturally arbitrary regarding the building shapes, but these schemes must be accommodated by professional structural engineers.

Now occupied mostly as a salesman for his firm, the architect does not have time to do any of the detailed drafting which is now performed by armies of architectural school graduates. The draftsmen, seeing their student dreams of holding the prime design initiative fading away, function as only specialists in searching catalogues and in retrieving repetitive details.

The draftsmen's dismay will soon be terminated—and so will their jobs, for their work as automatons is about to be replaced by automation. And this automation will become a chain reaction, leading back to the real estate earnings analysis. Into the catalogue bank of the computer will be fed the data on progressively improving dimensionally interchangeable components of the building industry, so that the computer will design, order, and coordinate the logistics of assembly of the building which has been chosen by the computer as most efficiently profitable for a given site at a given evolutionary advance moment. The client can then press the exterior-décor selections button of his choice: Edward Stone "Harem"; Yamasaki "Venetian"; Mies van der Rohe "Black Strap"; I. M. Pei "Regimental"; or just computer "Anonymous."

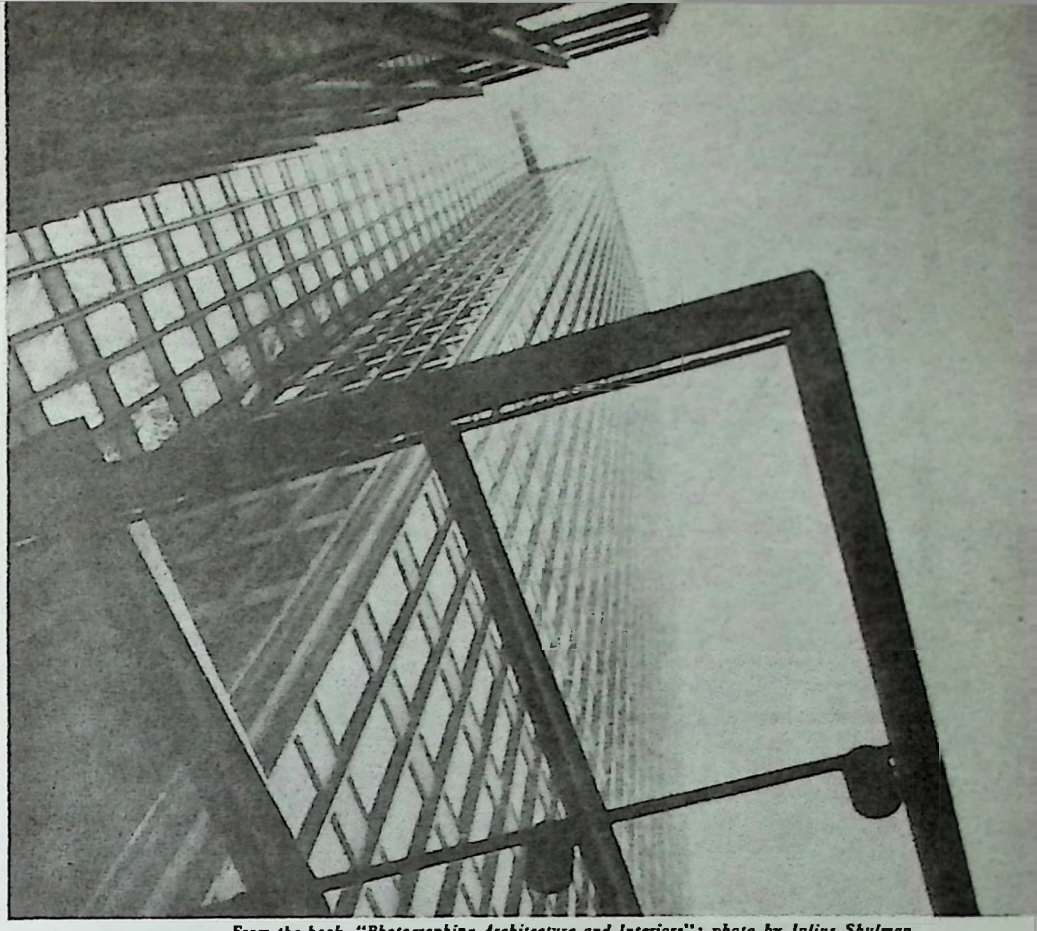
Computerization will soon highlight the inefficiencies of on-the-site building assemblage under adverse weather and traffic conditions. This discovery will lead swiftly to the conversion of the air-space industry's capabilities to solve the urban-buildings program. Ten thousand passenger air liners, already on the aircraft manufacturers' boards, will be modifiable into air-deliverable and vertically landed, Empire State-size city buildings entirely produced under factory conditions and weighing no more than 10 per cent of the weight of today's comparable-capacity Nysky buildings. Here we will have "instant cities" as a number of the astro-age skyscrapers are flown into place in one day in the same manner that great navy fleets, entering harbors and anchoring, constitute whole cities in themselves.

THIS seems hard on the draftsmen, but it is not, for they detest their automaton tasks. Automation will not only generate wealth faster in the form of better building, but it will implement the aspirations of those who wish to become real architects. They can become so by seizing the initiative in the comprehensive design revolution which alone can render the world's resources adequate to a high standard of living for all humanity. This can be done only by trebling the performance-per-pound of the resources used. This is easy for the same technical-evolution reasons that a single one-quarter-ton communications satellite with the same ground facilities is now outperforming the trans-oceanic communications capabilities of 175,000 tons of copper cable.

The really great architect of the Nysky age has been completely unrecognized and unsung. His name is Knud Lönberg-Holm. In America, where this global trillion-dollar vertical building industry first developed, Lönberg-Holm is the No. 1 man responsible for its having now become imminently convertible into a completely automatable success.

Lönberg-Holm was born and educated in Denmark to be a combination

—Berko (Pix).



—From the book, "Photographing Architecture and Interiors"; photo by Julius Shulman.

Seagram Building, New York (right), by Mies van der Rohe (above)—"Black Strap."

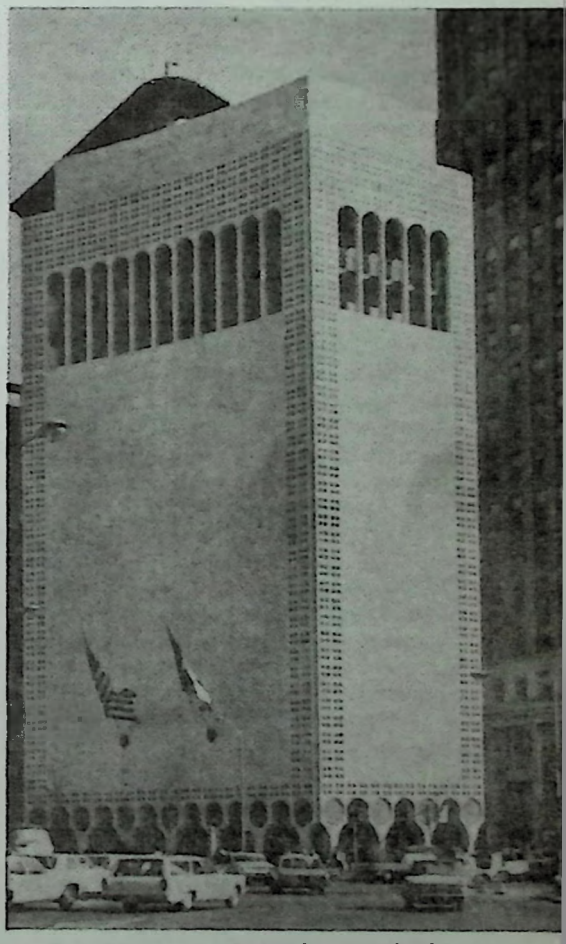
naval and land architect and engineer. His most important early design was a shipyard built in Copenhagen. He visited the United States after World War I and was deeply impressed with the fundamental technology that had developed just prior to and during the war as a consequence of the enormous production requirements of the United States and its allies. Knud Lönberg-Holm traveled around the United States with a camera, photographing the great reinforced-concrete railway and dockside grain and cement elevators and the first large steel or reinforced-concrete framed and floored factories. In these were used the first prefabricated, welded-steel, waterproof window frames. Their walls were filled in with either brick or hollow tile and preglazed steel window sash.

IN this highly simplified and tool-implemented factory-and-granary type structuring, Lönberg-Holm saw not only the hard engineering but also the economical solution of the generalized enclosure of office, dwelling, and all-purpose fireproof space. Returning to Europe, his photographs were eagerly circulated among leading architects who, like *couturiers*, are always scouting the trends of one another's styles.

After World War I, Germany's war losses were compounded with intolerable reparation penalties. Moneyless and in dire need of buildings, German perspicacity for employment of good technology was excited by Lönberg-Holm's photographs. In Germany were the resources: blast furnaces and know-how to produce the steel, cement, and glass—components of modern fireproof building. The Germans forsook their beleaguered government and started a new government. Under its cautious budgeting, the architects who had the task of designing the buildings had no excess capital available for yesterday's decorative considerations. For them, pre-World War I architecture was dead.

Forwarded to the German architects by Dutch and Danish architects, Lönberg-Holm's photographs were the first to excite Walter Gropius and the Bauhaus group of now-famous architects. In France, which was also under war-exhausted conditions, Corbusier's book, *Towards a New Architecture*, provoked the world's favorable consideration of the new architectural styling. Founded on new photos of the same American scenes first photographed by Lönberg-Holm, the new styling also drew on photographs of the steel ships and their excitingly dramatic structural features.

One by one, more of the Bauhaus group came to America from Germany with their cameras to photograph the economical factory and grain-bin engineering and that of the ocean liners on which they crossed. The Bauhaus then



—D. Jordan Wilson (Pix).

Gallery of Modern Art, New York (above), by Edward Durrell Stone (left)—"Harem."

cleaned up this naked, engineer-simplified construction technique. One by one the Bauhaus men migrated to America and enjoyed success as designers of such esthetically tailored bare buildings —all except for Lönberg-Holm.

Lönberg-Holm became the head of the research department of Sweet's Architectural and Engineering catalogues, which are the prime source of fundamental design information for all the building hardware produced in America. Lönberg-Holm became the intimate adviser of the corporations producing the building hardware. One by one he taught them about the obsolescence of classical architecture. He showed them how to improve their techniques and he designed hardware for them which would produce the kinds of simplified buildings that the Bauhaus men wanted. He persuaded the materials producers to institute research departments to develop and perfect aluminum extrusion window boxes; complete, windowed, exterior shell modules; and good lighting equipment.

Lönberg-Holm thus became the research design coordinator of all the research departments of the myriad of mass-production suppliers of building materials to America. He persuaded them all to simplify and to develop alloys that would not need painting. To do all this, he developed for himself a theory of information-cataloguing which in many ways anticipated the present cybernetics of information storage, retrieval, and question programing.

Before Lönberg-Holm began to counsel them, the American companies thought of architecture as something mystically inexplicable, to be coped with only by the architect upon whom they waited as abject slaves. Lönberg-Holm gradually gave the manufacturers confidence that if they produced the highly simplified and successfully functioning hardware, it would be used, and in increasingly large degree. His counseling covered every ramification of the building industry. Gradually, as the effect of his work was felt by the industry, the purchasing executives of the big corporations found that they needed the architects only as a clothing manufacturer needs a prestige name. Thus the building-hardware world which had advertised in the architects' journals found it necessary to switch their advertising to the business executives' magazines; the industrialist now made the buying decisions.

Lönberg-Holm was the first architect in my knowledge ever to talk about the ultimately invisible architecture. In 1929, when I first met him, he said the greatest architect in history would be the one who finally developed the capability to give humanity completely effective environment control without any visible structure and machinery.

THUS we have in our day an unsung Leonardo of the building industry whose scientific foresight and design competence are largely responsible for the present world-around state of advancement of the buildings arts.

While Lönberg-Holm's work leads to the optimum realization of in-place building under outdoor conditions, there is no consideration in the present land-building industry—as there always must be in naval, aeronautical, and astronautical designing—of the advantages that might accrue to world society by accomplishing even higher standards of living with greatly reduced weights of material, ergs of energy, and hours of time per each and every function served by the buildings and their environment-controlling mechanics. At present neither architect nor public know what any of their buildings weigh; yet the public knows that the steamship *Queen Elizabeth* weighs 85,000 tons and a Boeing 707 weighs 70 tons. If the public does not know what its buildings weigh, then obviously the buildings on land are not thought of in the terms of performance per pound.

What society can afford to do is not predicated on how many dollars it thinks it has, but upon the resources and know-how available to produce what society needs. At the present time all the world's high-performance resources are invested in machinery and structures which, operating at full capacity, can take care of only 46 per cent of all humanity. There is nothing that any political system, per se, can do about altering the fact that 56 per cent of humanity will continue to be neglected to such an extent that they will survive in want for only one-third of their potential life span. Until this condition is changed, the majority are being killed by the inadequacy of our employment of the world's physical materials and energy as well as our metaphysical time and know-how resources. Only the design revolution of doing vastly more with less in the transport arts—as pioneered in naval architecture, vastly accelerated in aeronautical architecture, and multiplied again many fold in the astronautical architecture—can solve the problem of caring for all humanity and eliminating the prime causes of war. Only by employing the highest-capability architecture can we make totally successful the human passengers aboard spaceship Earth—and technoscientifically it is eminently feasible to do so.

Since man's fear-conditioned reflexes prevent him from voluntarily freeing his spherical spaceship from its success-paralyzing sovereignties, we must look to the computers to clarify the ways in which success for all may be found. No politician can yield to another politician, but all politicians can—and eventually will—yield to the complex problem solutions of the computers. The first of those steps to be taken through complex computer analysis will be to stop humanity from trying futilely to compete with the machines as real wealth producers, and instead grant each unemployed human being lucrative fellowship to re-enter the educational processes, and where logical, to engage in research and development of the doing-more-with-less technologies.

If we ask the computers the right questions in the right way, heed the answers, institute the Age of Astro-Architecture, and find out how to make man a success anywhere in the universe, the first fallout of the process will be to make him successful aboard his own little pollution-becancered spaceship—Earth.

—*Daniel (Pix).*

Bauhaus school, Dessau, Germany—American influence via Lönberg-Holm.

APRIL 1968

TODAY'S SECRETARY

50 CENTS

BUCKMINSTER FULLER

EXPO'S GEODESIC GENIUS

A busy dynamo creating ways to make the world work better—that's R. Buckminster Fuller. Put a label on him and maybe it sticks, but it's much too small to be seen. His talents are as multifaceted as the surface of his geodesic domes—he is architect, scientist, inventor, artist, lecturer, poet, philosopher; holder of enough honorary degrees, awards, and professional memberships to cover a twenty-page list. His ideas span many fields and many centuries, but they are all focused on his basic belief that anything is possible—that man's potential is limitless.

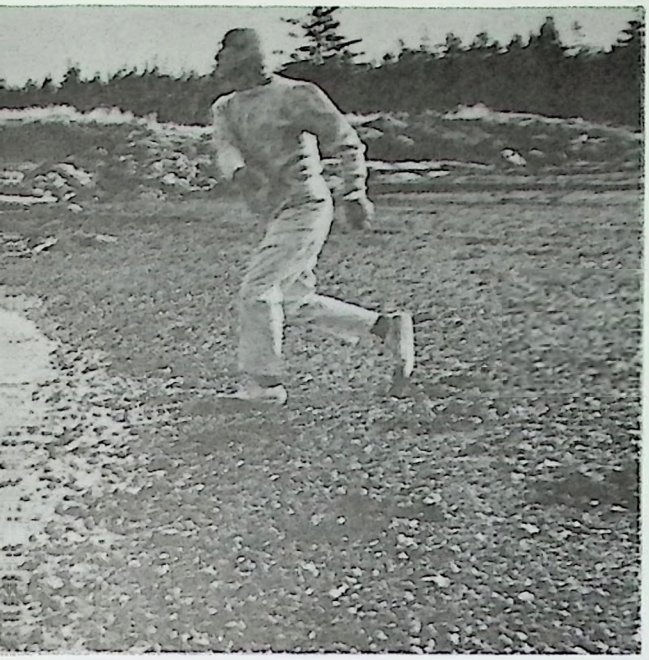
Everything Buckminster Fuller does is dedicated to seeing human potential more fully realized. To that end, he has traveled more than three million miles in his seventy-two years and has published a vast string of articles and books. He has founded several manufacturing and design firms; served as a consultant to industry, research foundations, and the U.S. Government. He has been a visiting professor, lecturer, and critic on many campuses the world over. He has been called many names, including "some kind of nut"; but he is most often called "an extraordinary genius."

How in the world could anyone keep up with a job as secretary to such a man? Naomi Wallace, the secretary who manages to do so, says it's not easy. But in the same breath, she says she's very excited about the whole situation.

"If I had to choose one word to describe working for Dr. Fuller," she smiles, "I'd say 'challenging.' That's really the only constant thing about the job—the day-to-day challenge. I can't count on anything else, except Dr. Fuller's nature—which is always warm and kind."

Naomi's headquarters are in Carbondale, Illinois, on the Southern Illinois University campus where "Bucky" (as his friends call him) is professor of design science exploration. As visiting lecturer, critic, researcher, and consultant, Dr. Fuller spends about ten months of every year traveling, which may include going around the world three times. He is never home for longer than two weeks. (As far as he's concerned, though, "home" is really the world.) Naomi makes all his arrangements for travel and handles correspondence on speaking engagements, book reprints, and general inquiries. She organizes his monumental schedule and keeps in touch with him daily by telephone wherever he is. "He compliments me on being well coordinated," she says. It would seem she'd have to be.

"Actually," Naomi continues, "that compliment covers quite a few things. Dr. Fuller's main concern is that people use their creative potential to the fullest possible extent. He even admires a simple thing like my bowling or golf score. And when we're driving—I drive him to and from the airport a great deal—and he thinks I shouldn't pass a car, he'll say, 'I still think you're well-coordinated, dawling [he has a Massachusetts accent], but I really



Bucky Fuller spends summers at Bear Island, Maine. "Nature is my inspiration," he says. "And at seventy-two, I can run again"—he just lost fifty pounds. At left, he and secretary Naomi Wallace at work over tea.

BY BERT LUNAN AND SUE CHASE

PHOTOS BY PER KRUSE
FOR PACE MAGAZINE

don't think you should do that.' His sense of humor is one of the joys of my job."

Naomi finds her boss' ideas and conversation inspirational as well. Describing an idea, for instance, he is clear and stimulating: "Do you remember what it was like playing house in the woods? It was wonderful—until it rained. Well, I could build you that house today, where the sunlight would come through just as in the forest. A house with no walls, no doors, no windows—only paths of green ferns and green trees through a rainbow of flowers. And it would never rain."

Another inspiration—and joy—of the job, Naomi feels, is the occasional opportunity she has to travel. Last summer, for instance, she and Dr. Fuller interrupted a two-week New York work stint to visit Expo 67, where "Bucky's Bubble"—one of his geodesic domes—housed the widely acclaimed U.S. pavilion.

But Naomi's travel isn't always for pleasure. It usually has to do with office work. When Dr. Fuller is in the U.S. (where he does the major part of his speaking), Naomi periodically gathers up all his first-class mail and other pressing material, and joins him—wherever he is—for a few days or as long as a month. It could be in California or New York, but very often it's on Bear Island, Maine, where Dr. Fuller has spent sixty-six summers. "He never stops finding inspiration there," Naomi explains. "He loves the water, the simplicity of the life, the direct contact with nature. I take dictation on lobster boats."

Since she took the job five years ago, Naomi's had to take dictation in other unusual places. "When he's crisscrossing the country, I arrange two- to three-hour layovers in St. Louis so I can meet his plane. We find a table in the terminal restaurant, and he dictates until his flight is called. Or he might drive me to the airport and dictate as he drives. He'll keep dictating right up to the plane gate!"

. . . or right up to the lunch table. Dr. Fuller usually reads his voluminous correspondence and dictates answers during meals. A typical letter may be from a teenager in Europe who admires his

futuristic housing designs or from a distinguished organization requesting his services. Whatever the source, he pays meticulous attention to details and thinks his answers out carefully. Naomi, too, concentrates hard. "Sometimes too hard!" she laughs. "I instinctively record everything he says—because I have to most of the time. But occasionally I'll start transcribing and discover, " 'I'd like fruit, please.' (That was his answer to Mrs. Fuller when she said, 'Bucky, dear, what would you like for dessert?')"

Naomi's skills and concentration must always be in top form. "His vocabulary is amazing—and the way he uses it is, too. The first year I worked for him, my list of new words probably averaged twenty-five a day, and I'm still learning. But let me tell you about the *first* day!

"When he interviewed me for the job, I told Dr. Fuller my shorthand might be rusty. He said he thought we could work things out until I got in some practice. Well, the first day he had one important letter to do before leaving for a trip. He started dictating at nine and stopped at noon. I went home for lunch and cried a lot. I thought, 'I just won't go back; I can't possibly read those words.' I'd never even heard of half of the ones he used. I went back and told him I just couldn't read his dictation. He said, 'Do your best dawling'; and I've been doing that ever since. (That, 'letter' later became an article in a national magazine.)"

Naomi isn't just whistling "Dixie" when she describes the vocabulary difficulties. How would *you* like to put this down in shorthand: "Ephemeralization was also accelerated by ever-increasing quantities of invisible energy events of universe, detoured by human intellect from their previously only cosmically flowing patterns . . ."?

Consequently Naomi must study constantly for her dictation. "Since he was away the first two weeks I worked for him," she remembers, "I looked up the words he'd given me that were new and practiced them in shorthand. I really crammed for that two weeks—but he came back with another subject and another vocabulary. So I went back to cramming." Naomi doesn't just study vocabulary, either. (She couldn't be a mental slouch and still work for Buckminster Fuller.) She's now working toward a college degree. "I'm taking new math and trying to understand it. He encourages me constantly—mathematics is one of his fields. My degree will be in business education—when I get it!"

In Carbondale, Naomi divides her time between the office and the dome—yes *dome*. "I thought he said 'home,' the first time myself," she smiles. "Before my job interview, he called to ask if I could come to his dome to discuss my application. When I asked him the address, he said it was the only dome in South Forest Street. I was still thinking 'home,' and I knew there were many on Forest, so I insisted on the house number. Well, you can imagine my embarrassment when I arrived and saw his geodesic home."

Dr. Fuller's dome is not only his castle—it's the one of his many inventions that has gained the most attention and acceptance around the world. The transparent, geometrically-sectioned domes have covered more square feet of the earth than any other single kind of shelter.

The domes have endless possibilities, according to Dr. Fuller. He envisions whole cities under them, so buildings can be constructed solely for people—aesthetically and functionally—without concern for protection against the elements. Under the domes, too, mass air conditioning would eliminate many discomforts and health hazards.

Qualified people in all "Bucky's" fields have highly praised his work and creativity, but the everyday world has only just started to catch up with him. The last five years have brought him recognition; almost half of his one hundred forty-five patents have been granted, and five of his six books published, during this period.

His ideas are far-reaching. Take, for example, the Dymaxion House, a strong, spacious, but low-cost home suspended from a central mast; or the plan for a floating city in tetrahedron (pyramid) shape; or the sky-floating geodesic sphere which he foresees for our future homes.

Which of his staggering array of ideas does Naomi feel most involved with? "Well, I'm involved with all of them in many ways, and it's hard to pick one. But I'd say the most interesting one to me is his theory that the auto will become obsolete next."

Of all his qualities, Naomi most admires Dr. Fuller's patience and kindness. "He always takes time to explain a complicated theory, and he's always generous with his time and money if he believes in what an individual or group is doing.

"Actually," she continues, "his attitude toward money is very interesting—he feels he hasn't time to worry about it. He tells me, 'It will take care of itself as long as I do what I should be doing.' So his decisions are focused on getting projects underway with the least complication or on helping a talented student, rather than on being economical. He's not interested in living luxuriously or having money for himself. I handle all his financial affairs."

This task is a very complicated and responsible part of Naomi's job. She deals with hundreds of thousands of dollars, and Dr. Fuller relies on her completely. "It's funny sometimes," she says. "He'll go to Maine and pick up a thirty-foot boat and forget to tell me. Of course, he always remembers to tell them to arrange with me for payment!"

Naomi handles several other administrative duties in her job, including supervision of three typists. "We need that many," she explains. "All Dr. Fuller's lectures are 'thinking out loud.' He talks with audiences, no matter what size, as he'd converse directly with one or two friends. He speaks seven thousand words per hour. This means a two-hour lecture requires a full, book-length manuscript—perhaps forty-two thousand words to convey the 'out loud thinking' in print. Each transcript requires an average of seven retypings and reworkings."

"Also," Naomi says, "he keeps at least three manuscripts in preparation all the time. I'm amazed at the way he keeps them separate in his mind and adds to one or another during the same day."

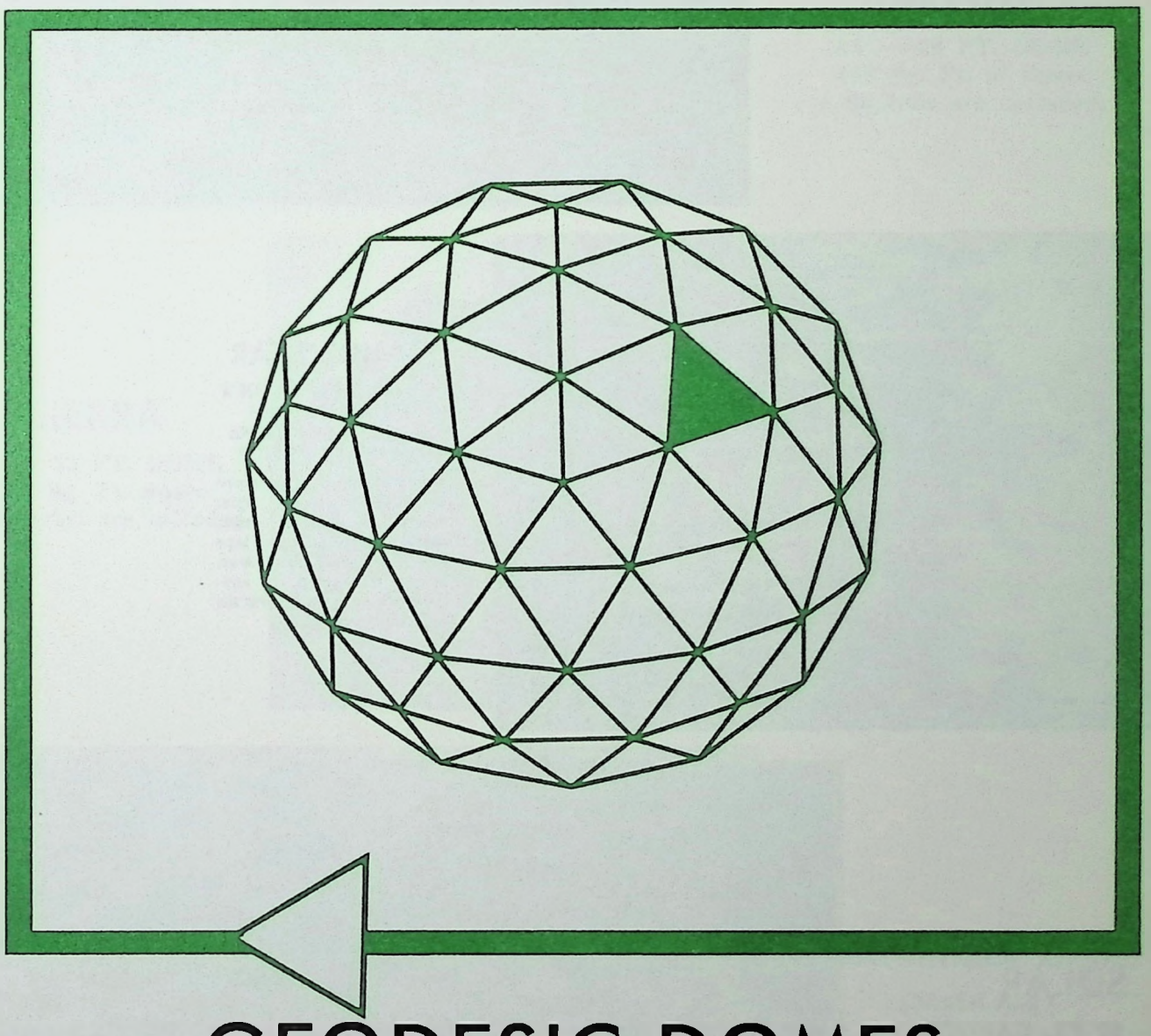
Naomi describes his work process as "getting his thoughts on paper the first time—and really not seeing me at all. He sits with his eyes closed and his hands together, forming shapes and designs. A journalist once wrote that he sees more with his eyes closed than most people see with theirs open."

Dr. Fuller himself points out that he was born cross-eyed, and never saw small objects—a teardrop, a bird—until the age of four. Then the cause—extreme farsightedness—was discovered. But he regards the vision problem as "his luck." He believes the habit of "seeing big-pattern clues" has helped his creative process.

Naomi Wallace enjoys working for a man with such a "vision problem." To work for Buckminster Fuller is to be involved with something very exciting: as Dr. Fuller puts it, helping man "get a little closer to the truth of his creative self." *

PEASE DOMES
WORLDS MOST EFFICIENT BUILDINGS

THE BUILDING OF TOMORROW IS AVAILABLE NOW.
See our display at 10290 Davison Rd., Davison, Mich.



GEODESIC DOMES

U. S. PAT. NO. 2682235 — OTHER PATS. APPLIED FOR

Manufactured by Geodesic Manufacturing and sold by Pease Domes,
10290 Davison Rd., Davison, Mich. 48423 Phone 653-2383

AS CONCEIVED BY
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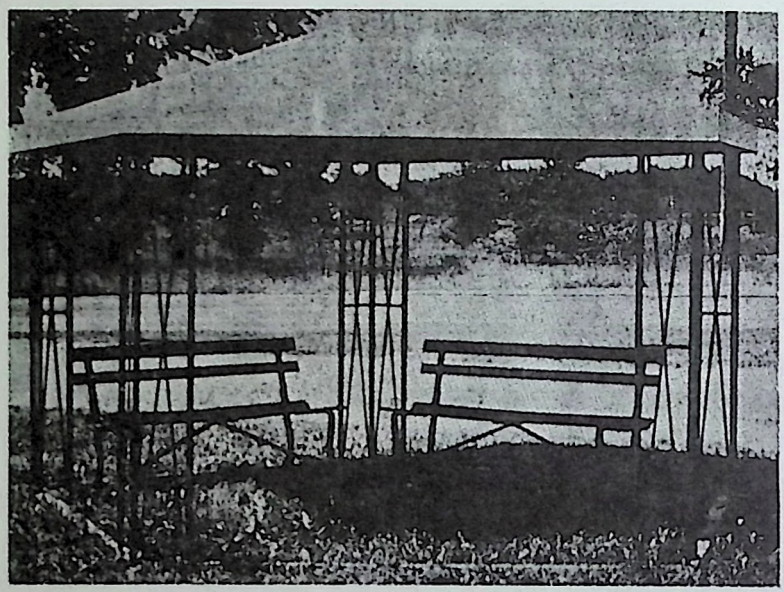
PEBBLE BEACH

A1 — 23 FT. CANOPY
365 Sq. Ft. of Space



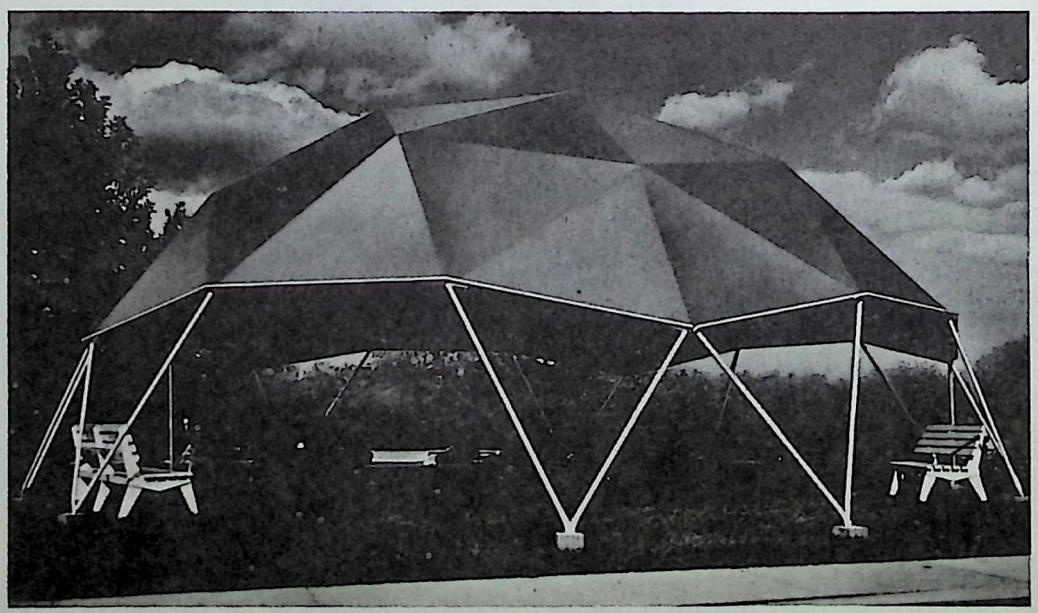
TAHOE STAR

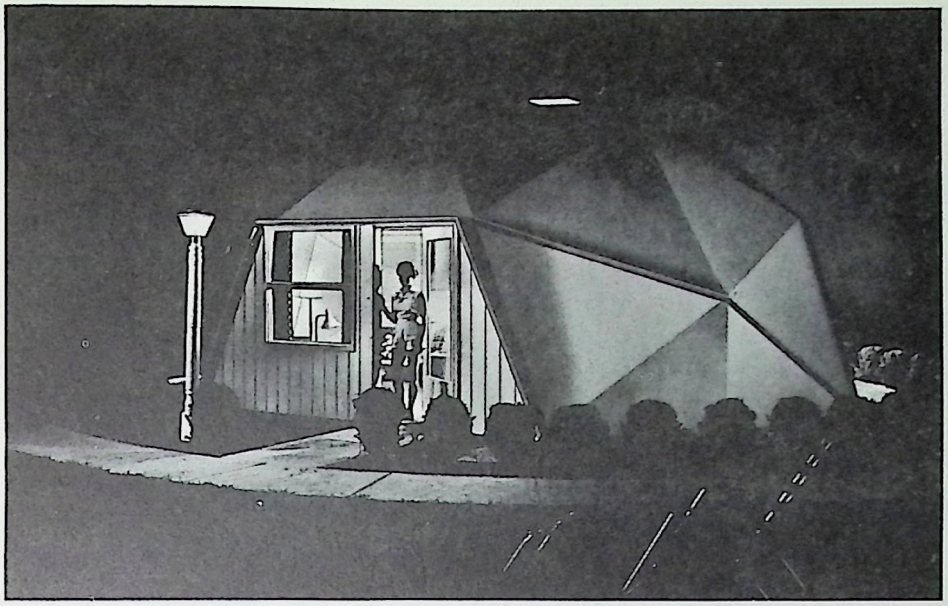
AB — 12 FT. CANOPY
125 Sq. Ft. Space
for GOLF SHELTERS
and HOME PATIOS

Has 5 triangles of 1x4 faced with 5/16" duraply. Trim boards of Sterling grade white pine, all bolts and tape and 5 wrought iron legs. Forms for cement or temporary base and all parts for erection.

SOLAR

B1 — 39 FT. CANOPY
1,100 Sq. Ft. of Space





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Davison, Michigan

ALPINE

A6 — 26 FT. DOME
485 Sq. Ft. of Space
4 Skylites are included.

SIERRA

B-6 — 39 FT. DOME
1,100 Sq. Ft. Space
10 Skylights are included

Adirondack Dome

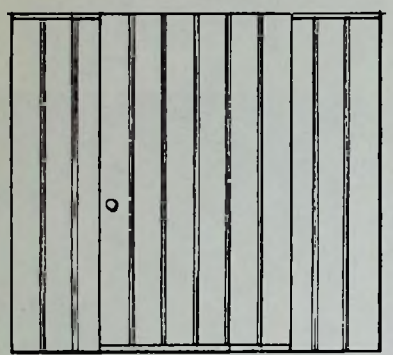
(Model A-8)

Price complete, 365 sq. ft. floor space
Refer to Price Sheet

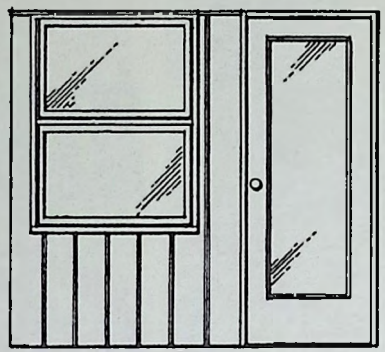
Whatever your building needs . . . personal, institutional, industrial, agricultural, public, the modern Pease Dome structure is the most economical answer.

A wide variety of alternate sections for the two openings in the 26′ diameter models, of the five openings in the 39′ diameter models, are available in any combination desired to make *your* Dome do *the* job it is assigned. Select the openings that best fit your needs, and you can start now to design the building you want . . . as you want it.

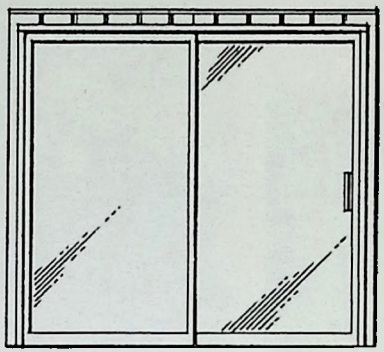
Enjoy this NEW way to build for LESS!



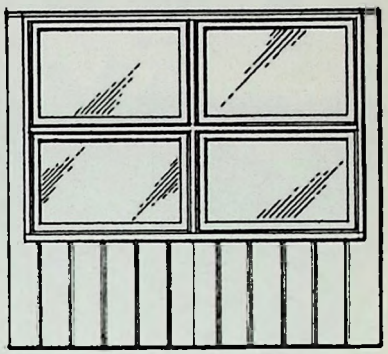
2617
Single solid entrance door.



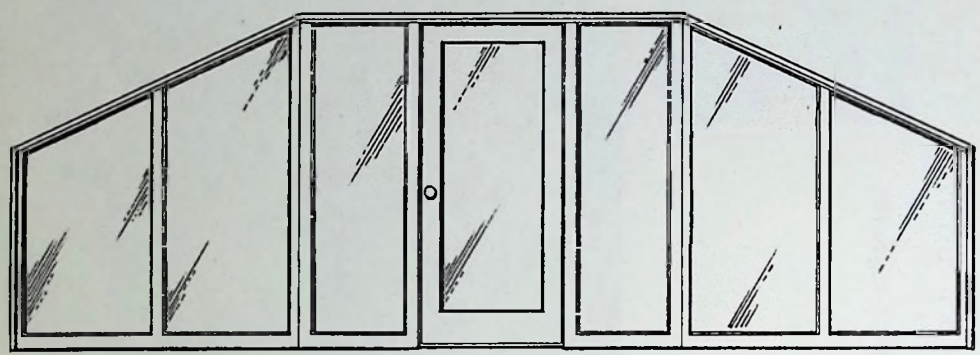
2618 or 3918 (If door is desired on left side, please specify.) One wide, two high ventilating wood awning window units with screens, and swing-in glass door and screen door.



2619 or 3919
7′3″x 6′5 ¼″ type XO aluminum sliding glass door with sliding screen panel and outside lock set.

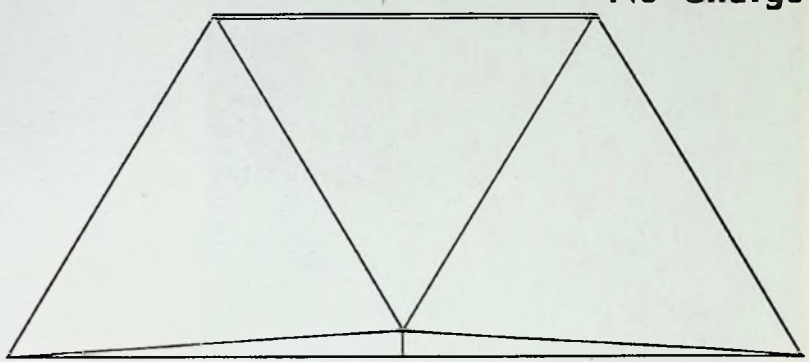


2620 or 3920
Two wide, two high ventilating wood awning window units with four screens.

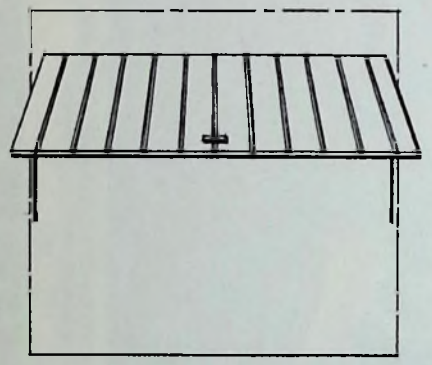


2623
Six fixed glass sidelights and 3′0″x 6′5″ swing-out glass door.

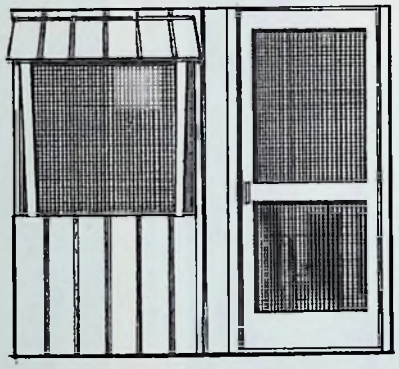
No Charge



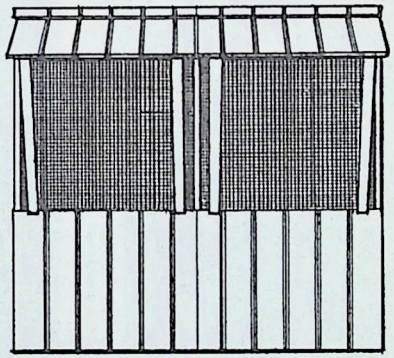
2-2601 & **1-2602** (for 26′ Dome) **3-3902** (for 39′ Dome) Three solid triangular space frame panels and base plates to fill in one opening to form a continuous outside wall.



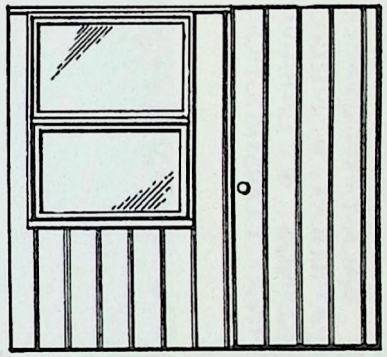
2611 or 3911
Solid Swing up Garage Door section.



2614 or 3914 (If door is desired on left side, please specify.) 4'0"x 4'0" screened opening with storm panel, and solid swing-out entrance door and screen door.



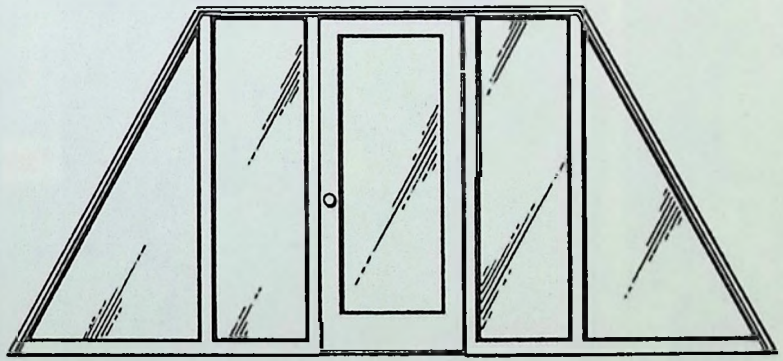
2615 or 3915
Two 4'0"x 4'0" screened openings with storm panels.



2616 or 3916 (If door is desired on left side, please specify.) One wide, two high (bottom ventilating) wood awning window units with screen, and solid swing-out entrance door.

2621 or 3921 (If door is desired on left side, please specify.) 3'1"x 4'2 5/8" aluminum-glass jalousie window with screen, and swing-out jalousie door, also with screen panel.

2622 or 3922
Two wide, one high aluminum-glass jalousie window units with screen panels.



3923
Four fixed glass sidelights and 3'0"x 6'8" swing-out glass door.

THE PEASE DOME puts the shape of things to come within your reach today by adapting the strongest, most efficient system of structuring yet developed—the geodesic dome—for use in countless phases of home, business or institutional life. For shade and shelter . . . living units . . . or accessory buildings, the versatile Pease Dome is your answer. Here's why:

MAXIMUM STRENGTH AND SPACE are inherent in the Pease Dome design. The Pease Dome, developed by R. Buckminster Fuller is an engineered system of triangular space frames. These frames create a self-reinforcing roof and siding unit based on mathematically precise divisions of the sphere. This results in extra strength, because stress is distributed equally throughout the building, and weight is transferred directly to the ground at angular points around the base of the dome. It adds up to space, too . . . in unobstructed floor area and volume within the least amount of surface area, because it eliminates the need for internal supports or load-bearing walls.

LOW COST IN EVERY WAY. Designed to satisfy the ever-increasing demand for low cost shelter, Pease Domes drastically reduce the quality and weight of building materials required. Short, lightweight framing members mean extra economy. And, though Pease Domes are usually erected on a concrete slab, you can utilize dirt or other type floors by bolting the structure to piers at angular points around the base of the dome. What's more, you save on costly labor. Two unskilled men with average tools can easily assemble a Pease Dome in a day.

VACATION HOMES • YEAR 'ROUND RESIDENCE • SALES OFFICES • CAMPING BUILDINGS • SI
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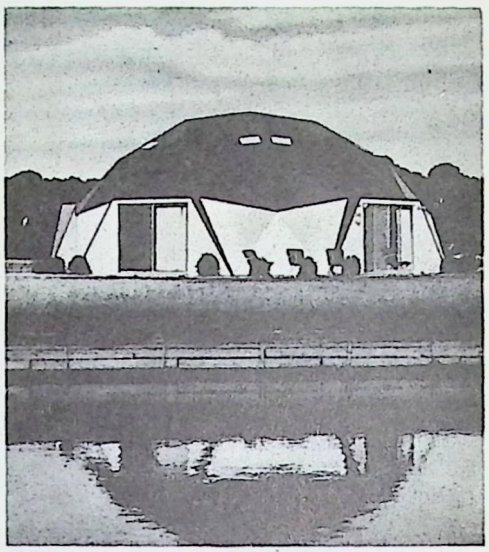
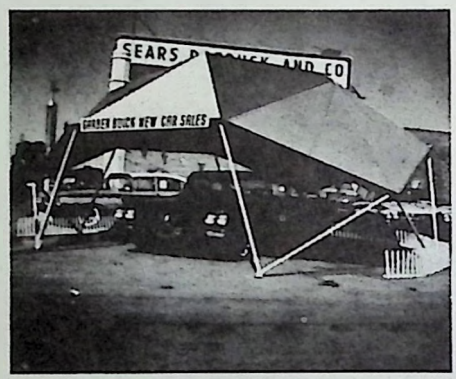
COIN OPERATED DRY CLEANING • AMUSEMENT BUILDINGS • BACK-YARD CRAFT SHELTERS •
ICE RINK SHELTERS • AMUSEMENT PARK GAME BOOTHS • CHURCH PAVILLION • SHELTER FOR MOTE
SKEET RANGE SHELTER • DRIVE-INS • LODGES • STORAGE BUILDINGS • CABANAS • CLUB
ARCHITECT'S OFFICE • MOTELS • FARM BUILDINGS • HIGHWAY CONSTRUCTION OFFICES
PARK SHELTERS • SKI LODGES

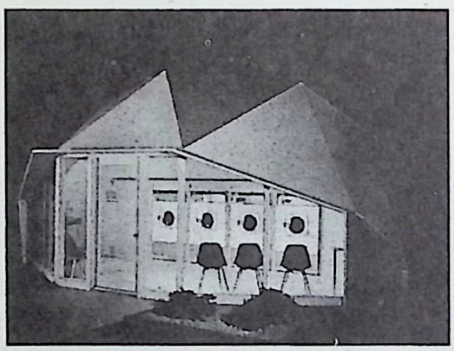
Here is a Model B-1 CANOPY DOME picnic shelter used in St. Louis park.



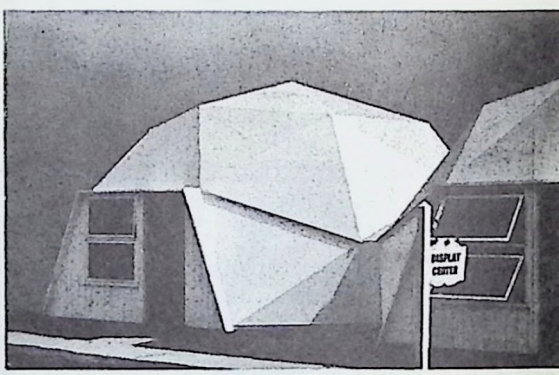
VACATION DOME, Model B-6 has been built as a permanent residence on Lake Erie.



A CANOPY DOME is attention-getting outdoor display room for a Florida car dealer.



A Model A-6 DOME, using one No. 2623 alternate opening section, makes a perfect coin-operated laundry building.



Two 26' diameter PEASE DOMES joined together form a sal
Used two years, it will soon be dismantled and rebuilt at

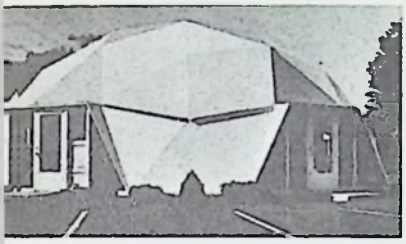
Model A-1 CANOPY DOME used as craft shelter at National Girls Scout Camp, Bethesda, Maryland.

A 23' CANOPY DOME used as a poolside patio cover at a summer resort in Tennessee.

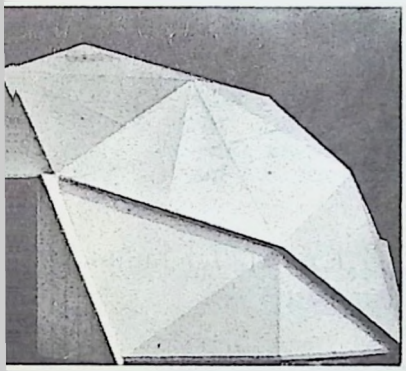
TRULY A BUILDING O

ELTERS
DISPLAY BUILDINGS
LOW COST HOUSING
BAR-B-QUE PIT
HOUSES

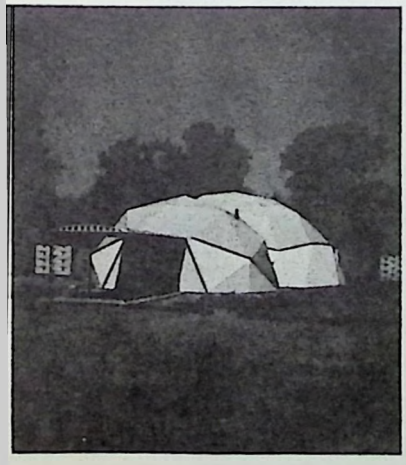
odel B 6 VACATION DOME and a Model CANOPY DOME combine as a summer and carport near a Michigan lake.



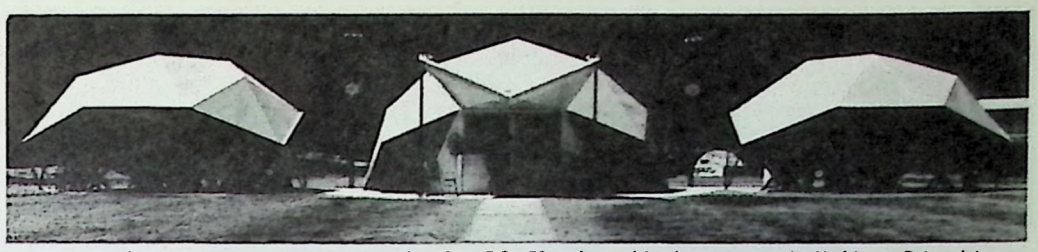
odel B-6 DOME using No. 3923 alternate ings makes an excellent food market.



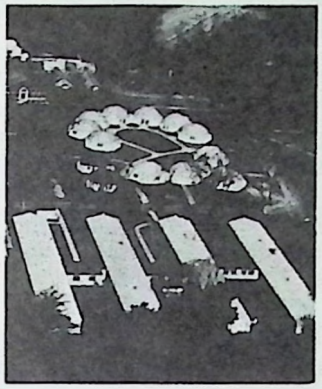
and construction office for a large builder. other location.

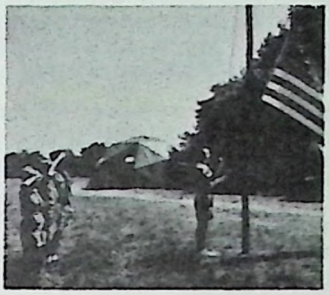


A 26' diameter and a 39' diameter PEASE DOME connected to form a night club and dance hall in Pennsylvania.



One 26' diameter PEASE DOME and two CANOPY DOMES make a drive-in restaurant in Michigan. Painted in colorful pastels, domes offer extra attention value for commercial buildings.





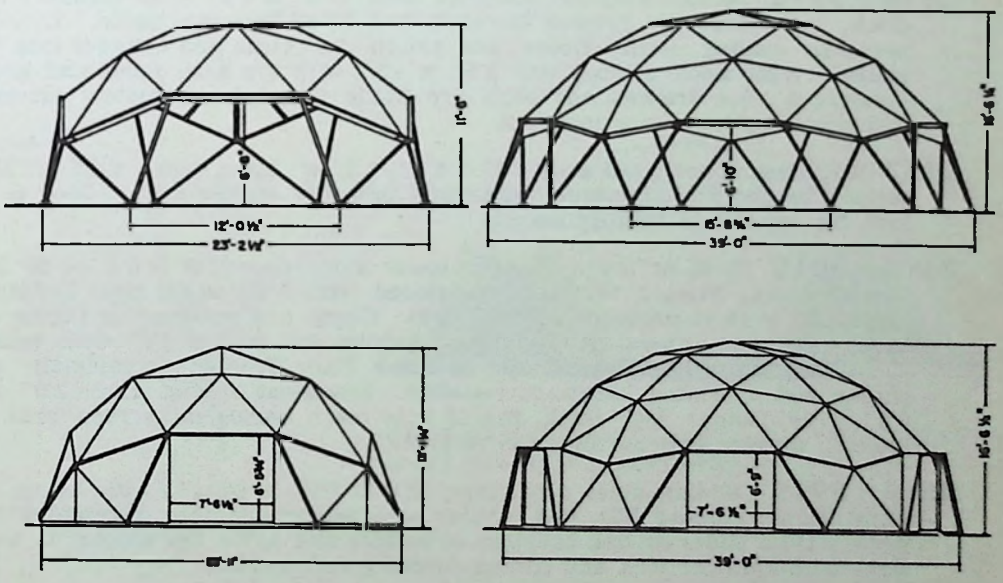
A Boy Scout Camp uses a 26' diameter DOME all year 'round for permanent first aid station.

PEASE DOME, Model A-6, with one No. 2614 (front) and one No. 2615 (back) screened openings makes ideal northwoods camp.

39' diameter PEASE DOMES joined together forming classroom buildings demonstrates the versatility of these structures. DOMES make ideal, low-cost school rooms.

An ADIRONDACK DOME is successfully used as a ceremonial building in a Girl Scout camp in Ohio.

A "nature den" CANOPY DOME is a permanent addition to a Boy Scout camp in Indiana.



F A THOUSAND USES

PEASE DOMES MATERIAL SPECIFICATIONS

1. Triangular space frames are made of 5/16" Duraply DFPA exterior grade Douglas Fir plywood with medium density plastic overlay, surface-glued and stapled to 2" x 4" kiln dried Douglas Fir or Western Hemlock frame members. Interior metal clips are also applied and frame members pre-drilled for 3 bolts in each side.

2. Joints between triangular space frames are weatherproofed by caulking and then covered with Celastic, a plastic flashing furnished with necessary materials for field application.

3. Base plates are 2" x 4" kiln dried Douglas Fir or Western Hemlock, pre-drilled for anchor bolts. In the 26' Dome, base plates serve as forms for concrete slab. In the 39' Dome, 1" x 6" forms are furnished for concrete slab. Ribbon caulking is furnished for weatherproofing between base plates and concrete slab. 2" x 2" pointed form stakes are also furnished.

4. Hardware includes 3/8" x 4" hex head machine bolts with washers and nuts (for bolting space frames together); 3/8" x 8" hook anchor bolts, nuts and washers; 18 gauge electro-galvanized steel straps (1" x 12" for 26' Dome, and 1 7/8" x 10" for 39' Dome) and galvanized nails for installation. 3/8" x 3" lag screws are also supplied for the 26' Dome.

5. Left, Right and Overhead Canopies are 5/16" Duraply (an exterior grade Douglas Fir plywood overlaid with Crezon and permanently bonded with cellulose fibers saturated with phenolic resins), which is glued and stapled to both sides of 3/4" frame, 1 3/8" x 15". Wing panels have 2" x 4" studs and plates with 3/8" Primed Duratex Siding applied. 2" x 3" x 8' pre-shaped trim strips are included (8 for 26' Dome and 10 for 39' Dome) and necessary galvanized finishing nails for application.

6. Wall sections are 2" x 4" Douglas Fir or Western Hemlock frames with 3/8" Primed Duratex (same specifications as Duraply). Duratex with vertical groove design featuring multiple striations in bands 2" wide, spaced 8" on center. Exterior trim for trapezoidal openings is S4S, select Cedar.

WALL SECTIONS

2611 - 3911 One piece garage door (7'5" x 6'6" — 26' Dome) (7'5" x 6'10" — 39' Dome) faced with 3/8" Primed Duratex, prefit for overhead hardware which is included and field applied.

2614 - 3914 Solid swing-in wood door (3'0" x 6'5" — 26' Dome) 3'0" x 6'8" — 39' Dome) 1 7/16" thick, faced with 3/8" Primed Duratex and 5/16" Duraply inside. Door is pre-fit for butts and hasp lock. Aluminum threshold with vinyl pressure sealing strip. Swing-out screen door (3'0" x 6'5" — 26' Dome) (3'0" x 6'8" — 39' Dome), 1 1/8" thick, has 18 x 14 mesh aluminum screen cloth held in place with a flush mould. Screen door hardware included. One screen opening 3'7" x 3'11" with storm panel. Opening is covered with Fiberglas screen cloth held in place by flush mould. Outside storm panel is made of 3/8" Primed Duratex, pre-hung to swing outward, and includes two hold-up props and inside locking barrel bolt.

2615 - 3915 Twin screen openings (3'7" x 3'11") with hinged storm panels. Each opening is covered with Fiberglas screen cloth held in place by flush mould. Outside storm panel is made of 3/8" Primed Duratex, pre-hung to swing outward, and includes two hold-up props and inside locking barrel bolt.

2616 - 3916 Solid swing-out entrance door (3'0" x 6'5" — 26' Dome) 3'0" x 6'8" — 39' Dome) 1 7/16" thick, faced with 3/8" Primed Duratex, and 5/16" Duraply inside. Threshold is aluminum with vinyl pressure sealing strip. Doors are pre-fit for butts and cylinder lock for easy field installation. Installed 1W2H wood awning unit 3'5" x 4'3" with top sash fixed and lowered sash ventilating. Clear Ponderosa Pine frames and sash are Toxic Treated, completely assembled and glazed with screen and operating hardware installed.

2617 Solid swing-out wood door 4'0" x 6'5", 1 7/16" thick, faced with 3/8" Duratex and 5/16" Duraply inside. Threshold is aluminum with vinyl pressure sealing strip. Door is pre-fit for butts and cylinder lock for easy field installation.

2618 - 3918 Left or Right swing-in glass store door (3'0" x 6'5" — 26' Dome) (2'8" x 6'8"—39' Dome) is 1 3/4" thick, Primed VG Hemlock glazed with 3/16" sheet glass bedded in mastic. Aluminum threshold with a vinyl pressure sealing strip. Doors are pre-hung in jambs and pre-fit for which cylinder lock is included. Installed 1W2H wood awning unit 3'5" x 4'5" with ventilating top and bottom sash. Clear Ponderosa Pine frames and sash are Toxic Treated, completely assembled and glazed, with screen and operating hardware installed. Swing-out screen door (3'0" x 6'5" — 26' Dome) (2'8" x 6'8" — 39' Dome), 1 1/8" thick, has 18 x 14 mesh aluminum screen cloth held in place with a flush mould. Screen door hardware is included.

2619 - 3919 Sliding glass door, type XO, is 7'3" x 6'5 1/4", with heavy anodized extruded aluminum alloy frame, shipped KD, and tubular sash sections factory assembled and glazed with 3/16" sheet glass. Door slides on ball bearings at bottom and nylon top guides, is weatherstripped, and has hardware with cylinder lock and sliding screen panel included.

2620 - 3920 Installed 2W2H wood awning units are 6'10" x 4'5" with ventilating top and bottom sash. Clear Ponderosa Pine frames and sash are Toxic Treated, completely assembled and glazed, with screen and operating hardware installed.

2621 - 3921 Wood rimmed jalousie door (3'0" x 6' 5" — 26' Dome) (2'8" x 6'8" — 39' Dome) is 1 3/4" thick and comes with the aluminum jalousies in place. Door has 4" clear glass louvers, aluminum

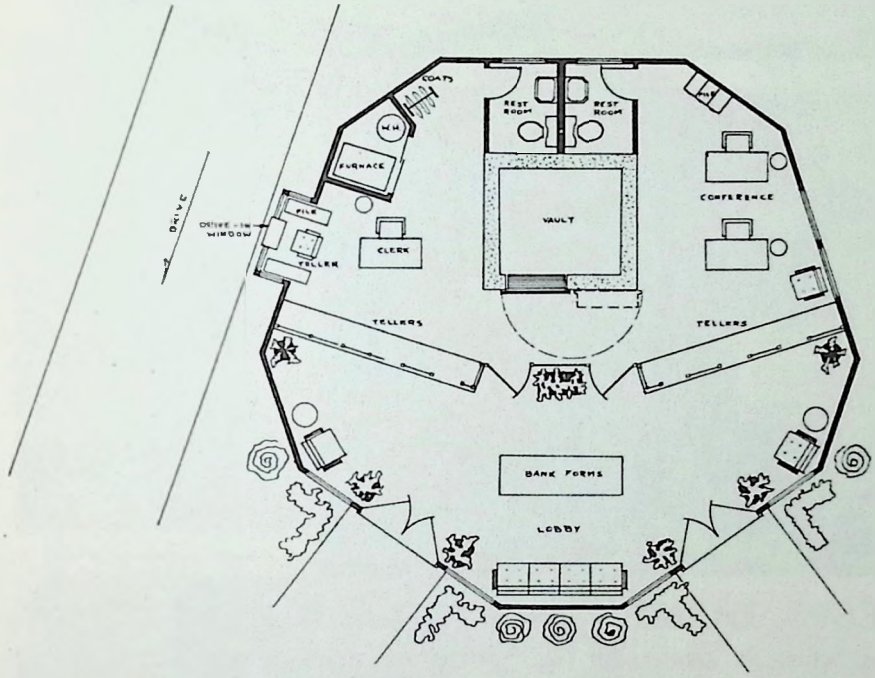
screen, and rotary operator on the inside. Aluminum threshold with a vinyl pressure sealing strip. Door is pre-hung in jambs and pre-fit for cylinder lock which is included. Installed 1W1H aluminum jalousie window, 3'1" x 4'2⅝" has 4" clear glass louvers and rotary operator.

2623 - 3923 3'0" x 6'5" (26' Dome) or 3'0" x 6'8" (39' Dome) swing-out No. 303A glass store door is 1¾" thick, Primed VG Hemlock, glazed with 3/16" sheet glass bedded in mastic. Glass sidelight and wing panels (6 for 26' Dome, 4 for 39' Dome) have 7/32" sheet glass glazed in mastic with wood stops. Aluminum vinyl threshold included.

7. Skylights 18" x 24" (4 for 26' Dome) (10 for 39' Dome) of reinforced translucent acrylic sheets are supplied for field installation in factory prepared openings 15½" x 21½" (also framed for interior finish). Lights are secured with Celastic flashing.

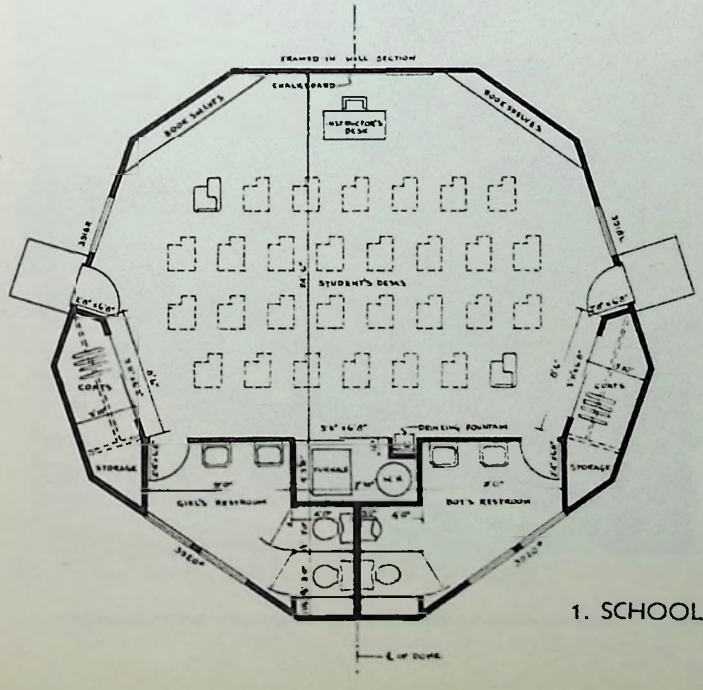
8. Insulation package consists of Owens-Corning Fiberglas insulation, 1" thick, type P. F. 612 (2½ lb. density), installed in all triangular space frames and trapezoidal sections. This insulation provides a U factor of .193 and reduces the BTU requirements (at zero° F) to approximately 29,000 BTU instead of 70,000 BTU for uninsulated 26' dome and to approximately 66,000 BTU instead of 120,000 BTU for uninsulated 39' dome.

9. Plywood interior finish package for Models A-6 and B-6 consists of ¼" AC Douglas Fir Plywood, cut to size for sidewalls, and includes 5/16" x ⅝" Ponderosa Pine half round trim strips to cover sidewall joints. Base trim (26' Dome ½" x ¾" base shoe) (39' Dome ¾" x 2¼" bevel base) is also included. Trim for interior of wall sections is ¾" x 1¼" select cedar.

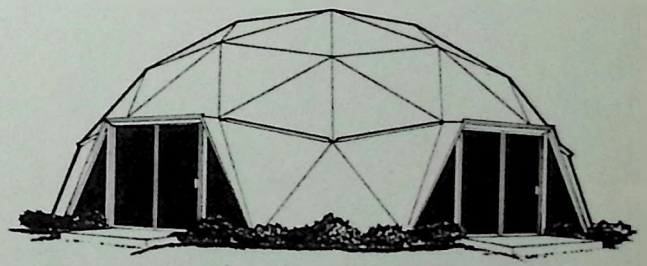


INSTITUTIONAL Branch banks . . . Camp living quarters . . . school classrooms . . . boathouses . . . fraternal clubhouses . . . resort cabins . . . golf pro shops or caddy houses . . . ranger stations . . . dormitories.

2. PROPOSED BRANCH BANK LAYOUT

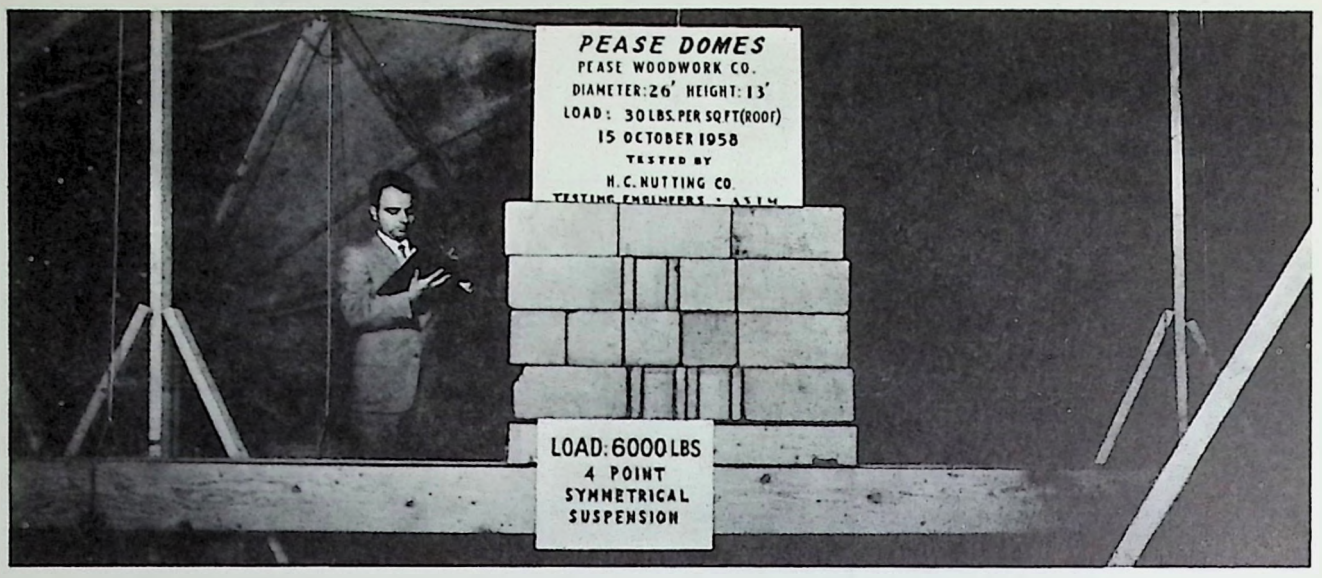


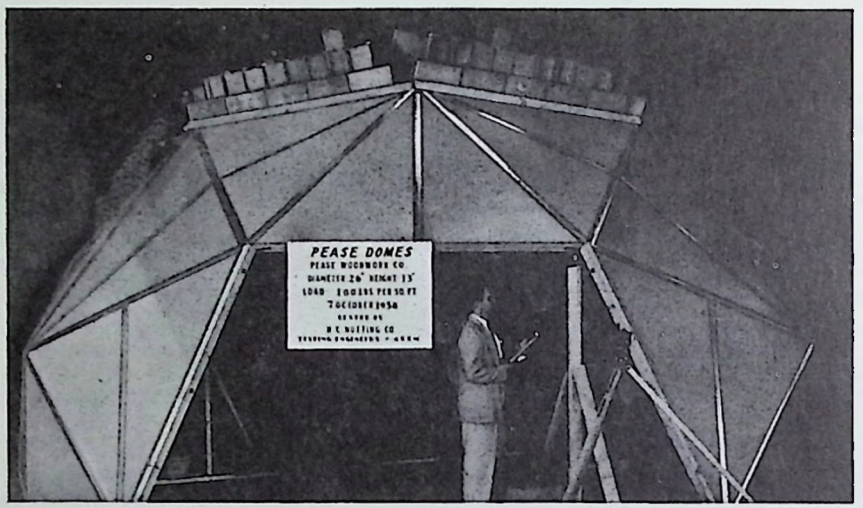
1. SCHOOL CLASSROOM LAYOUT



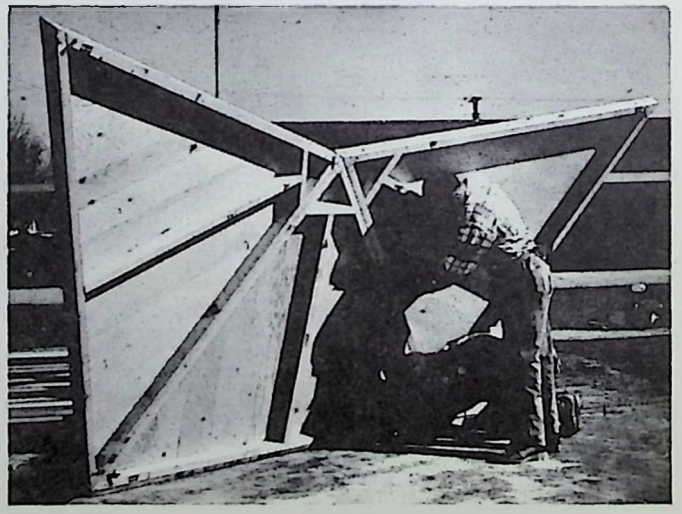
A PEASE MODEL B-6 DOME LAYOUT MAY SERVE MANY PRACTICAL PURPOSES.

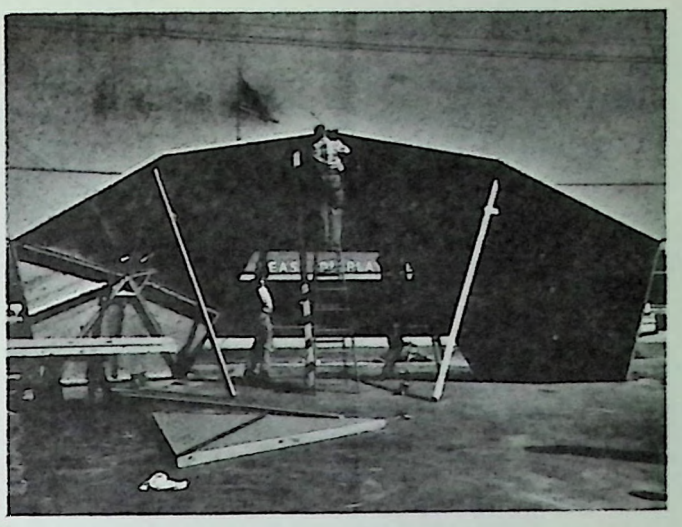
SUPERIOR STRENGTH—PROVEN BY TESTS

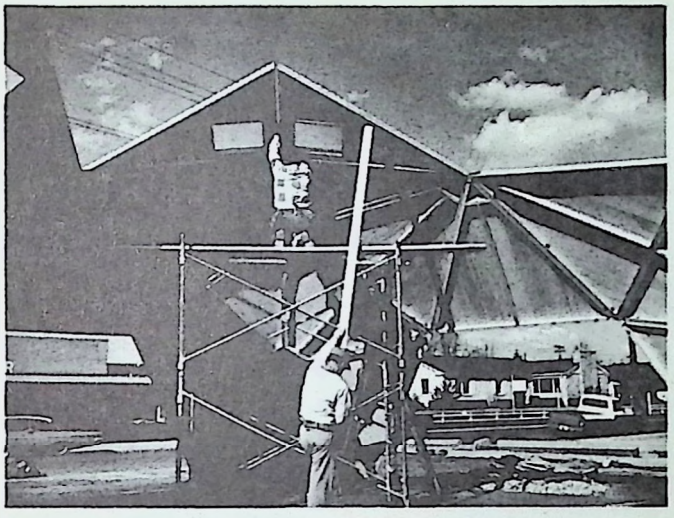


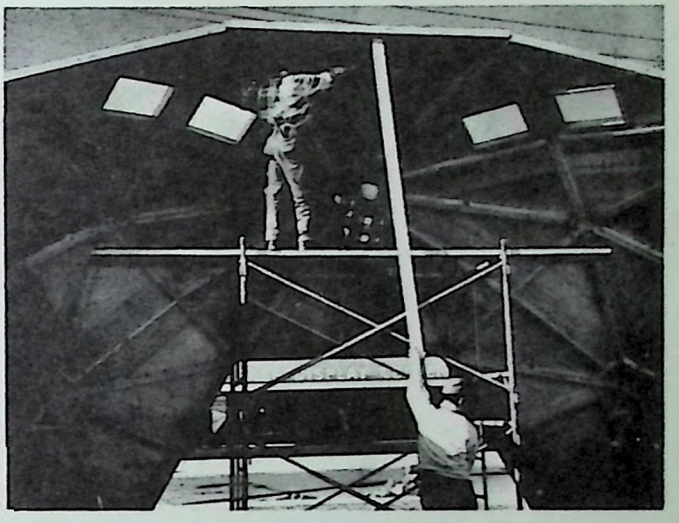


WHAT IS A GEODESIC DOME? It is a geometrical joining of materials in such a fashion that it covers a maximum of area with a minimum of materials, and has the highest strength rating per weight of any structure ever conceived by man.









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The Washington Post
Times Herald

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That Bucky Fuller Sure Is a High Flier

Cityscape

Shoots Moon

By Wolf Von Eckardt

"THE ANSWER to the housing problem lies on the way to the moon," Buckminster Fuller, the great prophet of technology, said the other day in an interview.

The inventor of the dymaxion dome and other new structural systems was in town for consultations with the United States Information Agency, which is building his largest dome yet for next year's world exposition at Montreal.

"Our present approach to housing is totally antiquated and totally wrong," Fuller said matter-of-factly. "We will never be able to build enough decent homes for the millions of people in the slums in this country and around the world as long as we cling to real estate and heavy shells, like Siamese twins holding on to their guts."

Fuller is finding salvation at Cape Kennedy in the complex apparatus now being developed there to keep man in outer space for a protracted period of time. The astronauts must have clean air at the proper temperature, water and the means to dispose of their waste. The machinery to provide the ecological regeneraton of these essentials by way of chemical recirculation must be light and compact enough to fit in the space capsule.

"LET'S CALL this complex machinery 'the little black box,'" said Fuller—like all prophets, forever the teacher, calmly assessing my attention quotient through his thick glasses. "We are investing $7 billion in it. It weighs 500 pounds. We can probably mass-produce it for $2 a pound.

"That means we can give all the things they need foremost in a house—water, heat, cooling and waste regeneration—for $1000. And we can give it to them without tying them down to real estate with its wastefully expensive water pipes and sewers. Why, with high-pressure sprays and chemical regeneration, a man can quench his thirst and clean himself for a long time with just a glass of water.

"The little black box also solves the pollution problem. Our present expensive sewage system is, of course, part of pollution.

"The shell of the house is not important. But everyone is mesmerized by the shell. The architects never look at the plumbing. There has been only one change since running water and sewers were invented in India in 2500 B.C. That change was made 100 years ago when the air lock was invented to seal water in the plumbing line.

"When I entered the building world 44 years ago," Fuller continued, "what is called 'mechanical inclusions' made up 18 per cent of a house. They were mainly a sink in the kitchen and a furnace. You still bought the ice and put it in a box. Then we had all this fallout from the Navy, electric refrigeration, oil burners, radios and so on.

"At the time of the Depression, the 'mechanical inclusions' in the house made up 28 per cent. After World War II, it was 45 per cent, with all the new plumbing, heating and wiring. Today it is 60 per cent. The cost of electricity has gone down. The cost of the house shell has gone up and up, though the house has become smaller and smaller. And any barn is better built."

THE WAY TO bring the cost of the house down, Fuller has long maintained, is to concentrate not on pretty housing shells but on energy regeneration, on the little black box. The time is now ripe for it, he believes, because the big corporations involved in research and development for the National Aeronautics and Space Administration are casting around for new things to do.

"We will solve the housing problem with the same money and the same effort we are spending to get to the moon," Fuller says. That may be wishful thinking. Undoubtedly one of the few true geniuses of our time, Fuller is also one of the few remaining true optimists. In a way, this is easy because Fuller immerses himself only in technical problems, forever probing the architecture of nature, as it were, and stays completely away from human problems, ideologies, politics, traditions and prejudices. Not that he evades them. They simply don't fit his precise, all-challenging logic.

If in that sense he is a technocrat par excellence, he is an endearingly human one. You will rarely meet a man who has absolutely no airs, not even the airs of having no airs. Smallish, with close-cropped gray hair and those owlish thick glasses, he looks like a New England country school teacher and far younger than his 71 years.

Though he has been continually lecturing and expounding his evolving ideas for most of those years, he talked about some of them again in our interview with the youthful enthusiasm of a boy who has just discovered how the bicycle works. But to Bucky (and his humble, friendly personality invites this familiar use of his nickname), you can listen for hours. Thousands of admiring students do, all around the world. He has been know to lecture unceasingly for four and five hours at a time.

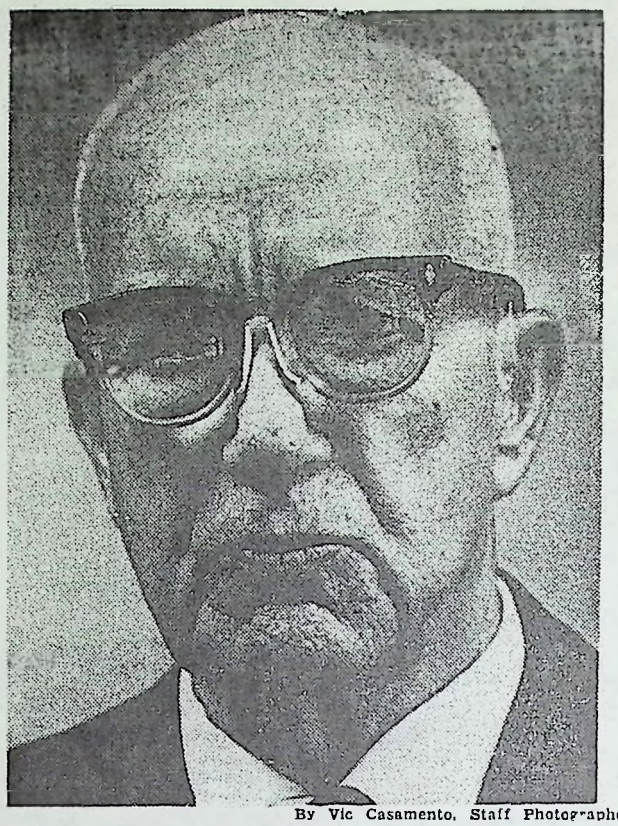
Once technology has compressed the essential "mechanical inclusions" of the house into a light-weight, inexpensive "little black box," Fuller believes, people are freed from our static notions about the city and the clutches of the "real estators." We can dwell anywhere we please on lovely mountain tops or seashore dunes. For the shelter to house us and our little black box is, of course, also lightweight, industrially mass-produced and easily movable.

FULLER DOESN'T think that people will object to such a nomadic, dymaxion tent life. The average American, he points out, already moves every four years. He considers the assumption that people want to stay put in a permanent nest completely outdated.

He cites the fact that millions of Americans live in what used to be called trailers and are now "mobile homes." They are mass-produced, compact and livable at relatively low cost. The only reason they look awkward, Fuller explains, is that they are designed to be moved on the road with its curves and underpasses.

"They wouldn't look like trailers if you moved them by helicopter," says Bucky.

What Bucky himself seems to need is a mobile home with wings and a jet engine.



By Vic Casamento, Staff Photographer

Buckminster Fuller . . . How high the moon.

He is continually flying about, lecturing and consulting. He stays put in his nest in Carbondale, where he is research professor at Southern Illinois University, no more than about two months out of the year in stretches of two or three weeks at the time.

On the morning of the day of our talk, he had flown in from Carbondale, where he had spent a few days to catch up after a brief vacation in Maine. Before that he had been in Tokyo, Hong Kong, Prague, Belgrade, Cairo . . . "about three times around the world this past year," he said, beaming.

For all his globetrotting, he looks healthier than a man half his age who spends his time on the golf course.

NOR DOES his orbiting interfere with his work, considering that he is constantly inventing, discovering and experimenting with new scientifically based structural approaches "to doing more with less." He has three books nearly ready to come out. The most important one deals with his mathematical work on what he calls "Cynergetics."

These books are partly written by him, partly dictated and partly based on his rambling lectures, but he rewrites the concoction as often as seven times.

Oh, yes, there'll have to be cities, Bucky concedes, but they can't sprawl horizontally much longer if there are to be mountain tops and seashore dunes left. "We'll have to go up," he says. He means way up. He has the structure of mile-high cities in the sky all figured out. The cells in these beehives would be assembly line produced, practically self-sufficient dwelling units (no sewer lines and pipes) and complete with garden terraces.

What happens to the old cities? "Once we really start moving forward into the future, we will also learn to look back into the past," says Bucky. And in his future, everybody will spend most of his time going to school. The decayed and obsolete parts of the old cities will be weeded out and the rest will be turned into huge universities and museums.

How do we bring this about? Bucky's answer is a "comprehensive design science." So far, scientists, he says, work only with weaponry. "What would happen if the scientists helped us to use everything they and we have learned to make the world a success for man?"