EDUCATION AUTOMATION

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Freeing the scholar to return to his studies

by **R. BUCKMINSTER FULLER**

Foreword by CHARLES D. TENNEY

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FOREWORD

For many years, R. Buckminster Fuller and his accomplishments were shamefully neglected, if not ignored. He is the kind of person who does not rapidly win recognition—a man of solid common sense, but the common sense of several generations ahead; a gentle revolutionist; a lovable genius; a visionary who is sensitive to the fact that the whole world is leaving home base and moving out into left field. He was a nonconformist before nonconformity became a form of conformity. To express his views and explain his discoveries, he felt it necessary to invent his own modes of expression, even his own vocabulary—a vocabulary which often makes English teachers shudder and plain readers scratch their heads, but which will no doubt be easily intelligible to sons and daughters of astronauts living under climate-proof geodesic domes.

Fortunately, he has not had to wait for recognition until posterity accords it. He has already achieved the dignity of a full-dress biography; he has recently filled the Charles Eliot Norton chair of poetry at Harvard (an institution which twice dismissed him while he was an undergraduate); he is a Research Professor at Southern Illinois University; he is a consultant to governmental and private agencies; he is an active businessman. Indeed, he is now subject to all the dangers of success.

But he did not come round to the world; the world came round to him. His radical innocence has not changed. Most often, he is still to be found talking like an angel (his head thrown back, his eyes seemingly closed, his hands pressed palm to palm in front of him, his halo almost visible) to a group of listeners who, some time during the second hour, are swept into the stream of his thinking, are convinced that they understand him, and are unwilling ever to let him go.

One of Mr. Fuller's extraordinary discourses to a rapt audience resulted in this book. The attendant circumstances also were unusual. It is the final business of this foreword to recount them as briefly as possible and then yield the reader over to Mr. Fuller.

For several years now, Southern Illinois University at Carbondale has been developing a new campus in southwestern Illinois. Since 1949 the University had been operating a small residence center at Belleville, but the citizens of that part of the state felt the need of additional higher education for their young people at a cost they could afford. They were able to provide for the University's use the former campus of a small liberal arts college at Alton and a former high school building at East St. Louis. These facilities were obviously inadequate to the needs of their populous area, and so they raised money toward the purchase of land for a new campus near Edwardsville, in beautiful, rolling countryside. Furthermore, the citizens of the State of Illinois shortly thereafter approved a bond issue from which was provided $25,000,000 for the construction of buildings on the new site.

Southern Illinois University therefore had the rare opportunity to plan a second major campus from scratch. Buildings, grounds, roads and walkways, parking facilities, and utilities,

could be designed as a unit, instead of evolving in a haphazard fashion over several generations, as is customary for university campuses. In October of 1960, President D. W. Morris named a planning committee of professors, administrators, architects, and associate architects to consider proposals for the new Edwardsville campus in the light of their adequacy to the educational requirements of southwestern Illinois.

Quite early it became apparent that problems of financing, design, aesthetics, procedure, timing, objectives, community services, zoning, access, parking, social philosophy, and instructional methods were so interinvolved that the usual advice of technicians would have to be supplemented by the thinking of highly creative people experienced in educational and architectural planning. From early March to early June of 1961, therefore, the planning committee met once a week at East St. Louis with a series of distinguished visitors, each of whom brought the weight of his knowledge to bear on one or more of the problems. The full effect of their suggestions will become known only after the new campus is completed and occupied, but everyone who participated in the planning sessions came away with gratitude to the consultants for adding to his store of insights and for stretching his understanding. The consultants included William Birenbaum of Wayne State University; Francis H. Horn, President of the University of Rhode Island; Alonzo F. Myers and John Dale Russell of New York University; Ernest O. Melby and John X. Jamrich of Michigan State University; Howard Y. McClusky of the University of Michigan; Harold Taylor, formerly President of Sarah Lawrence College; Edmund Bacon, Philadelphia city planner; Howard Becker, sociologist of Kansas City, Missouri; Earl Bolton of the University of California; Sybil Moholy-Nagy of Pratt Institute;

Hideo Sasaki, landscape architect from Harvard University; Paolo Soleri, Arizona architect and sculptor—and R. Buckminster Fuller.

Mr. Fuller's talk to the planning committee, East St. Louis, April 22, 1961, was startling and rare because of its profound comprehensiveness. It was in part a personal confession and credo, in part an account of his discoveries, in part a criticism of society, in part a prophecy, and in part a statement of educational philosophy in relation to general philosophy. It contained enough ideas about university planning to keep busy for decades ahead the staffs of several research institutes in higher education. But, most significantly, it placed these ideas in a context which is intricate, difficult, vast, and all-embracing, like the tight, technological world into which we are now immerging. In sum, Mr. Fuller's talk had such a pronounced effect on all those engaged in planning the development of Southern Illinois University that it is now being issued as a book, with the hope that it will stimulate and influence others who must attack similar problems of comprehensive planning.

CHARLES D. TENNEY

Carbondale, Illinois
October 16, 1962

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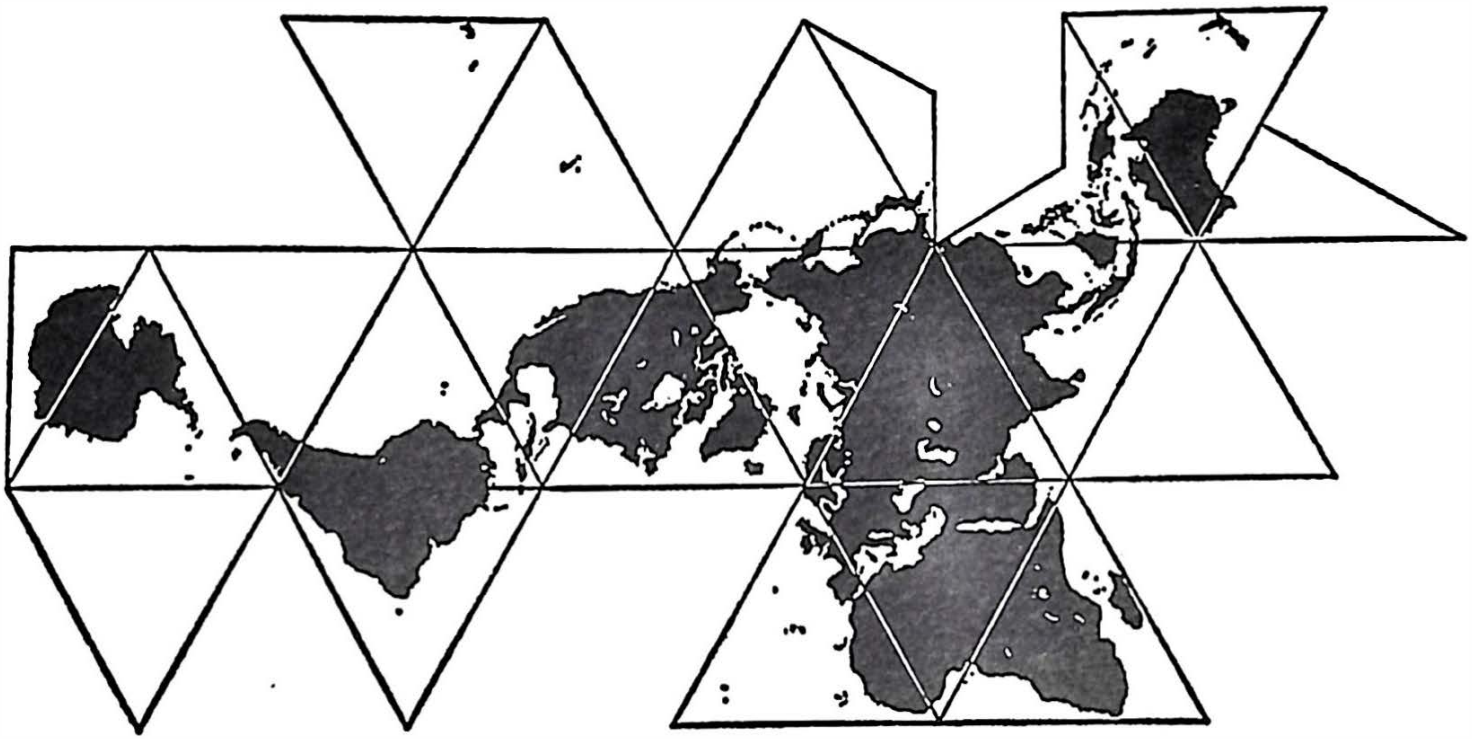

Dymaxion Airocean World

My feeling about today's meeting with you is first, that it is a tremendous privilege as a human being to stand with other human beings who are concerned fundamentally and deeply, as you are, with the process and further implementation of education and to be allowed to disclose to you what I think I have discovered regarding education's trending evolutionary needs. I am quite confident that the Southern Illinois University's new Edwardsville Campus studies are uniquely important.

Because President Morris has mentioned it in his introduction of me to this meeting, let me begin with some of my own student experiences at Harvard, for what I have to offer to you today springs from my several educational experiences. I am a New Englander, and I entered Harvard immaturely. I was too puerilely in love with a special, romantic, mythical Harvard of my own conjuring—an Olympian world of super athletes and alluring, grown-up, worldly heroes. I was the fifth generation of a direct line of fathers and their sons attending Harvard College. I arrived there in 1913 before World War I and found myself primarily involved in phases of Harvard that were completely irrelevant to Harvard's educational system. For instance, because I had been quarterback on a preparatory school team

whose quarterbacks before me had frequently become quarterbacks of the Harvard football team, I had hoped that I too might follow that precedent, but I broke my knee, and that ambition was frustrated. Just before entering college I was painfully jilted in my first schoolboy into-love-falling. Though I had entered Harvard with honor grades I obtained only "good" to "passing" marks in my college work, which I adolescently looked upon as a chore done only to earn the right to live in the Harvard community. But above all, I was confronted with social problems of clubs and so forth. The Harvard clubs played a role in those days very different from today. The problems they generated were solved by the great House system that was inaugurated after World War I. My father died when I was quite young, and though my family was relatively poor I had come to Harvard from a preparatory school for quite well-to-do families. I soon saw that I wasn't going to be included in the clubs as I might have been if I had been very wealthy or had a father looking out for me, for much of the clubs' membership was prearranged by the clubs' graduate committees. I was shockingly surprised by the looming situation. I hadn't anticipated these social developments. I suddenly saw a class system existing in Harvard of which I had never dreamed. I was not aware up to that moment that there was a social class system and that there were different grades of citizens. My thoughts had been idealistically democratic. Some people had good luck and others bad, but not because they were not equal. I considered myself about to be ostracized or compassionately tolerated by the boys I had grown up with. I felt that my social degradation would bring disgrace to my family. If I had gone to another college where I knew no one, it would not have mattered at all to me whether or not I was taken into some society. It was being dropped by all

those who had been my friends that hurt, even though I knew that they had almost nothing to do with the selecting. I became panicky about that disintegration of my idealistic Harvard world, went on a pretended "lark," cut classes, and was "fired."

Out of college, I went to work and worked hard. In no time at all, reports went to Harvard that I was a good and able boy and that I really ought to go back to college; so Harvard took me back. However, I was now considered a social maverick, and I saw none of my old friends; it hurt too much. Again I cut classes, spent all my year's allowance, and once more was "fired." After my second "firing" I again worked very hard. If World War I hadn't come along, I am sure the university would have taken me back again, and I am sure I would have been "fired" again. Each time I returned to Harvard I entered a world of gnawing apprehensions, not an educational institution, and that was the problem.

But I did get an education in due and slow course—but an education largely of my own inquiring, experimenting, and self-disciplining. Forty-seven years later Harvard's Dean Bundy, who is now one of Kennedy's White House advisors, invited me to come back to Harvard in 1962, to be the Charles Eliot Norton Professor of Poetry. This is regarded as an honor. The Norton professorship is a one-year appointment. The chair was founded because its donor felt that the university needed to bring in individuals who on their own initiative have long undertaken objective realizations reflecting the wisdom harvested by the educators, which realizations might tend to regenerate the vigor of the university world. Harvard fills this professorship with men who are artists, playwrights, authors, architects, and poets. The word *poet* in this professorship of poetry is a very general term for a person who *puts things together* in an era of great speciali-

zation wherein most people are differentiating or "*taking*" *things apart*. Demonstrated capability in the integration of ideas is the general qualification for this professorship. I am able to accept the Norton professorship for 1961–62 even though I am a professor on the faculty of Southern Illinois University because I have to be in residence at Harvard only for the months of February and March, 1962, when I am officially absent from Carbondale.

In the last thirty years of the half century that has passed since my Harvard fiasco, I have been invited as a lecturer, critic, or experimental seminarist to visit 106 universities around the world, and many of them quite frequently. I have had appointments, for instance, to Princeton University nine times, starting back in 1929, M. I. T. eight times, North Carolina State eight times, University of Michigan five times, Cornell University four times, and that's the way it has gone. There have been many revisits, and all of my visits have been entirely a consequence of their inviting me to come. I developed a self-discipline long ago regarding exploration on the science, technology, philosophic, and economic frontiers which requires that I must not spend any time asking people to listen to me or to look at what I may be doing. If, however, what I am discovering seems to be of interest to others and they ask me what it is that I am working on, I will tell them. I am quite confident that if in the evolutionary processes we deliberately attempt direct personal exploitation of the economic advantages accruing to our personal scientific explorations, we inadvertently become preoccupied and prejudiced with the item we have to sell and are no longer free to explore scientifically with a wholesome intellectual integrity.

By my own rules, I may not profess any special preoccupa-

tion or capability. I am a random element. Considering these self-imposed conditions, I am happy that I have been asked back to the universities, and I am happy that several of them have seen fit to give me an honorary degree. At Washington University, where I had been a one-month visiting critic and lecturer for four successive years, the University gave me a degree of Doctor of Science, "with all the rights and privileges thereonto attached." I feel that this was not an exclusively honorary degree; the circumstances were akin to those of a doctoral candidate. My degree was voted unanimously by the University faculty as a direct consequence of my campus work. Though I have degrees awarded by other leading universities under similar working or earned circumstances as Doctor of Arts, Doctor of Design, and Doctor of Humanities, I am confident that I am not professionally classifiable. I do know, however, from personal experience that there is nothing even mildly extraordinary about me except that I think I am durable and inquisitive in a comprehensive pattern. I have learned much; but I don't *know* very much; but what I have learned, I have learned by trial and error. And I have great confidence in the meager store of wisdom that I have secured.

As a consequence of my university visiting, I have had about two thousand students who have worked with me in different parts of the world. As I go around the world I find these students active and doing well. When I arrive in New Delhi, Nairobi, or Beirut I find that the students know that I am coming. They are waiting for me with programs they have arranged, and I am able to assess the effect of the kind of learning and communication we have shared. I am confident that the boys I *have* worked with are trending to become strong citizens around the world. That, *I* find, is one of the best tests of the

validity of whatever communicable wisdom I may have harvested and disbursed from my experiences.

My experience is now world-around. During one-third of a century of experimental work, I have been operating on the philosophic premise that all thoughts and all experiences can be translated much farther than just into words and abstract thought patterns. I saw that they can be translated into patterns which may be realized in various *physical* projections—by which we can alter the physical environment itself and thereby induce other men to subconsciously alter their ecological patterning. My own conclusion is that man has been given the capability to alter and accelerate the evolutionary transformation of the a priori physical environment—that is to participate objectively, directly, and consciously in universal evolution—and I assume that the great, complex integrity of omni-co-ordinate and inter-accommodative yet periodically unique and non-simultaneously co-operative generalized principles, and their myriad of special case realizations, all of which we speak of as universe and may think intuitively of as God, is an intellectual invention system which counts on man's employing these capabilities. If he does not do so consciously, events will transpire so that he functions subconsciously in the inexorable evolutionary transformations.

As a consequence of man's having the faculty to apprehend patterns external to himself and the capability of altering those patterns, interesting changes in the conscious relationship of man to universe are now multiplyingly in evidence. Unlike any of the other living species, man has succeeded both consciously and subconsciously in greatly altering his fundamental ecological patterning. None of the other living species have altered their ecological patterning. All the species other than man are

distinguishable throughout geologic and biologic history by their approximately unaltered ecological patterning. In the last half-century, man has graduated from a local twelve-mile radius daily domain into a world around multi-thousand-miles radius daily domain, as a consequence of his ability to alter his own ecological patterning.

I have for a third of a century been convinced that thoughts must be translated into patterns that can be articulated out of the organized capabilities of man and that these patterns, which can be translated from our thoughts into physical actions, then become utterly impersonal facilities that begin when adopted in emergencies to change the relative advantage of man spontaneously and subconsciously with respect to his total environment. It is a philosophic requirement of my comprehensive working hypotheses that the intellectually-projected tools which result in new ecological patternings must give man, consciously appreciable, advantage increase. My experience shows that these impersonal tools tend to eliminate many of the errors of conceptioning that men who have not translated their thoughts into experimental physical undertakings have heretofore imposed upon one another as inherited *conventional* thoughts and misinterpretations of their respective experiences—misconceptions which they have hopefully and lovingly gone on relaying for ages from one generation to the next.

I am convinced that humanity is characterized by extraordinary love for its new life and yet has been misinforming its new life to such an extent that the new life is continually at a greater disadvantage than it would be if abandoned in the wilderness by the parents. For an instance of misconception extension there is my own case. I was born in 1895. The airplane was invented when I was nine years old. Up to the time I was nine

years old, the idea that man could fly was held to be preposterous, and anybody could tell you so. My own boyhood attempts to make flying machines were considered wasted time. I have lived deeply into the period when flying is no longer impossible, but nonetheless a period in which the supremely ruling social conventions and economic dogma have continued to presuppose a non-flying-man ecology.

My daughter was not born into the kind of a world that I was; so she doesn't have to struggle to sustain the validity of the particular set of spontaneously-logical conceptions that were pronounced "impossible" in my day, nor need she deal with the seemingly illogical concepts that the older life thought to be "evident" and "obvious" in my day. The new life is continually born into a set of conditions where it is easier for it to acquire more accurate information, generated almost entirely outside of family life and folklore, regarding what is going on in human affairs and in nature in general; and, therefore, the new life has the advantage of much more unshaken intellectual courage with respect to the total experiences than have its as yet living elders who have had to overcome these errors, but who retain deep-rooted delusively-conditioned, subconscious reflexes.

As a startling consequence of the as yet prevalent and almost total misconceptioning regarding traditional education, both formal and informal, I have heard the following problem discussed among leading scientists. A serious question arises when a university student demonstrates extraordinary capability in science as judged by our present academic criteria. The exceptionally high-ranking student has completed his graduate work, and if enabled to develop further there is high probability that he might be able to make important contributions to science and therethrough to society. There are funds available to fos-

ter the super education of this promising individual, but first there is a decision to be made concerning resources much more important than money. This man is going to have to be associated with some of the senior, proven, living scientists—some of the very rare great men—in order for the latter to find out whether the neophyte is a real front-rank scientist. The neophyte is going to have to be given the opportunity to grow in that association with the proven great one. Therefore, society is going to have to risk wasting some of the preciously meager remaining lifetime of its proven, really high-powered intellects, should the candidate fail to demonstrate exceptional capability. Whether that risk is warranted becomes the strategic question. As a consequence, the kind of examination procedure that our science foundations and other science leaders have developed is one in which they explore to discover whether this capable student is able to unlearn everything he has learned, because experience has shown that that is what he is going to have to do if he is to become a front-rank scientist. The frontiers of science are such that almost every morning many of our hypotheses of yesterday are found inadequate or in error. So great is the frontier acceleration that now in a year of such events much of yesterday's conceptioning becomes obsolete.

I said I started a number of years ago exploring for ways in which the individual could employ his experience analytically to reorganize patterns around him by design of impersonal tools. To be effective, this reorganization must incorporate the latest knowledge gained by man. It also should make it an increasingly facile matter for the new life to apprehend what is going on. It should eliminate the necessity of new life asking questions of people who don't know the answers, thereby avoiding cluttering up the new minds with bad answers which would

soon have to be discarded. I felt that the evolving inventory of information "decontaminated" through competent design might be "piped" right into the environment of the home. Please remember my philosophy is one which had always to be translated into inanimate artifacts. My self-discipline ruled that it would be all right for me to talk after I had translated my philosophy and thoughts into actions and artifacts, but I must never talk about the thoughts until I have developed a physical invention—not a social reform.

That is the philosophy I evolved in 1927, when at thirty-two I began my own thinking. I have been operating since then on the 1927 premises, looking exploratorily for tasks that needed to be done, which would, when done, provide tool complexes that would begin to operate inanimately at higher advantage for the new life. I am the opposite of a reformer; I am what I call a new former. The new form must be spontaneously complimentary to the innate faculties *and* capabilities of life. I am quite confident that humanity is born with its total intellectual capability already on inventory and that human beings do not add anything to any other human being in the way of faculties and capacities. What usually happens in the educational process is that the faculties are dulled, overloaded, stuffed and paralyzed, so that by the time that most people are mature they have lost use of many of their innate capabilities. My long-time hope is that we may soon begin to realize what we are doing and may alter the "education" process in such a way as only to help the new life to demonstrate some of its very powerful innate capabilities.

I went to the World Affairs Conference in Colorado last week. At the meeting were many important individuals—the ambassadors of Ghana, Nigeria, and so forth. Also participating

were economists, sociologists, and scientists, and among them was a Yale scientist, Dr. Omar Moore. Dr. Omar Moore, you may recall, was reported on in *Time* magazine last year. At Yale University in the Child Study Clinic, he began to be suspicious that there were drives in human beings other than those of *fear* and *longing* which have been the assumed *fundamental* drives. He developed a hypothetical working assumption that there was a drive of the new life to *demonstrate competence*, and began working with his own child when she was two and one-half years old. He took an electric typewriter and colored the keys to correspond with the touch system. He then colored his child's fingernails to correspond with the keys each finger should operate. He had a hidden electric key, and when she didn't match the correct finger to the typewriter key the circuit was not closed. When she put the correctly colored finger on it the key worked, and quickly she learned to match her fingers to the proper keys. Every time she touched a key with the proper finger, not only did it print on the paper, but a big letter also came up in a window. By the time the child was three she was typing swiftly with the touch system the stories that were generated in her imagination. She seemed to find it just as easy to communicate this way as by talking. Dr. Moore's community and a number of his colleagues who happened to live in the same little town became fascinated, and began working experimentally with their children. There was a wave of excitement. These men say they used to like to get the children to bed early so they could have the evening to themselves, but now they hate to have the children go to bed early because everyone is so excited and stimulated by what this new life is demonstrating in capacity and capability. These are just some of the inklings corroborating what I am saying regarding very powerful fac-

ulties born in the human being which, if given the opportunity, may very readily regenerate to higher advantage for other men.

As a consequence of my kind of technically objective philosophy, I have had wide and copious experiences and firsthand practice in mechanics and structures. I am an engineer by tutorial work with one of our country's leading engineers of the 1920's; I am capable in the general world of physics and mildly capable in the world of chemistry; I am a mathematical explorer. I have been able to translate many of my philosophies into physical inventions in gap areas where there have been no previously recognized functions whatsoever—where people have not thought of the problems as being soluble by some device, but soluble only by social procedure reforms. As a consequence, I have developed quite a number of unprecedented devices and structures. At the present there are almost two thousand of my geodesic domes in forty countries around the world. All of those structures are of an unprecedented type. They were patentable in the countries around the world because they were unprecedented and were not included in structural engineering theory and therefore were true inventions. They enclose environments at about 1 per cent of the invested weight of resources of comparable volume enclosed by conventional structures with which you are familiar. They had to meet the hurricanes, the snow loads, and so forth. My structures are also earthquake proof; most of their comparable conventional counterparts are not. I have found it possible to do much more with less.

I have been able to demonstrate that there are important patterns to be employed by men and that there are inherently-available ways of thinking which are simple and logical. My exploration into mathematics has disclosed extraordinary and

comprehensive mathematical patternings of nature. I am quite confident that I have discovered the co-ordinate system employed by nature itself, in contradistinction to the arbitrarily adopted X, Y, Z system which science employs and by virtue of which it translates its calculus through analytical geometry into informations which can be used technically.

All my discourse to you thus far has been given as an introduction in which I have related examples of my experiences and their derived philosophy. I gave you this in the hope of earning your credit for whatever I may be able to say exploratorily regarding what I think is going to happen in the immediate, educational-process future with which you are specifically concerned.

I am a student of trends. I am confident that my over-all trend data is good and that my forecasting capability has proven reliable. From 1938 to 1940, I was technical editor on *Fortune* magazine—at least that was my function; they don't have that title on their masthead. In the period 1936 to 1938, I had been assistant to the director of research of the Phelps Dodge Corporation, which was the third largest copper corporation in the world. For Phelps Dodge, and indirectly for the World Copper Committee, I developed some comprehensive world economic-trend patternings in order to learn what the over-all trend in world industry might be and what copper's functioning within it might be. Many of my trend prognostications were fulfilled and acknowledged by Phelps Dodge. These world economic-trend patterns were of renewed value when my suggested main

theme and research were adopted by *Fortune* magazine in February 1940 for the subject of their tenth anniversary issue. I had to employ a number of the accounting staff of Time, Inc., to carry out the large-scale work, because the subject was "U.S.A. and the World." We went into all that was known at that time about the economic patternings of man on earth, the industrial equation, and the posture of the U.S.A. in that picture. That issue of *Fortune* was so successful that it went into three reprintings and took *Fortune* from the red into the black side of the ledger.

Incidentally, the relative world economic advantage of the United States as of 1940 was so prodigious that it was astounding. Our relative advantage today is anything but that. It was not that we had about 75 per cent of all the world's industrial products but that we had the confidence of much of the world that democracy was unbeatably the most favorable political system. We have been frittering away an enormously high credit that the world spontaneously extended to us. Our world credit has deteriorated. The ambitions of world man and the needs of man have not been wisely serviced by us in the last score of years, 1940 to 1960. Because national, foreign, and domestic policies of government and business failed to heed such world-trend studies and continued to revert to the pre-air-age conventions and concepts of independent local sovereignties and business anarchy we have lost that world credit of our initiative and integrity. It can be won back, but only through the integrity of education.

Out of my general world-pattern-trend studies there now comes strong evidence that nothing is going to be quite so surprising or abrupt in the forward history of man as the forward evolution in the educational processes. People think that it is

exciting to consider going to the moon and that such a trip will be a revolutionary affair. Of course it will. We may have all kinds of world warring and so forth, and these are spectacular. But in our shifting times the world tends to think of its educational processes as well-developed and quite reliable, needing only expansion, therefore not subject to excitingly important changes, and therefore the antithesis of news-making moon-shots.

As a consequence of this public attitude there is the prevalent tendency of politicians to feel that they are going to be secure of their return to office by virtue of getting all they can for their constituents in the way of "educational facilities" as a well-established and familiar commodity. It is very characteristic of all those undertakings that when the politicans think about education they immediately begin to think about buildings and apparatus. There is a conventional picture or concept of school that is very powerful in most men's minds, and I think a great surprise is coming. I don't think that what is going to happen in education is apprehended or anticipated at all by the political states. I know that there is awareness of coming change amongst the forward thinkers of the educational ranks, but, I feel, even they will be astonished at the magnitude of the transformation about to take place in the educational processes.

I have put up on the wall my Dymaxion Airocean World Map. I am sure it doesn't look familiar to you. Some of you may have seen it—there was an early version of it published in *Life* magazine in 1943—but it was a little different from the one on the wall. The same spectrum colors were used, but it was a slightly different geometrical pattern. If we were to go around this school building and look at the world maps on its walls, we would probably see several Mercator maps. Sometimes we

would see U.N. maps. These projections do not show the Antarctic. The U.N. map is a north-polar azimuthal. It is greatly distorted in the Southern Hemisphere and has no Antarctic and, therefore, misses a very large continent. You are probably thinking that my world map is "interesting," but that you would rather have a "regular" map. Our concept of the "regular" map is typical of our mental fixation in the educational processes. On the Mercator, as you know, the North Pole area is so completely distorted that it is seemingly thousands of miles from Greenland to Alaska. Many thousands of miles are indicated at the top edge of the Mercator between North Pole points one mile apart—completely misinforming. The Mercator map tends to show Europe and Asia split in two, so that "never the twain shall meet," as Kipling said. The Americas are in the center. The "tops" of the continents don't join together at all, and there are the great open blank spaces of the Arctic and Antarctic. Those were very good maps for the era of sailing when the Arctic and Antarctic were unexplored "infinities."

My world map which you are looking at on the wall has strange sixty-degree angle-edge patterns. If you will cut out along the gray edges and bring them together, you will find that the map will make an icosahedron—that is, a "solid" faced with twenty equilateral triangles. If you will compare its data and graphic patterning with that of a globe, you won't find any fault with it at all. It will seem to be saying just what the world globe says. The shapes of the land masses are correct; there is no visible distortion of the relative shapes or relative sizes of its geographical features. This is a pretty good map because no other projection will do that. The polar azimuthals, the polyconics, and the Mercators—the prime "regular" types—all have a very great distortion in them. My map does not. I dis-

covered a topological transformation between spheres and planes. I was able to get a United States patent—the first United States patent ever granted on a method of projection. Though my map is hung in many distinguished men's offices, the fact is that it is not hung in the schools. The big map companies go right on turning out the maps that, as far as I am concerned, are extremely distorted, misinforming, and obsolete.

Let me point out next that when you transfer the projected data from the surface of a sphere to a plane you have to break open the spherical skin in order to "peel" it. There will be various angular cuts in the periphery of the skin when it is layed out flat, just as when you take the skin off an animal. The openings along the edge are called sinuses. The sinuses on my map all occur in the water. None of the cuts go into the land. Therefore, I am able to take all of the data off the earth globe and make it accurately available to you in the flat. You can't see around the world globe; in fact you can only *read* one fourth of the globe at any one time; so it is good now that you can see all the data at once in the flat without visible distortion or breaks in the continental contours. My map in effect shows one world-island in one world-ocean. We have been aware that only one quarter of the earth's surface is dry land, but we have not acknowledged that there is one ocean. We speak of at least three oceans. When this one-world-island is rotated as you now see it displayed on the wall, you say, "I see the United States now and it is 'right side up.' " The fact is, there is no such orientation in the universe as "right side up"; so what you mean is your habitual way of looking at things. This map can be cut into triangles. You can put them together in many different ways. The arrangement on the wall just happens to be a preferred way of putting the triangles together. I watched the head of

the mathematics department of a leading university observe his children putting a similar map together on the floor. He said, "No, darlings, you have it upside down. You are supposed to have the United States so that it's up." The children were quite right, of course, and the head of the math department was wrong. He was demonstrating a debilitating fixation on the *conventional* map. I assert that this disclosure is typical of our entire educational process, of the kinds of conceptual fixations we have that are debilitating to the older people in considering the needs of the young peoples' world and the enormous new potentials that can be integrated to the advantage of the young.

Four per cent of humanity is for the moment in South America. One per cent is in Central America, 7 per cent in North America—a total of 12 per cent in the combined Americas. From anywhere in the United States, as only my map shows, I can fly on the shortest great-circle routes to reach 84 per cent of humanity without flying either over the Atlantic or Pacific oceans. This is not the pattern that we have been thinking about with our Mercator maps. With them we think in terms of *necessarily* crossing the Atlantic and Pacific, going back to the great sailing era days and the great significance of the ports of embarkation and debarkation and of the great tonnages being shipped between them. In terms of air transportation, however, *this*—the one-world-island land mass on the Fuller map—becomes the airstrip of the world which is most significant, and this airstrip is oriented at 90 degrees to the Mercator stretch-out. This is the appropriate world communications and transport orientation for the present moment. Older people still think they must go to New York from St. Louis to go to Europe, but that really is not the right way to go. This is the right way to go—northern great-circle routes. That is why

Chicago, despite New York and San Francisco being very attractive places to embark from, is the most heavily used airport in America.

People generally think "go north go cold, go south go warm." That is a fixation which is also not true. On my map, the spectrum colors are used. I use these for the mean low temperatures for the year. The mean highs are about the same everywhere; that is, in Eastern Siberia it gets as hot in the summer as it gets in mid-continent Africa on certain days. The major climatic differences between the various parts of the world are in the extremes of cold, or the "lows," not in the "highs," or heats. The hottest days in Brazil and India are about the same as the hottest days in Eastern Siberia and Alaska. The cold pole of the Northern Hemisphere is in Eastern Siberia. The cold pole for the Southern Hemisphere happens to coincide geographically with the south pole of the earth's rotational axis. You see on my map how the colors change from blue to green to yellow to red. Blue is coldest. Red is hottest. We find that the red masses of Africa, South America, and South Asia belong to the Northern Hemisphere's color-spectrum bull's-eye. The world thermal map in effect makes a "target" pattern, with the spectrum color-ring zones primarily co-ordinate in terms of the Northern Hemisphere. There is also a small secondary color-spectrum temperature-zone bull's-eye associated with the Southern Hemisphere's cold pole, but it is much smaller than the Northern. It has green in the southern tip of South America and some yellow and red. There is a little yellow and mild red that belongs to the Southern Hemisphere in Australia. Only the southernmost tips of Australia, Africa, and South America are primarily affected by the south cold pole. The rest of the world temperature-patterning relates to the north cold pole. Ninety-nine per

cent of the world's population lives at present in the north cold pole's weather domain.

In Europe you will find that the spectrum of thermal-zone lines runs north and south, contrary to the "go north go cold, go south go warm" fixation. The hottest place in Europe is Spain, and Europe gets colder as we go *east*, not north. Napoleon, thinking as everybody does, that when you stay in your home latitude you will have about the same temperature and weather, went east into Russia prepared to find conditions similar to his home conditions. He was licked by the cold. He dissipated enormous amounts of energy against the cold, the great negative of energy. You would think that by the time Hitler came along men would have learned something about this thermal map. They had not, and Hitler, too, went east into Russia. He was licked logistically by the unexpected magnitude of cold. For an instance, he did not have the right locomotive greases for the temperatures that his army ran into. As a consequence of the thermal ignorance, his forces were not properly supplied, and their hitting power was dissipated by the cold. The cold turned Hitler's tide. This was due, then, to the fact that the concept of go north to cold is wrong. This is ignorance again typical of the educational fallacies. I am sure that parents are still going to teach this geographical error to their children, but the fact is that where 76 per cent of humanity now exists it is "go east, go cold" and in only 24 per cent of the world's land is "go north go cold, go south go warm" true.

We can also look at the colors on the map and compare them with the colors of men's skins. The map temperature colors have to do with the radiation, the inhibition of energy from the sun. As we get into the great cold areas, the skin gets very, very white. Men have to hibernate a great deal of the time. In other

parts of the world they could be naked with a great deal of sun. The colors of the map are related, then, also to the color of pigmentation of the skins. This has something to do with the solar system and nothing to do with some mysterious "different kinds of tribes" around the faces of the earth. If there are any special differences in the shapes of noses or heights of men, it has to do very much with the long isolation of men and the developing of certain amounts of hybridism in relation to adapting to special local conditions. There are some dark-skinned people up in the Arctic among the Eskimos, and they are people who came there relatively recently from the tropics and Japan, from the darker regions, by water. They are water people. That is enough discussion of the map.

I was asked to speak in Japan a month ago by Governor Azuma of Tokyo, now the world's largest city. Tokyo is a province as well as a city. There are so many people they make it a province with a governor. He asked me to speak to his planners and council about planning for Tokyo's future. I pointed out to him that in most of the universities I visit we get into town planning. The planning game is always operative in the terms of a "San Francisco plan," a "St. Louis plan," "East St. Louis plan," or "Lack of East St. Louis plan." Planning as taught is a target-town discipline. I pointed out that this is no longer an adequate way of looking at the planning problem. We will have to find out first what is happening to humanity in the big world pattern—where it is going—find out what the world's probable and comprehensive changes are in order to understand what you've got to plan for any particular city. I recalled that at

Massachusetts Institute of Technology in 1949 the planning department was working on the greater Boston plan. It turned out in the end that despite M.I.T.'s exclusively local considerations what was really happening to Boston in an entirely unplanned manner was that it was becoming a vast clover leaf for a continental highway delivery system of our national hitting power from the entire complex of industry in the Eastern United States focussed to the northeasternmost "jump off" point of the United States, should there be a hot war. They were really rubbing out old Boston to make room for the military highway system. The preoccupation with Boston was nonsense. M.I.T.'s planners ought at least to have been talking about the larger highway system and much better about the big world traffic patterns that are developing and how Boston might possibly function in them. They should have been asking: "What does Boston have that is going to make it of any importance whatsoever tomorrow?" If you can find out what that is, then you will know how not to be surprised by what happens and you will know how to accommodate what is going to happen. Boston, despite much "planning," is in 1961 one of the United States' prime depressed areas while many nonplanned areas are booming.

There are many big patternings transcendental to man's general apprehension which are developing gradually into inevitable recognition in the world. One of the biggest *inevitables* concerns world-man ecology and discloses the fact that at present men are completely mistaken in fundamental ecological thinking regarding themselves. They tend to think of themselves as a tree, as having roots. Up to World War I, the "good citizen" was the man who "owned his own home"—a very well-known expression even today. Men also think of them-

selves as natives of one country, of one state, of one town, of one homestead. There are two ways in which life tends to be ecologically successful. One is in a static way as a tree. Trees do have roots, and the pine tree as a species "goes around the world" by having its seeds airborne. The pine moves around the world not as an individual tree but by successive generation relaying and airborne regenerations. Man is one of the species that does not have roots and is successful by virtue of his dynamic ability to advance and retreat. He is mobile. Man's little legs are very small, and he doesn't cover much territory compared, for example, with a sea gull. Man, therefore, has tended to think of himself as being more like a tree simply because of the diminutive size of his daily perigrinations. He found it difficult to get along without close association with other men, and up to World War I, with minor exceptions, remained essentially within a very small geographical pattern—that is, the territory or even the town in which he was born.

The average distance viewed from the top of a tree to the horizon is fourteen miles. To the horizon and back is, then, about twenty-eight miles. One learns in the Army that twenty-five miles is a very good day's hike. When man's movement was only by legs very few people ever went all the way to the horizon. They stayed pretty well within the sight of one another. They had to develop very static rules and mores—customs that would be acceptable to the dullest and rudest while seeing a whole lot of one another. Our popular political and social and economic reflexing developed along those lines, and holds vigorously today. The concepts of real estate, or of banking and mortgage economics, are theoretically predicted upon people staying "put." Our whole political system is based on the assumption that people belong to special pieces of land, as do

trees, and they are expected to stay there. They have political representatives from each geographical point. "Where is your home?" or "Where do you come from?" are considered logical questions.

In the last two United States' censuses there were some surprises for those static-roots concepts. The census seven years ago showed that every year an average of 20 per cent of America moved out of town. When I was a little boy, we had two "moving days" each year in the New England towns, and I understand they had them in the Western towns, too. About twice a year people made new lease contracts for the next year's rented quarters. The economic successes of the previous year began to show up; so some people moved to worse quarters and some to better quarters—a kind of economic musical chairs. What we learned from our census seven years ago was that every year 20 per cent of America moved *out of town*. They didn't just move around and play musical chairs in town as they used to forty years ago. This meant that, in effect, *every five years all of America moved out of town*. The preliminary figures are coming in from the last census of a year and a half ago, and they show that America is now moving out of town *every three years*. This is quite an acceleration. Within six years America has accelerated from moving out of town every five years to moving out of town every three years. We are not staying put at all. We are in an enormous pattern of comprehensive acceleration which, however, like the hands of a clock, is a subvisible rate of motion. If you or any one else can say, "I have never moved out of town," it is because many such as I move out of town every week or month.

Up to World War I most men had only their feet to get around on; a relatively few people had horses. Men all around

the world—as has been measured with pedometers by a number of the world's armies—averaged 1,300 miles walking per capita per annum. This is an average which includes the extremes ranging from the postman to the bed-ridden invalid. Up to World War I those 1,300 walked miles constituted the limit of man's possible ecological sweepout—1,300 miles per annum local to-and-froing. As we entered World War I, Americans were getting from one place to another by some means other than their own legs, a distance of approximately 350 miles a year. They were walking 1,300 and riding 350 by trains, horses, or ships; so they were predominately a walking device, and the mechanical addition though notable as yet added only 25 per cent. As we came out of World War I, the phenomena of mobilization—the production of trucks, cars, railway rolling stock, and ships in enormous numbers—suddenly brought about a change in America. By 1919 the average American was moving annually 1,600 miles by mechanical vehicles and continuing to walk the 1,300 as well. For the first time in all history, man had suddenly increased his ecological sweepout. The wolves don't increase their ecological sweepout; the gulls don't; the crabs don't. But man suddenly occupied a bigger territory, ergo, entered into an entirely new kind of "life." Since that time, the miles per capita per annum of man have increased enormously not only in America by Americans but all around the world by almost all the world's peoples.

As we entered World War II, in America we were up to 4,000 mechanized miles per capita per annum in addition to the constant 1,300 miles of annual footsteps. However, special categories of man were doing much more. The average American housewife was doing 10,000, salesmen 30,000, the air hostess 100,000 miles per year. At the present moment we are sweep-

ing out an average of approximately 9,000 miles per capita per annum. Also, at the present moment there are more Americans at all times outside of the United States—actually in world travel—than the number of people populating the U.S. when it was founded. We are swiftly approaching a complete annual world sweepout by all world people. By the end of this coming decade man will be able to take a commercial plane, catching it at the nearest commercial airport, and after breakfast reach any part of the world, do his day's work, and be home for dinner. We will be in a "one town world" in a realistic way.

We talk about ourselves as a *nation*. We are not a nation and never have been. Russia has about 150 *nations*. These nations are people who have been isolated remotely from other nations for thousands of years and have become enormously hybrid in relation to their special success in their special geographical areas. This hybridism is temporary, a consequence of the areas and environments, and not of there being fundamentally different species of people around earth. How does that evolutionary hybridism come about in the Darwinian mechanics? It does not come about through physical transformation in any one man in his lifetime but through changes in successive generations. For instance, certain birds live in an area where they get out of the water something vital that is their main food. Suddenly the water begins to recede in that area, and the birds have to dig even more deeply into the mud for food. The birds that don't have long beaks can't reach the food, and though the longer-beakers could relay food to the shorter-beakers there is not time enough for them to do so and survive. Thus only the long-beakers survive; the shorter-beakers starve and become extinct. This means that when the long-beakers want to get married there are only long-beakers around; so they

begin to inbreed long-beakers, for the probability is that two similar hybrids will produce a similar hybrid. This is the way the hybrids develop in any special area. That is why *nations* require many generations of utter isolation to develop unique national characteristics.

What is happening on our world during recent milleniums is that there has been a net western motion of man. In the very early days there was a comprehensive eastern motion of man drifting with the tides and the prevailing winds, but for the last eight or ten thousand years, there has been a net comprehensive motion westward heading into the prevailing winds. Implemented with the swiftly improving tools which came out of the seafaring evolution, people moved on the high sea, and with the kinds of technology and economics which the sea developed these people became great structural and geographic and mathematical and commercial and piscatorial pattern masters. Off of the early raft came the shelter, which had to be a very light hut structure, else the raft would sink. Gradually some raft people took their sheep up on the land, and they didn't have to carry the structure with them for their housing, because they could remember the structural pattern. They could get saplings where they went and weave them together as a large upside down basket from the remembered pattern. Then they could take the skins of the goats and sheep which they tended and ate and make them into covers. Consequently, they were able to survive in very cold areas. The 150 nations of Russia today are people who went westward from the seashores of the Orient into the vast Asiatic hinterland many cold milleniums ago.

As men began to learn with catamarans how to design ships that would sail into the wind they went westward into the

prevailing winds. These westbound seafaring people kept coming together westwardly along the Indian Ocean coasts with the hinterland wandering peoples coming down finally out of the hills from their cold hibernating westward peregrinations. Finally, these coastal convergences of westward-bound overseas and overland peoples occur in a very big way historically as the westbound into-the-winds overland tribes and the westward-bound into-the-wind sailors came together in Mesopotamia and next on the Mediterranean shores. The Ionian Greeks are a crossbred product of the people coming both from over the vast inland reaches of the Eurasian continent and from over the Indian Ocean waters having first hit the eastern coast of Africa and then boated northward "down" the Nile to the Mediterranean or navigated with camels, "ocean schooners," across Mesopotamia and Arabia to the Mediterranean. Thereafter we have a continual pouring together of these westbound land and sea people along the northern and southern shores of the Mediterranean—flowing eventually into Europe. Ultimately, many overland and overseas westbound tribes crossbreeding, crossbreeding, crossbreeding, completely absorb the earlier static European nations of long-pocketed hybrids. The westward migrating overland and sea people were continually developing more comprehensive adaptability out of the complex of hybrid-demonstrated functions through invention of better and better tools to replace those integral body-articulated functions. Then we have the western jump completely across the Atlantic to America. The people who first came to the eastern shores of America from Europe were already extremely crossbred—the French, English and Germans. America's population today is, then, a westbound, complexedly crossbreeding man—not a nation.

Very interestingly, I heard at the World Affairs Conference in Boulder four years ago a leading English journalist get up and say, "We might as well face it, the white race is about to be exterminated by the black and the yellow." I asked him what color white is, and he said, "Well, what color is it?" I told him it is *all* colors. What we call the white man is really a pink man. We pink-whites are the products of Arabic-Indian sailor men and overland Vandals, Goths, Mongols, etc., moving along the waterfronts, running into the local hybrids, and crossbreeding with them over a great period of years. We are not only a crossbreed people in America but also an advanced state of reversion to a generalized type which becomes the pink-white, all-colors man—the antithesis of local national hybrid types. We are simply the westernmost frontier of crossbreeding men trending toward a generalized world-man type, and very *rapidly*, evolutionarily speaking. You will have to realize that this is so in preparing your new educational processes in which you will have all kinds of problems arising from false fixations of society in respect to a supposedly persisting and valid nationalism, which in reality scarcely exists anywhere anymore and not at all in America except amongst the Indians.

The headache of a president of a great university is today probably the next biggest headache to that of a quasi-nation's president. Take the problem of how to get the funds for this enormous educational undertaking. You educators are uniquely associated with people who are well educated and who have a great feeling of responsibility toward the new life. There is an enormous task to be done, and the budget gets to be formidable.

How do you raise the funds? The now world-populated state universities have to keep raising funds from a political base which as constituted is inherently static, operating exclusively in terms of Illinois or Ohio or whichever state it may be.

The point is that we—both as individuals and as society—are quite rapidly uprooting ourselves. We never were trees and never had roots, but due to shortsightedness we believed blindly and behaved as though we did. Today we are extraordinarily mobile. In this last election, 10 per cent of the national electorate were unable to vote because they hadn't been in their new places long enough. The accelerating mobility curve that I just gave you indicates that by the next election 25 per cent of America will not be able to vote due to recentness of moving, and in the following election possibly less than the majority will be able to vote. We are simply going to have to change our political basis. We are now at the point where the concept of our geographically-based representation—which assumes that it realistically represents the *human* beings—is no longer valid. The political machine alone will continue to stay local. It sees the people as statically local. So those who are politically ambitious just stay put while society moves on, and, therefore, the static politicians become invisible to the swiftly moving body politic, which cannot keep track of their static machinations since society does not stay long enough in any one place to be effective in reviewing the local political initiations. The political machines soon will have no one to challenge realistically their existence validity except the local newspapers, whose purely local political news becomes progressively of less interest to a world-mobilizing society.

Comprehensively, the world is going from a Newtonian static norm to an Einsteinian all-motion norm. That is the big-

gest thing that is happening at this moment in history. We are becoming "quick" and the graveyards of the dead become progressively less logical. I would say, then, that your educational planners are going to have your worst headaches because you will have political machines that are less and less visible to the people because the people are more and more mobile. You will have to be serving the children of the mobile people who really, in a sense, don't have a base, and you will have to justify it with very hard-boiled local political exploitation. I am not particularly optimistic about the kind of results you are going to get. Therefore, when I begin to talk about the educational revolution ahead I see that the old system is probably going to become paralyzed. That is why your headache will get worse and worse until nature just evolutes and makes enormous emergency adjustments. President Morris, I not only recognize that your job is fabulously challenging, I recognize you as an extraordinarily able man. Yet I see that you are going to have a harder and harder time, and nobody could care more than you do about the good results you might get. What I am saying, then, is realistic. It is also going to be obvious to you, I am sure, that the kind of changes I will talk about next are probably going to have to take place.

We know that our world population is increasing incomprehendibly swiftly. There are enormous numbers to be educated. We are going to develop very new attitudes about our crossbreeding and our reversion to universal pigmentation. That is going to be slow, but it is going to be a great and inevitable event. In the end we are going to recognize that there are no different species of living man, and we will get over that kind of color class-distinction.

The big question is how are we, as educators, going to

handle the enormous increase in the new life. How do we make available to these new students what we have been able to discover fairly accurately about the universe and the way it is operating? How are we going to be able to get to them the true net value won blindly through the long tradition of ignorant dedications and hard-won lessons of all the unknown mothers and all the other invisibly heroic people who have given hopefully to the new life, such as, for instance, the fabulous heritage of men's stoic capacity to carry on despite immense hardships?

The new life needs to be inspired with the realization that it has all kinds of new advantages that have been gained through great dedications of unknown, unsung heroes of intellectual exploration and great intuitively faithful integrities of men groping in the dark. Unless the new life is highly appreciative of those who have gone before, it won't be able to take effective advantage of its heritage. It will not be as regenerated and inspired as it might be if it appreciated the comprehensive love invested in that heritage.

The old political way of looking at things is such that the political machine says we first must get a "school house" for our constituents, and it must look like Harvard University, or it must be Georgian and a whole big pile of it. "We see that the rich kids went to school in automobiles; so let's get beautiful buses for our kids." "Harvard and Yale have long had football; our school is going to have football." There is nothing boys used to have that they are not going to "get" from their politicians, who, above all, know best how to exploit the inferiority complex which they understand so well as handed down from the ages and ages of 99 per cent have-not-ness of mankind. There is a sort of class inferiority amelioration battle that goes on with the politicos in seeking the favor of their constituents to get into or

back into office, and little if any attention is paid to the real educational problems at hand.

In thinking about these problems, I have thought a lot about what I have learned that may be useful as proven by experiments in my own self-discipling. I have met some powerful thinkers. I met Dr. Einstein. I wrote three chapters in a book about Dr. Einstein, and my publishers said that they wouldn't publish it because I wasn't on the list of people who understood Einstein. I asked them to send the typescript to Einstein, and they did. He then said he approved of it—that I had interpreted him properly—and so the chapters did get published. When Einstein approved of my typescript he asked me to come and meet him and talk about my book. I am quite confident that I can say with authority that Einstein, when he wanted to study, didn't sit in the middle of a school room. That is probably the poorest place he could have gone to study. When an individual is really thinking, he is tremendously isolated. He may manage to isolate himself in Grand Central Station, but it is *despite* the environment rather than because of it. The place to study is not in a school room.

Parents quite clearly love their children; that is a safe general observation. We don't say parents send their children to school to get rid of them. The fact is, however, that it is very convenient for mothers, in order to be able to clean the house for the family, to have the children out of the way for a little while. The little red school house was not entirely motivated by educational ambitions.

There is also a general baby-sitting function which is called school. While the children are being "baby sat," they might as well be given something to read. We find that they get along pretty well with the game of "reading"; so we give them more

to read, and we add writing and arithmetic. Very seriously, much of what goes on in our schools is strictly related to social experiences, and that is fine—that's good for the kids. But I would say we are going to add much more in the very near future by taking advantage of the children's ability to show us what they need.

I have taken photographs of my grandchildren looking at television. Without consideration of the "value," the actual concentration of a child on the message which is coming to him is fabulous. They really "latch on." Given the chance to get accurate, logical, and lucid information at the time when they want and need to get it, they will go after it and inhibit it in a most effective manner. I am quite certain that we are soon going to begin to do the following: At our universities we will take the men who are the faculty leaders in research or in teaching. We are not going to ask them to give the same lectures over and over each year from their curriculum cards, finding themselves confronted with another roomful of people and asking themselves, "What was it I said last year?" This is a routine which deadens the faculty member. We are going to select, instead, the people who are authorities on various subjects—the men who are most respected by other men within their respective departments and fields. They will give their basic lecture course just once to a group of human beings, including both the experts in their own subject and bright children and adults without special training in their field. This lecture will be recorded as Southern Illinois University did my last lecture series of fifty-two hours in October 1960. They will make moving picture footage of the lecture as well as hi-fi tape recording. Then the professor and his faculty associates will listen to this recording time and again.

"What you say is very good," his associates may comment, "but we have heard you say it a little better at other times." The professor then dubs in a better statement. Thus begins complete reworking of the tape, cleaned up, and cleaned up some more, as in the moving picture cutting, and new illustrative "footage" will be added on. The whole of a university department will work on improving the message and conceptioning of a picture for many months, sometimes for years. The graduate students who want to be present in the university and who also qualify to be with the men who have great powers and intellectual capability together with the faculty may spend a year getting a documentary ready. They will not even depend upon the diction of the original lecturer, because the diction of that person may be very inadequate to his really fundamental conceptioning and information, which should be superb. His knowledge may be very great, but he may be a poor lecturer because of poor speaking habits or false teeth. Another voice will take over the task of getting his exact words across. Others will gradually process the tape and moving picture footage, using communications specialists, psychologists, etc.

For instance, I am quite certain that some day we will take a subject such as Einstein's Theory of Relativity, and with the "Einstein" of the subject and his colleagues working on it for a year, we will finally get it reduced down to what is "net" in the subject and enthusiastically approved by the "Einstein" who gave the original lecture. What is *net* will become communicated so well that any child can turn on a documentary device, a TV, and get the Einstein lucidity of thinking and get it quickly and firmly. I am quite sure that we are going to get research and development laboratories of education where the faculty will become producers of extraordinary moving-picture

documentaries. That is going to be the big, new educational trend.

The documentaries will be distributed by various means. One of the ways by which I am sure they will be distributed eventually has very much to do with an important evolution in communications history which will take a little describing. First, I point out to you that since the inauguration of the United States and adoption of its Constitution some very severe alterations have happened in the evolution of democracy's stimulation and response patterning and the velocity and frequency rates of that patterning's event-transformations.

At the time we founded our country, men were elected in small local areas out of communities wherein all the people were familiar with all the faces. Everybody knew Mr. Forbes or whatever his name was, and they trusted him and elected him to represent them in their federal assembly meetings. These "well known" representatives of the eighteenth and nineteenth centuries had to go to the Congress by foot or horse, for those were the means of travel. For instance, they went from some place in Massachusetts to Philadelphia or Washington, wherever the Congress was convening, and it took them a week or so to get there. They stopped along the way, meeting many friends and other folk and finding out what the aspirations of the different people's localities were.

Let us hypothetically consider how they conferred at their Congress on their individual needs and requirements; how they found certain things that were of general pertinence to all of them and found some things that were relevant only to individual areas. While they were meeting they received a letter from France, and they were very excited because France, who had helped them in the Revolution, now critically needed some help

from the new United States of America. They talked about what they might do about that letter. All of these men then went back by foot or horse to their different homes and conferred face to face with their townspeople. They told their constituents what they had found out about the various things, and they said: "Here's a letter from France; this is what the various representatives at the Congress thought about it—what do you think about it?" Then they went back to the central meeting place again and acted on that letter and other pertinent matters in view of their direct knowledge of their constituents' thoughts and ambitions. The term of office that we gave representatives was predicated upon this ecological pattern of on-foot and horseback traveling. It took about four years to complete the two trips just outlined to effect a basic democratic stimulation and response cycle. The velocity rates of stimulation and response were in a one-to-one correspondence.

Suddenly new industrial technology made scientific harvesting available through invention. Lincoln became the first "wired" president—the first head of a state to be able to talk directly by telegraph to his generals at the front. This was the first time generals no longer needed to be sovereignly autonomous, because now the head of state became practically available for the highest policy decisions right at the front. World War I brought in the radio, and in World War II, for the first time, the admirals at sea were hooked up directly to Washington. They didn't need the autonomy they had to have when they took the fleet away for a year with no way to communicate with the president other than by a messenger sailing ship. Now "we the people" have radio and TV, and we obtain world-around event information from the telegraph, newspaper, and broadcast. With world-around news broadcast to us in seconds,

there is no way we can respond directly to their problem-content stimuli.

We no longer have the one-to-one velocity and frequency correspondence between stimulation and response that we had in the early formative days of the U.S.A. We now have enormous numbers of stimulations and no way to say effectively what we think about them or what we would like to do about each of them. By the time that presidential voting comes around every four years we have accumulated ten thousand unvented, world-around emanating stimulations, and usually we are no longer in the same town with the representatives that we previously elected.

Automobiles move through the streets with pictures of political candidates' faces on their sides, and we try to pick out the candidates whom we think least offensive. We rarely know them or whether we may trust them. So we vote superficially for the "least offensive" ones, depending primarily on the major party selections. That is about the best we can do.

Because all this is so, those now doing the representing, wishing to be returned to office, wish to know what people are thinking about all the important issues. So the surveys of public opinion have developed, and congressional investigations of many phenomena have increased. We have to have a kind of anticipatory political reconnaissance going on all the time. Even then, when the elected man comes in he knows that it is only as the result of indirect effects of total psychological moods; so he pays little attention to any specific "mandates," and he begins to work right away on the psychological culturing of his next election. He is not really sure that there are any true mandates. He doesn't really know what the people think. That is one large reason why democracy is in great trouble today, be-

cause of the vacillation and compromise arising from the lack of one-to-one correspondence between stimulation and response of the electorate. The Communists and dictatorships scoff at democracy—saying it doesn't work. I am sure that democracy is inherently more powerful and capable and appropriate to man's needs than any other form of government, but it needs proper updated implementation to a one-to-one velocity correspondence in respect to each and every stimulation-and-response, and then democracy can work—magnificently.

I have talked to you about solving problems by design competence instead of by political reform. It is possible to get one-to-one correspondence of action and reaction without political revolution, warfare, and reform. I find it possible today with very short electromagnetic waves to make small reflectors by which modulated signals can be beamed. After World War II, we began to beam our TV messages from city to city. One reason television didn't get going before World War II was because of the difficulty in distributing signals over long distances from central sources on long waves or mildly short waves. We were working on coaxial cables between cities, but during the war we found new short ranges of electromagnetic frequencies. We worked practically with very much higher frequencies, very much shorter wave lengths. We found that we could beam these short waves from city to city. Television programs are brought into the small city now by beam from a few big cities and then *rebroadcast* locally to the home sets. That is the existing TV distribution pattern. My invention finds it is now possible to utilize the local TV masts in any community in a new way.

Going up to, say, two hundred, three hundred, or four hundred feet and looking down on a community you see the houses individually in the middle of their respective land plots. Therefore, with a few high masts having a number of tiny massers, lassers, or reflectors, each beam aimed accurately at a specific house, the entire community could be directly "hooked up" by beams, instead of being broadcast to. This means a great energy saving, for less than 1 per cent of the omnidirectionally *broadcast* pattern ever hits a receiving antenna. The beaming makes for very sharp, clear, frequency-modulated signals.

In the beaming system, you also have a reflector at the house that picks up the signal. It corresponds directly to the one on the mast and is aimed right back to the specific beaming cup on the mast from which it is receiving. This means that with beam casting you are able to send individual messages to each of those houses. There is a direct, fixed, wireless connection, an actual direct linkage to individuals; and it works in both directions. Therefore, the receiving individual can beam back, "I don't like it." He may and can say "yes" or "no." This "yes" or "no" is the basis of a binary mathematical system, and immediately brings in the "language" of the modern electronic computers. With two-way TV, constant referendum of democracy will be manifest, and democracy will become the most practical form of industrial and space-age government by all people, for all people.

It will be possible not only for an individual to say, "I don't like it," on his two-way TV but he can also beam-dial (without having to know mathematics), "I want number so and so." It is also possible with this kind of two-way TV linkage with individuals' homes to send out many different programs simultaneously; in fact, as many as there are two-way beamed-

up receiving sets and programs. It would be possible to have large central storages of documentaries—great libraries. A child could call for a special program information locally over the TV set.

With two-way TV we will develop selecting dials for the children which will not be primarily an alphabetical but a visual *species* and *chronological category* selecting device with secondary alphabetical subdivisions. The child will be able to call up any kind of information he wants about any subject and get his latest authoritative TV documentary, the production of which I have already described to you. The answers to his questions and probings will be *the best information* that man has available up to that minute in history.

All this will bring a profound change in education. We will stop training individuals to be "teachers," when all that most young girl "education" students really want to know is how they are going to earn a living in case they don't get married. Much of the educational system today is aimed at answering: "How am I going to survive? How am I going to get a job? I must earn a living." That is the priority item under which we are working all the time—the idea of *having to earn a living*. That problem of "how are we going to earn a living?" is going to go out the historical window, forever, in the next decade, and education is going to be disembarrassed of the unseen "practical" priority bogeyman. Education will then be concerned primarily with exploring to discover not only more about the universe and its history but about what the universe is trying to do, about why man is part of it, and about how can, and may man best function in universal evolution.

Automation is with us. There is no question about it. Automation was inevitable to intellect. Intellect was found to dif-

ferentiate out experience continually and to articulate and develop new tools to do physically repeated tasks. Man is now no longer *essential* as a worker in the fabulously complex industrial equation. Marx's *worker* is soon to become utterly obsolete. Automation is coming in Russia just as it is here. The word *worker* describing man as a muscle-and-reflex machine will not have its current 1961 meaning a decade hence. Therefore, if man is no longer essential as a worker we ask: "How can he live? How does he acquire the money or credits with which to purchase what he needs or what he wants that is available beyond immediate needs?" At the present time we are making all kinds of economic pretenses at covering up this overwhelming automation problem because we don't realize adequately the larger significance of the truly fundamental change that is taking place in respect to man-in-universe. As automation advanced man began to create secondary or nonproductive jobs to make himself look busy so that he could rationalize a necessity for himself by virtue of which he could "earn" his living. Take all of our bankers, for example. They are all fixtures; these men don't have anything to do that a counting machine couldn't do; a punch button box would suffice. They have no basic banking authority whatsoever today. They do not loan you their own wealth. They loan you your own wealth. But man has a sense of vanity and has to invent these things that make him look important.

I am trying to keep at the realities with you. Approximately total automation is coming. Men will be essential to the industrial equation but not as workers. People are going to be utterly essential as consumers—what I call *regenerative consumers*, however, not just swill pails.

The vast industrial complex undertakings and associated

capital investments are today so enormous and take so long to inaugurate that they require concomitantly rapid regenerative economics to support them. The enterprise must pay off very rapidly in order to be able to refund itself and obtain the economic advantage to inaugurate solution of the next task with still higher technical advantage. In that regenerative cycle of events, the more consumers there are the more the costs are divided and the lower the individual prices. The higher the frequency of the consuming the more quickly the capital cost can be refunded, and the sooner the system is ready for the next wave of better technology. So man is essential to the industrial equation as a consumer—as a regenerative consumer, a critical consumer, a man who tasting wants to taste better and who viewing realizes what he views can be accomplished more efficiently and more interestingly. The consumer thus becomes a highly critical regenerative function, requiring an educational system that fosters the consumer's regenerative capacity and capability.

At present, world economics is such that Russia and China work under an integrated socialist planning in competition with our literally disorganized economic world (for our anti-trust laws will not permit organization on a comprehensive basis). The Communists have high efficiency advantage because of their authoritarianism. We have very little centralized authority, save in "defense." The Communists now have the industrial equation, too, in large scale, and soon complete automation will be with them. They are very much aware of the fact that the more customers there are, the more successful the operation will be, because the unit costs are progressively lower. This is why the Soviets were historically lucky in getting China as customers. They would like also to have, exclusively, India and

Africa as customers. If Russia acquires the most customers, we will not be able to compete. They will always have the lower costs on any given level of technology. We are going to have to meet this possibility and meet it vigorously, swiftly, and intelligently. Within the next decade, if we survive at all as an organized set of crossbreeding men on the American continent it will be because we will have suddenly developed a completely new attitude on all these matters. In case you are apprehensive that social and political economics are to be so laggard as to impede your advanced educational programming, it is well to remember that the comprehensive world economics are going to force vast economic reforms of industries and nations, which incidentally will require utter modernization of the educational processes in order to be able to compete and survive.

Every time we educate a man, we as educators have a regenerative experience, and we ought to learn from that experience how to do it much better the next time. The more educated our population the more effective it becomes as an integral of regenerative consumer individuals. We are going to have to invest in our whole population to accelerate its consumer regeneration. We are going to be completely unemployed as muscle-working machines. *We as economic society are going to have to pay our whole population to go to school and pay it to stay at school.* That is, we are going to have to put our whole population into the educational process and get *everybody* realistically literate in many directions. Quite clearly, *the new political word* is going to be *investment*. It is not going to be *dole*, or socialism, or the idea of people hanging around in bread lines. The new popular *regenerative investment* idea is actually that of making people more familiar with the patterns of the universe, that is, with what man has learned about universe to date, and that of

getting everybody inter-communicative at ever higher levels of literacy. People are then going to stay in the education process. They are going to populate ever increasing numbers of research laboratories and universities.

As we now disemploy men as muscle and reflex machines, the one area where employment is gaining abnormally fast is the research and development area. Research and development are a part of the educational process itself. We are going to have to invest in our people and make available to them participation in the great educational process of research and development in order to learn more. When we learn more, we are able to do more with our given opportunities. We can rate federally paid-for education as a high return, mutual benefit investment. When we plant a seed and give it the opportunity to grow its fruits pay us back many fold. Man is going to "improve" rapidly in the same way by new federally underwritten educational "seeding" by new tools and processes.

Our educational processes are in fact the upcoming major world industry. This is *it*; this is the essence of today's educational facilities meeting. You are caught in that new educational upward draughting process. The cost of education will be funded regeneratively right out of earnings of the technology, the industrial equation, because we can only afford to reinvest continually in humanity's ability to go back and turn out a better job. As a result of the new educational processes our consuming costs will be progressively lower as we also gain ever higher performance per units of invested resources, which means that our wealth actually will be increasing at all times rather than "exhausted by spending." It is the "capability" wealth that really counts. It is very good that there is an international competitive system now operating, otherwise men

would tend to stagnate, particularly in large group undertakings. They would otherwise be afraid to venture in this great intellectual integrity regeneration.

I would say, then, that you are faced with a future in which education is going to be number one amongst the great world industries, within which will flourish an educational machine technology that will provide tools such as the individually selected and articulated two-way TV and an intercontinentally net-worked, documentaries call-up system, operative over any home two-way TV set.

The new educational technology will probably provide also an invention of mine called the Geoscope—a large two-hundred-foot diameter (or more) lightweight geodesic sphere hung hoveringly at one hundred feet above mid-campus by approximately invisible cables from three remote masts. This giant sphere is a miniature earth. Its entire exterior and interior surfaces will be covered with closely-packed electric bulbs, each with variable intensity controls. The lighting of the bulbs is scanningly controlled through an electric computer. The number of the bulbs and their minimum distance of one hundred feet from viewing eyes, either at the center of the sphere or on the ground outside and below the sphere, will produce the visual effect and resolution of a fine-screen halftone cut or that of an excellent television tube picture. The two-hundred-foot geoscope will cost about fifteen million dollars. It will make possible communication of phenomena that are not at present communicable to man's conceptual understanding. There are many motion patterns such as those of the hands of the clock or of the solar system planets or of the molecules of gas in a pneumatic ball or of atoms or the earth's annual weather that cannot be seen or comprehended by the human eye and brain relay and

are therefore inadequately comprehended and dealt with by the human mind.

The Geoscope may be illuminated to picture the earth and the motion of its complete cloud-cover history for years run off on its surface in minutes so that man may comprehend the cyclic patterning and predict. The complete census-by-census of world population history changes could be run off in minutes, giving a clear picture of the demological patterning and its clear trending. The total history of transportation and of world resource discovery, development, distribution, and redistribution could become comprehendible to the human mind, which would thus be able to forecast and plan in vastly greater magnitude than heretofore. The consequences of various world plans could be computed and projected. All world data would be dynamically viewable and picturable and relayable by radio to all the world, so that common consideration in a most educated manner of all world problems by all world people would become a practical event.

The universities are going to be wonderful places. Scholars will stay there for a long, long time—the rest of their lives—while they are developing more and more knowledge about the whole experience of man. All men will be going around the world in due process as everyday routine search and exploration, and the world experiencing patterning will be everywhere —all students from everywhere all over the world. That is all part of the new pattern that is rushing upon us. We will accelerate as rapidly into "yesterday" through archaeology as we do into "tomorrow." Archaeology both on land and under the seas will flourish equally with astronautics.

As I came to this meeting today, I wasn't surprised by East St. Louis, because I have been here many times. I have been traveling around the world so much that seeing East St. Louis once again reminds me that right in the center of America, pretty close to the center of population, we have the worst living and housing conditions that I have seen anywhere in all the world. There is nothing in Calcutta, Johannesburg, or Hong Kong that equals the squalor of the East St. Louis slums. There are some miserable conditions around the world, but East St. Louis shows the greatest lack of organized capability to deal with the great challenges of democracy and crossbreeding world man. It is shocking.

Your educational forces, if competently organized and instrumented, should stimulate the self clean-up. The politicians won't clean up; the only hope is through education. This would be much better than building some kind of a socialized system where money is put up for more "buildings" just to keep the construction industry going and to provide jobs for political payoffs. I am very glad that what I hope will be a powerful new magnitude of the educational system is coming to East St. Louis. This is appropriate. This is S.I.U.'s historical opportunity.

I think that all the patterns I have been giving you are going to unfold rapidly and that primarily the individual is going to *study* at home. That is in elementary, high school, and college years. Not until his graduate work days begin will he take residence on campus. I am quite sure that the students of all ages will keep on going to "school houses" to get *social experiences*—or to be "baby-sat." We will probably keep the schools open in the evening because of the growing need for baby-sitters. Real education, however, will be something to which

individuals will discipline themselves spontaneously under the stimulus of their own ticker-tapes—their individually unique chromosomes. Everyone has his own chromosomal pattern. No two persons have the same appetite at the same time. There is no reason why they should. There is no reason why everyone should be interested in the geography of Venezuela on the same day and hour unless there is some "news" event there, such as a revolution. However, most of us are going to be interested in the geography of Venezuela at some time—our own time—but not all on the same day. *Simultaneous curricula are obsolete.* We must make *all* the information immediately available over the two-way TV's ready for the different individual human chromosomal ticker-tapes to call for it.

There are two more things I would like to talk about if we have the time. I am a comprehensive designer—that is, I try to organize all the data and challenges and problems in such a manner that they may be solved by inanimate technology, as I mentioned to you earlier, rather than by organization reforms. Therefore, when I talk about educational problems, I am interested in how these can be satisfied by some kind of physical apparatus along the lines of the trend requirements I have been outlining to you. The kind of equipment that would be involved would be such as the two-way TV and the Geoscope and also what I call *automated education facilities.* We know about teaching machines, etc., today, and much of this is sound. In our consideration of equipment we must also include the environment-controlling structures which will house the computer-integrated equipment and activities.

I am going to give you one more "big" introductory concept that may shed considerable light on these problems and may lead to acquisition of logical apparatus of solution. C. P.

Snow, the writer, has a great following today. He writes about "two worlds." His two worlds are the literary world and the scientific world. In the literary world, man writes the books that people can understand with least effort. They seem to be good romance books because they seem to fit many lives. Science writes in ways that require complete dedication of effort to comprehend. Snow says the dichotomy between the two worlds began approximately two centuries ago with the inception of the industrial revolution. In England it is as yet evident that the popular writers of a century ago and since were not helped by the scientist. The scientist tended to be preoccupied, obscure, and not interested in the literary man's needs. A pertinent fact that Snow does not mention is that the important scientific events were often withheld from the public because of their unique military advantages. The scientist's information began to be the grist of the industrial technology. The scientist was intimately tied up with industry, even though he didn't look upon his personal work in terms of economics. The scientist was aloof to the ultimate fact that industry was the user of the information that he was able to gather.

The literary man, not understanding either science or its technology, developed an animosity toward industrialization. Snow points out for us that in America this dichotomy was in evidence, for instance, in Emerson and Thoreau, who were antipathetic to industrialization. As I grew up at the turn of the century I saw that society looked on industrialization as something noisy, smoky, and full of so-called "artificialities." (In my viewpoint, there is no meaning to the word "artificial." Man can only do what nature permits him to do. Man does not invent anything. He makes discoveries of principles operative in nature and often finds ways of generalizing those principles and

reapplying them in surprise directions. That is called invention. But he does not do anything artificial. Nature has to permit it, and if nature permits it, it is natural. There is naught which is unnatural.)

The literary and popular concept of industrialization grew out of erroneous definitions and terms. The static viewpoint was seemingly supported by the Newtonian statement that "a body persists in *a state of rest* (or in a line of motion) except as affected by other bodies." Primarily the norm was "at rest," and changes were therefore abnormal and undesirable. Changes were exploited from time to time only because of military advantage or because men could make large amounts of money out of the changes and not because of any social voting that the changes were constructively desirable. The literati just didn't try to understand change, and they stayed apart from science and abhorred the changes. Snow says the gulf between the scientist and the literati is now so great that the chasm is no longer spannable. He feels there has now developed an irreparable dichotomy between literary and scientific man. I do not agree with him as you shall learn.

Alfred North Whitehead came to Harvard University early in this twentieth century from the great universities of England. He said that one of the things that was very noticeable at Harvard was that this great private school was initiating a new kind of pattern. It was beginning to build and staff the great graduate schools. The graduate schools dealt in specializations. In England the special preoccupations could be taken up within the general university. There were no special schools. Whitehead said that the American populus applauded the high specialization, and Whitehead saw that this pattern was being followed by the other leading private schools, colleges, and universities.

Of course, the public schools and public universities immediately followed suit, taking on the graduate school patterns, because the political representatives of the public saw that their constituents would want the state school to incorporate these educational advances of the rich man's private schools. So specialization in graduate schools also became the "thing."

Whitehead said this meant that we deliberately sorted out the students, sieved them, picked out the bright ones, and persuaded the brights to stay in the university and to go on to the graduate school. This meant that we began to make specialists out of our bright ones. The bright ones within their own special category of their special school went on to develop further special nuances within their special areas. This all worked toward expertism and hybridism in the educational pursuits. It meant that the bright ones would learn much about their special subject. The public thought this to be desirable, because people like the idea of an "all-star" team. They thought that if we took groups of all-stars and put them together our commonwealth would surely prosper.

Whitehead said, "So far so good, and everybody is applauding." But he then said that the educational hybridism would mean that these men who were of high intellectual capabilities would have very high intellectual integrity. As men of high intellectual integrity they would quickly discover that they were making great progress in highly specialized areas of inquiry and thus also they would know how little any other man outside of their own field could possibly understand of what was going on inside their own and inside any one field other than their respective specializations. Therefore, no specialist of integrity would think of going into some other expert's field and making quick assumptions as to the significance of that unfamiliar

work. This would be considered preposterous. There would thus develop an increasing tendency to break down generalized communications and comprehensive prospecting between these experts. Certainly, they would not tend to join together and say: "I see I am developing this and you are developing that; if we associated them thus and so, such and such would be the economic consequences; therefore, let us do so by employing our credit as scientists with the banks in order to fund our undertakings." These men, Whitehead said, would do just the opposite and would become more and more subjective, growing into purer and purer scientists, to whom no banker would think of lending money on the basis of intellectual integrity alone. The scientists went in just the opposite direction of applied science. The more expert they were the less they would think of searching into the concept of how society might enjoy the fruits of their discoveries.

Whitehead pointed out that this system tended to break down the communication between the men of high intellectual capability in all special fields. Inasmuch as society wanted exploitation of the gains of their "all-star" teams, it meant that someone other than the prime intellects had to integrate and exploit their capabilities and their findings.

Then Whitehead said—which came as quite a surprise—inasmuch as we have deliberately sorted out the bright ones from the dull ones, we have inadvertently created a class of dull ones. Just as in mining, we have a big pile of tailings, and no one thinks much about tailings because they are interested only in the high-grade, quick-cash ore and the net metal that is taken out of the latter. He said that inasmuch as the "bright ones" are not going to be able to realize, integrate, and exploit their own potentials we will have to leave it to the not-so-brights to put

things together. This is what I have termed "Whitehead's dilemma."

I have developed "Whitehead's dilemma" a little further than he could go at that time. I find that there is a second grade of men who get passing marks, but are not selected to be specialists, who, however, though not "gleaming bright" have a dull polish and are good healthy fellows who play good football and are liked by everybody. These second grade "clean ones" become the first choice for executives in business, which does integrate potentials of demand and supply. Then as corporation executives these not-quite-so-brights take on the pure scientist experts and cultivate them like special hybrid egg-laying hens in special houses. The corporations take on the task of putting appropriate specializations together to exploit the synergetic advantages thus accruing. The businessman becomes the integrator of the bright ones' capabilities. The business executive himself, however, tends to be a specialist of a less fine order. Pretty soon, he will say, for instance: "I am in the automobile business and don't know anything about stockings; so I am just going to stick to my automobiles." He might also say: "I find that an automobile won't run across an open field. Therefore, it is only half of the invention—automotive transportation. The *highway* itself is a large part of the invention—high speed highway transportation." Automobiling is schematically like a monkey wrench—the ratchet half is the "highway," and the thumbscrew-adjustable traveling jaw is the "automobile." The automobile is literally geared by its tire-treads to the road. So the business executive might say: "An automobile company could not possibly afford to build the highways—it is a very difficult political matter; you have to have costly condemnation proceedings and so forth to get a highway through; it is all so

expensive that our company would never make a profit if we took the responsibility of providing highways. All we can produce is automobiles. To get the show going, however, we will have a little auto race track over here, and we will have automobile shows in many big cities and at county and state fairs. We will get people very excited about the way our automobile can go and how fascinating it looks." Thus it went, and the people began to envision personal use and enjoyment of the automobile "if only they had a highway." What the auto executive did was to excite the people into demanding highways for the cars.

We next come down to a duller class of not-so-brights—much duller—who didn't even go to college. This much duller class is that of the politicians. The politicians saw that the people in general wanted automobiles and wanted to "joy ride"; so they immediately voted for highways to get the peoples' votes for themselves.

Thus, a much bigger geographical pattern of the automobile emerged than the domain of the factory and the auto executive's specialized territory. The bigger pattern was the total highway system—state, interstate, and federal. We also find that generally speaking *the geographically larger the physical task to be done, the duller the conceptual brain that is brought to bear* upon the integration of the scientific discoveries and their technically realized applications. Finally, we get to international affairs, and you know what is happening today. The most highly polished of the dullest class, scientifically and intellectually speaking, may wear their striped pants very beautifully and be charming fellows, but they have not produced any mutually-acceptable, constructive, world peace generating ideas. They traffic successfully only in peoples' troubles and emergency

compromises. One of the great mistakes that society has been demonstrating in our last century has been that of leaving the most important problems to the men who are bankrupt in creative thinking ability.

World War I marked the end of the old great masters of the water-ocean earth commerce. These were the world "bankers" who were the not-too-dull businessmen who had high courage and co-ordination and who developed successful world-pattern cartels and trusts quite transcendentally to any one nation's anti-trust laws or to any one nation's popular knowledge, advantaged by men's world-around preoccupations with their own respective domestic affairs. These old masters kept the world peoples in complete ignorance of their world planning and let it be thought that the latter was the consequence of their appointed local politicians' deliberations.

At Harvard just before World War I—and this was the time when I was having my little troubles there—the dilemma Whitehead was talking about was developing in a very interesting way. What Whitehead didn't ask was how Harvard could afford those graduate schools. The fact is that neither Harvard nor any other university has ever operated at a profit. Certainly, schools, colleges, and universities don't have surplus earnings accruing which they can reinvest. Establishing graduate schools wasn't something private colleges could do on their own. The explanation is that the graduate schools were *given* to Harvard and the other leading private universities.

The next interesting question is, *who gave* them the graduate *specialty* schools? Well, the people who gave Harvard the schools were primarily the partners of J. P. Morgan and Company or they were men who were founders or presidents of companies whose boards were run by J. P. Morgan. J. P. Morgan

or his partners were at that time on the boards of nearly every important, powerful company in America. Morgan or his associates were also partners in the great unseen syndicate of world commerce mastery up to World War I.

If you were an invisible world master of the water-ocean earth you had to maintain the capability to create and run the top world navies—you had to have *physical* control of the biggest patterns. No matter what else we may say of these men today, they were magnificently imaginative big-scale operators. They had taken all that science had learned about energy and put it into their navies, faster, further, more accurately hitting power in order to keep in supreme command of physical affairs of mankind. Now, if you were world master, you would not be at all worried about being displaced by a *dull* one. You would only be apprehensive of and on guard against the bright ones. There is the old strategy of "divide and conquer." Anticipatory "divide and conquer" is more powerful than tardy "divide and conquer." The old masters, then, in order to prevent themselves from being displaced from their great ocean mastery deliberately went to work taking the young, bright ones as they came along, and divided them up anticipatorily into non-self-integratable *specializations*, which made them completely innocuous as challengers to comprehensive grand strategy thinking and practical affairs integration. The bright ones thus became subject to integration of their high potential only at the masters' command. That was the key to the world pattern mastery up to World War I, when general literacy of the rising world democracies posed threats to the old masters' all but impregnable sinecure.

World War I marked the end of the old masters. The old masters had set up local rulers of their own choosing all around

the world in the various nations. They invented the political nations. They invented the geographical names—Greece, Italy —their nations were welded out of many tribes and battles. The masters said to their head-men stooges: "You command and hold the port here. You are the strong man locally, and I will make you head man. You can stay head man because I have the line of supply of maximum hitting power and maximum energy duration. If anybody challenges you, you get the supplies and he doesn't, for I control the oceans which carry the supplies. Therefore, you are going to be able to win." This was the old and great pattern of world mastery. The local politician was a man (a king, or whatever) put into a position of strength by the great masters who themselves remained scrupulously invisible. They preferred to remain invisible. The more invisible they were the longer they could stay master. No challenges would arise, because there was nothing visible to challenge. Secrecy was one of the greatest of the tools of the old masters. The visible head man on the beach—the local head man—was strong, however, simply by virtue of the old invisible master.

The old masters went out with World War I when their total gold resource became inadequate to accounting and accrediting of the extraordinary new magnitudes of wealth generated by industrialization. For instance, just in the U.S. alone, during World War I we produced 178 billion dollars worth of "hard" or capital goods, compared with only 40 billion dollars worth of gold extant in all the world to "pay for it." The gold was suddently utterly inadequate to the new magnitudes of economic traffic. The masters had up to then run the world traffic with gold.

During World War I the incumbent world masters had been challenged by the organized "outs" who were the com-

petitor commerce group of potential masters who were beginning to put the new potentials of science together faster than the old masters had seen fit to do. The "outs" invented *going under the sea* to break down the line of supply with submarines and going *above the earth and sea* with the airplane.

The old masters were being so vigorously challenged by the expansion of war patterns into new dimensions that they were about to be displaced, when suddenly a powerful scientific suggestion was made in England to the high command. A scientist said that there were ways in which the guns that reached the front could be made to last twice as long. He said: "Wouldn't this be as good as getting twice as many guns to the front? That is, even if the line of supplies were being critically slowed down by sinkings, the guns which did reach the front would last twice as long." The old high command said: "This is nonsense, but what do you have in mind?" Then the scientist said: "Well, we have had it here in the drawer since 1854; chrome nickel steel alloy." The old masters had never trusted anything they could not see, touch, or smell. They co-ordinated by virtue of their extraordinary sensorial ability—they were very *physical* human beings. They could count masts of ships swiftly, they could knock another guy down, they could play beautiful polo, and they could sail a very fast yacht. They did things in that sensorial way. But they were suspicious of anything invisible; internal structural functions of alloys were invisible; ergo, they were unaccredited by the old masters.

At the turn of the century we were coming to the point where there were the X-rays, alloys, and all kinds of invisible events of scientific specializations' discoveries, but the old masters didn't want any of that invisible phenomena let loose. They were suspicious of its portent. They said: "The kind of steel we

are making is good—it is all right and will do." In America they owned U.S. Steel and so forth and were turning out what was called "mild steel." That is not a *specification* steel at all. It was the steel of the great rust dumps of pre-World War I. Finally, because of the submarine sinkings of their ships, in order to survive the old masters had to unleash the manufacture of the alloys which made the tools last longer.

Thus in World War I industry suddenly went from the visible to the invisible base, from the track to the trackless, from the wire to the wireless, from visible structuring to invisible structuring in alloys. The big thing about World War I is that man *went off the sensorial spectrum forever* as the prime criterion of accrediting initiations.

All major advances since World War I have been in the *infra* and the *ultrasensorial* frequencies of the electromagnetic spectrum. All the important technical affairs of men today are invisible. This is the prime reason that the educational processes are now essential to survival, for only through highly literate disciplining may man control the invisible events of nature.

We see then that the old masters, who were sensorialists, had unleashed a Pandora's box of non-sensorially controllable phenomena, which they had avoided accrediting up to that time. At that great critical moment when they unleashed non-sensorially controllable physical phenomena they suddenly lost their true mastery, because from then on *they didn't personally understand what was going on.* If you don't understand you cannot master.

Since World War I, the old masters have been extinct. Because they operated always in secret, they of course didn't announce their own demise. As they died secretly they inadvert-

ently left many accepted patterns, such as, for instance, the "head men" on the world thrones and the university patterns which Whitehead described. As the new problems brought about by the old masters' demise arose, everybody began to turn to the local political head men and new head men who arose easily, pushing over the old who no longer had the support of the now defunct invisible masters.

After World War I in Germany—where the old masters had taken all of the money away from their conquered challengers—the people said: "There is a blast furnace right there; it already exists. We know how to run it. There is the iron and there is the coal; why don't we make steel?" They didn't have any money to put their plans into effect; so they began using a new kind of wealth. They said: "The only thing we need in order to use these resources is the know-how which we have and the authority to do so." Since all the money had been taken away by "reparations," the Germans simply forsook their old government who had agreed to the reparations payments. They said: "We need a new political man, and all we have to do is to get a couple of soldiers and some guns and take over the post office. Then we take over the blast furnace and we are in business." Thus it was discovered that you could be in business without money, if you really had the scientific and technical know-how.

That was also the pattern of new industrialism's initiations that Russia copied from the U.S., who had peacefully seized or taken over as "government" in World War I all their prime productive capabilities from the panicked old masters. Next, all the dictatorships of Europe followed suit and seized their industries. We went into a period of a new authority being vested in the political men who everybody locally had always thought of

as all powerful. The transition of stooges into dictators of real power was invisible and unreported. World people hadn't realized that their local leaders' power sprang solely from the strength of the invisible old masters secretly backing them. They thought of their respective nations as sovereign and mystically endowed with unseen destiny of sovereign survival eminence.

As a consequence, since 1918 world men speaking always under their conditioned reflex concepts of static geographical "nations" have been challenging the local political heads with the responsibility of getting them out of their troubles. The suddenly, realistically "head men" haven't the slightest idea how to solve such problems. These were problems that only their old masters could solve. Nobody could have been duller in *world* strategems than the political leaders of the world's many separate nations. Ruthless, tough bluffing became the new winning technique, but it was implemented by the politicians exploitation of their respective hybrid, economic slaves, the scientific specialists.

In respect to "Whitehead's dilemma" everybody today tends to believe that specialization is the best way to earn a living, by establishing one's own special monopoly at some strategic point in the specialization network. As a consequence of comprehensively undertaken specialization we have today a general lack of comprehensive thinking. The specialist is therefore, in effect, a slave to the economic system in which he happens to function. The concept of inevitable specialization by the brightest has become approximately *absolute* in today's social-economic reflexing. The fixation is false and is soon to be altered.

I went to the U.S. Naval Academy at the moment in World War I when the grand masters and the British Navy for the first time in history had to acknowledge the American Navy as an equal and give it great support *or else* the old masters were probably going to lose their world mastery. As a consequence the British Navy began to disclose to the U.S. Navy some of the inner secrets of its grand strategy. In addition to information given to top-rank admirals, much that was of basic strategic significance was disclosed to the young men who were being trained at the U.S. Naval Academy at that moment. To us at Annapolis there were disclosed some of the grand theories as well as special strategies used by the old masters. One of the prime theories I learned as one of those Naval Academy students was that in the *naval academies* of Britain, the United States and other European countries, in contradistinction to all private and public universities and the military academies, they picked the *bright ones* to be *trained* as *comprehensivists* rather than as *specialists*. In the armies the officers became specialists for life as cavalrymen, artillerymen, etc., but the admirals were trained to function ultimately and exclusively as the *comprehensive* assistants to the great invisible masters who were running the earth.

This comprehensivity of admirals came about in the following manner. The old masters had commanded that the highest economic priority go toward using *everything* man had learned in physics and chemistry to produce the highest hitting-power navy, as the greatest tool with which to master the earth. This was due to the simple fact that you could carry bigger guns on ships than you could pull overland with horses. The Navy represented the focused objective for application of all that man knew

about science, about mathematics, chemistry, and physics. All science was reduced to versatile, mobile practice in the Navy. Armies and fortresses were static and good for local war. Navies where the dynamic and the inherent world tools up to and through World War I.

In sending the Navy off to the high seas with all the nation's most important hardware, the nation had to develop admirals and captains whom the old masters could not only count on to be their most competent right hand men but who could also be trusted with competent command and maintenance of this most powerful tool even when out of sight of the old masters. They had to have men who understood the world economic patterns as did the masters themselves. They needed admirals and officers in general who could take a great Navy halfway around the world from home bases and build a new naval base, say in South America or in any other remote place, who understood technology in every way, who could handle thousands of men, millions of dollars, thousands of technical and psychological and economic problems—very *comprehensive* men, the antithesis of specialists. The training scheme in the Navy was to pick the brightest and send them first over to the Bureau of Ships where they could learn the theory and history of ships themselves and their great comprehensive patterning. Then the Navy Department deliberately rotated their officers' services, sending these men alternately to sea on different types of ships —every type and kind: submarines, battleships, destroyers, supply ships, and airships. Between ship assignments the Navy rotated its line officers into Naval stations around the world. They rotated them back and forth, out of the ships into jurisprudence, into managing great naval shipyards which had the most powerful industrial tools of those days, and then to foreign

embassies to get world statesmanship experience, and finally into the comprehensive world strategy studying at the Naval War College. The Navy's top-rank officers were always selecting the junior officers to be promoted. There was no automatic promotion by numbers in the advance ranks of the Navy, as there was in the Army. The admirals simply selected the two-and-one-half-stripers who were most comprehensively capable and moved them up rapidly. The grand masters were then able to pick the officers they most trusted amongst those who had the most comprehensive ability.

After World War I the radio made physical centralization of political authority inevitable, and with political centralization and the demise of the old masters came the end of the autonomous admiral, ergo, the end of the need for comprehensive training. With this came oblivion for the concept of comprehensive capability and "finis" for the comprehensivist educational systems. Today the Navy, too, is specialized with "submarine officers" and "naval aviators," etc. By good fortune, I experienced the Naval Academy's last era of *comprehensive training*. I began in 1917 to study these great theories of Navy, the development of general logistical support of navies by great nations, and the establishment and maintenance of lines of supplies up to the critical moment of contact, when major naval engagements were decided on the first and second salvos, which demonstrated indubitably who had the best hardware, a condition that could only be altered by decades of new technology.

I saw that this comprehensivity of the top navy strategists all represented *great anticipatory design science, enormous vision, and supreme economic-wealth-investing-initiative.* I saw that the *theory* of Navy might be identified as a *comprehensive design problem*. The Navy and its industrial and logistic support of

1917 demonstrated well what I meant by *comprehensive anticipatory design science*. I saw that the matter of finally firing cannons from a moving ship on the heaving sea at another moving ship on the heaving sea represented all the variables that would be operative in firing from any steerable planet against any other steerable planet in the free heavens. All the mathematical complexities of all the variables of universe were inherent in the problem. Therefore, I said this special Navy logistics and ballistics case might be *generalized* subjectively into what I call the *comprehensive minimum-maximum family* of *universally variable factors*. These could then be generalized objectively as a *comprehensive anticipatory design science* which could be applied to any special case such as world naval mastery or world industrialization planning, etc.

I considered it inadequate to apply this science only to the Navy, and I intuited that *comprehensive anticipatory design science* might be applied also to the larger question of *how we can make life on earth a general success for all men* instead of assuming negatively that success and even prolonged survival were for the rare and fortunate few. I felt strongly that there might be a day when society would need to state its objective in just that way. I found myself working toward comprehensive strategies and capabilities which brought me to the only truly generalized and, therefore, most powerful tool of all, and that was mathematics itself. Mathematics has been on highest priority in my grand strategy. The reason I spoke to you earlier about my having some kind of unique behavior pattern in my day is because I am a *comprehensivist* in contradistinction to a *specialist*, and nowadays there are approximately none other than specialists. I don't know anybody else who has actually been operating with the same comprehensive strategy as mine in my

day, for my Navy friends were comprehensive specialists, whereas I became a comprehensive generalist.

At the World Affairs Conference in Colorado this last week, they brought Ludwig Von Bertalanffy together with me on five panels. Ludwig Von Bertalanffy is a great biologist. He is in the front ranks of the "academy." As a great scientist in biology, he discovered that there were comprehensive system behaviors in nature unpredicted by the behaviors of the systems' components, a phenomenon known to scientists as synergy. Von Bertalanffy, along with other mathematicians who had discovered synergy in the theories of games and so forth, began to discover that there were complex patterns which could never be apprehended, understood, operated on, or dealt with if we approached them only in terms of their separate elements; that is, *literally* in an *elementary* manner. Our whole educational process, all the way up from the elementary school, is one of taking the child who has an innate comprehensive co-ordinate capability (not only to teach itself to walk but to be interested in the *heavens*) and give him differentiated parts—elements to work with. The prime patrons of the planetariums and the like are the children, because they are spontaneously interested in the universe, that is, in the comprehensive rather than in the speciality—the elements. We get them to school, and we say forget the universe, and we give them A, B, and C. We go toward the very opposite of comprehensiveness. We go to the specialization right away. We render the children more and more specialized from elementary school onwards. Ludwig Von Bertalanffy began to find that nature, as biology, did not tend toward hybridism or more limited specialization by itself. Nature reverted toward generalism. Nature tended to work toward broader adaptation, ergo, more comprehensive capabilities. As a consequence, Dr.

Von Bertalanffy was the scientist who developed an expression you are quite familiar with today—General Systems Theory. Von Bertalanffy employs his General Systems Theory subjectively. He agreed with me that my *comprehensive anticipatory design science* is an objective employment of systems theory and that I had discovered the same phenomenon that he had discovered through completely different circumstances.

If we apply General Systems Theory to the analysis of our total world problem, today we obtain an excellent view of the techno-scientific, industrial theatre and the *socio-economic drama* in which our swiftly evolving educational processes are going to function and we can see far more clearly what the roles therein may be of the kinds of new educational developments which I have been describing to you. We will also be able to comprehend better the problems that were insurmountable to the old "world masters" and how the coming universities may now solve them under the newer circumstances.

Our pertinent *socio-economic drama* begins at the first moment in history when economic data was coming in from all around the earth to one place on earth—England. Thomas Malthus, integrating that data, discovered that the world's people were multiplying their numbers more rapidly than they were producing goods to supply themselves. Malthus' discovery coincided with the moment when Darwin was discovering his theory of evolution and adopting his hypothesis that evolution was predicated upon survival of the fittest. As a consequence, Malthus' pattern seemed to validate survival of the fittest among men as fulfilling Darwin's scientific law. Up to that moment in history, whether world societies fared well or ill had seemed to be a matter of fate or of a whimsical decision of the gods. Suddenly the Malthusian concept of survival-of-the-

fittest, i.e., you-or-me, not both—"you have to make a choice" —seemingly became a stark scientific fact which confronted the political and economic leaders of nations. From that moment in history it was clearly a matter of "you or me," and the leaders of great nations felt it was their obviously mandated responsibility to be sure that it was not their own nations that went down. At this present 1961 moment in history the "you or me" motivation founded on Malthus still constitutes the mainspring of world political policy and action.

The solutions under the Malthusian "you or me" challenge fell into two main political categories: (1) ruthless but often polite decimation of the unsupportable fractions, or leaving the unsupportable fractions to their unhappy fate; (2) socialism —the theory of austerity for all and sharing of the inadequacy with slow mutual approach to certain untimely demise.

In view of the seemingly scientific inexorability of the Malthusian concept, it comes as a great surprise that in this century a new pattern has emerged which not only questions the fundamental validity of the Malthusian and Darwinian theories but even seems to promise their complete invalidation in both the economic and social domains.

At the turn of the century the technology of the industrial revolution was beginning to integrate, developing patterns of higher leverage in the doing of man's work than had been anticipated. As of 1900, less than 1 per cent of humanity was participating in the high advantages of the industrial network. (I developed a physical measure of what I mean by participating in the industrial equation when I was Technical Consultant to *Fortune* magazine in 1933. When the equivalent of the physical foot-pounds per hour work that could be done by two hundred human slaves was available and being used in electrical and

other energy units in the industrial equation per each human family of five members, I rated this family as an industrial "have" family.) The inter-technology jelling was occurring at such an important rate at the turn of the century that by 1914 and the beginning of World War I, the percentage of human family participation in the industrial network advantage had grown from less than 1 per cent to 6 per cent. It was unquestionably this swift integration of new levels of technology that emboldened the political world "outs" to challenge the political "ins" in World War I. As World War II began, 20 per cent of humanity was participating in the advantages of the industrial network. At the present moment approximately 43 per cent of humanity is participating in the ever-higher advantages of the integrated industrial network.

This emergence of a new economic pattern in which man's relative survival advantage is amplified is news to you. This is not surprising, however, because it is a discovery of my own and has not been widely published. The *New York Times* made mention of my discovery of this economic curve in 1952. The curve of acceleration of those participating in industrialization indicates that the whole of the human family will be participating in the highest technical advantages before the end of the twentieth century and at a level of human satisfaction as yet not even dreamed of by any man.

To understand the surprising significance of this curve it must be understood that what I speak of as the industrial network embraces *all the resources of the earth* that enter into the establishment and maintenance of the industrial processes. As the percentage of world population participating in the high industrial network advantage increased from 1 per cent to 43 per cent, it meant that the total of organized world tonnages in me-

tallic and metabolic resources were exclusively supplying only 1 per cent, then 6 per cent, then 20 per cent, then 43 per cent of the world's population. During this first half of the twentieth century of realized industrialization, the world's population has been increasing at a faster rate than additional resources have been discovered. *That is, the per capita ratio of world copper, mined or unmined, or of iron, mined or unmined, has been continually decreasing.* Therefore, these ratio increases in the industrially advantaged numbers-served has not been the result of the addition of more resources, but the consequence of the scientifically designed multiplication of the technical performance or relative efficiency of output per units of invested resource. Transferring communication from wire to wireless is a typical means of doing more with less. At present we are engaged in converting all of the two-ton American automobiles into twice as many one-ton higher performance automobiles.

I am confident that the architects and engineers of the world will not claim that they have been consciously engaged either singly or co-ordinately in the deliberate increasing and improving of the *over-all world performance ratios* of the comprehensive world resources pattern. I am confident they will agree with me that this was not the declared policy of any nation or of any business corporation or of any professional groups or individuals. How then did it all come about? The answer is that the performance increase has been a by-product of the development of weaponry and of the concomitant tools-to-make-tools investments to produce and support that massive weaponry. The fabulous capital investments for the weaponry and its supporting effort were all predicated upon the Malthusian "you or me" concept. As each level of weaponry advance becomes progressively obsolete by a new level of attainment, the technology

which arose to produce and support the previous top level then becomes available to world society for everyday technical-economical satisfactions.

The change in the world's standard of living, its utter change of man's ecological patterning from yesterday's little, local, on-foot, visible horizon sweepout, to the world-around sweep-out of 1961 has been, then, an inadvertent expediency of secondary commerce sequitor to our preoccupation with weaponry.

Two and a half trillion dollars were invested by the nations of the earth in the subsidy of the airplane as a weapon in the first half-century of the airplane. This amounts to sixty-two times the value of all the gold in the world. The two and one-half trillion was the cumulative value of a regenerative investing pattern employing the tooled wealth to create higher tooled capability and to inhibit more energy from world energy patterning by shunting previously unharnessed energy into men's industrial networks to apply it to the end of his ever-regeneratively larger and more incisive levers. The cumulative reinvestible capital-capability-wealth is vast and has made gold and the concept of intrinsic wealth utterly obsolete, for the harnessed industrial-energy and its tooled-up-capability and the reworked and recirculated physical chemistry and the *ever improving* know-how altogether integrate as the real wealth of the world.

How did it happen that the native preoccupations of men in weaponry continually improved the performance per units of invested resources? It was because the ability to carry the hitting power of the weaponry the greatest distance in the shortest time involved ships, and ships had limited displacement, due to nature's pattern of floatability. Therefore, the design challenge

was to produce the most powerful ship with the least weight invested in the ship, thus enabling it to carry the greatest load of weaponry, ammunition, and fuel to get it there faster. As we went from the ships of the sea to the ships of the air, the performance per pound of the equipment and fuel became of even higher importance than on the sea. Finally, with the breakthrough to rocketry, we see a transition of startling magnitude in speed, distance, and energy load carried per weight of vehicle or ship and its fuel.

Architects know that neither they nor their patrons have ever been concerned with the weights of their buildings or with any ratings of performance per units of weight investment. Neither the architects nor society know what buildings weigh. Society knows well what the Queen Mary and the Douglas DC-8 weigh; the public knows what the sea and air ships' performance capabilities are. The public thinks of performance per pound ratings, but the world of housing, the world of architecture, has always been a world of opinionated dealing with the left-overs after the high-priority technologies have been applied exclusively to the weaponry and its supporting industries.

It is a fundamental characteristic of industrial evolution that each successful invention is followed by a period of expansion of the use of the invented tools in which more performance by that type of tool is accomplished only by more of those tools of bigger and bigger capacity until the elephantine level is attained; e.g., in ocean ships, the *Queen Mary*. Thereafter there develops a period of converting the doing-more-with-*more* phase of that tool into a doing-more-with-*less* phase, which uses new alloys and techniques, accomplishing as much as the elephantine with a tool of lesser size; e.g., the *United States*, carrying the same number of passengers and tonnage of cargo at the

same speed with 30 per cent less tonnage and size than the *Queen Mary*'s.

Then follows a third period in which an entirely new type of tool does the same task with a small fraction of the weight of the previously invested resources, but only with an investment of fabulous magnitudes of completely weightless scientific activity. For instance, one jet airplane succeeds in one year in outperforming the annual trans-Atlantic passenger ferrying capability of the *Queen Mary* or the *United States*, with of course many more accomplished round-trips of its diminutive passenger capacity. Previously complex radio tubes replaced by transistors is typical of the progressive diminution in size and weight of the newly-invented tool for an old task.

When Sputnik went into the sky the now suddenly "elephantine" airplane weaponry system yielded its premiership to a weapon transportation system with enormously increased hitting power which is not only far swifter but which also employs a miniscule fraction of the physical resource tonnage in its supporting tools as well as in the weapons themselves. This new vastly more efficient system requires, however, a fabulous, abstract (no weight) investment of the essential scientific resource, i.e., man's disciplined mind activity. With the obsolescence of the aircraft industry as a prime *weaponry* resource, 90 per cent of that industry's now obsolete massive high-performance technology production capacity was potentially released for application to *livingry*.

The world's architects are faced with the fact that the munitions industry managements will be henceforth increasingly panicked to obtain economic survival tasks for their soon-to-be 90-per-cent-unused aircraft technology production capacity, and will attempt to apply that capacity to the great

industrial vacuum, the building industry, using their own ignorant opinions to determine the designs of products to be produced and, as already demonstrated, will produce aluminum versions of Cotswold cottages and other technical substitutions for components of conventional building, such as curtain walls and partitioning, all of which are of the design conception level which serves only 40 per cent of humanity with 100 per cent of the world's resources.

Neither the philosophy nor the fundamental volition, transcendental to immediate economic survival considerations, exist in the aircraft munitions industry that might otherwise bring it to the inauguration of unprecedented world-around, air-deliverable, high-standard livingry systems designed at an entirely new level of design invention competence as is now feasible within the aircraft technology and production capacity. In the latter now exists the potential of evolving augmentation of technical performance in livingry adequate to supply and maintain the advanced service of 100 per cent of humanity with less than 100 per cent of the world's resources and is feasible through design ingenuity and only through design ingenuity applied directly to livingry.

We discover in the picture that I have given you the fact that the upping of the performance per pound of the world's resources for improving standards of living has never been a direct objective of the politicians or the military servants of the politicians. Gradually we realize the startling significance of this emerging pattern of improvement of the performance of the world's resources as applied secondarily to "livingry" of man. This unheralded unpremeditated emergent pattern indicates the inexorable realization of 100-per-cent industrialization of mankind, to be realized before 2000 A.D. but only as a by-

product of man's negative lethal warfare preoccupation, which means that it will be realized only through an increasing succession of world-around military threat emergencies of the kind which mankind now finds himself apparently helplessly enmeshed in.

Because the forward transformation of the resources from their going low efficiency functions into other functions of higher performance represents a continual revolution in design it is a pattern that could be mastered by man as a *comprehensive anticipatory design scientist*. There are at present no design scientists. Architects and engineers are the nearest approach to such a profession. If, however, architects and engineers, as has been their custom, wait for a patron to command their services before they engage in their designing practice, it is easy to see that neither the politician nor the great industrialist nor any private patron will engage the architectural profession in this anticipatory design command of the total world resources investment and total world technical evolution, because the politico and the industrialist and the private patron are all still convinced of the inexorableness of the Malthusian "you or me" and the "survival only of the fittest."

What I now propose is that all the universities around the world be encouraged to invest the next ten years in a continuing problem of *how to make the total world's resources, which now serve only 43 per cent, serve 100 per cent of humanity through competent complex design science.*

The general theory of education at present starts students off with elementary components and gradually increases the

size of the complex of components with which the student will be concerned. The scheme is to go from the particular toward the whole but never to reach the whole. In many of the architectural schools the first-year student is given a problem in terms of a country town and has to plan and design the buildings for that country town. The next year he must do a larger town, a small industrial town. In the third year he is engaged in a large industrial city, and in his fourth year he is engaged with the largest cities, such as London or New York. The schools never reach out to national, let alone world, problems. As a consequence, local town planning everywhere is almost completely invalidated by the sweep of world events. The automobile highway clover-leaf programs are completely inadequate to the concept of total man being advantaged with his own vehicle. Parking problems continually frustrate and negate the too-local, too-small horizon of town planning.

The first year's total world planning by the students and its designed implementation may be expected to disclose great amateurishness and inadequacies, but out of the criticisms of the amateurishness and the inadequacies should emerge criticisms from the politicos, from the great economists, and great industrialists, excited by the students' plans treading on their doorsteps, out of which criticism the next year's round of world designing by the students may be greatly advantaged. The second, third, and fourth years should show swift acceleration in the comprehension of the problem and the degree of satisfaction of the problem. If the students present their progressive yearly solutions in documentary moving pictures they may be distributed around the world and may be called up over two-way TV.

The world planning by the students must be predicated

upon the concept of first things first, upon a scheduled hierarchy of events. These have been variously known as five-year plans, seven-year plans, etc., by the nations of the earth who have gone swiftly from almost complete "have noneness" and illiteracy to powerful "haveness" and almost 100-per-cent literacy. As each unindustrialized nation undertakes industrialization, the rate at which it accomplishes each of the progressive plan stages contracts—that is, the curve of overall world industrialization—is constantly accelerating.

At the present moment in history, what is spoken of as world policy by the respective nations consists essentially of their own special plans to bring about conditions which would uniquely foster their respective kinds of survival in the Malthusian "you or me-ness." For any one of the world policies of any of the nations or groups of nations to become a world plan would mean that approximately one-half of the world's nations would have to surrender their sovereignty and would mean the development of a highly biased plan as applied to the whole. In the nature of political compromises it is logical to assume that the world policy of any one political nation will never succeed in satisfying comprehensive world planning.

It is clearly manifest that students and scientists are able to think regarding such world planning in a manner utterly transcendental to any political bias. My experience around the world and amongst the students tells me that the students themselves tend always to transcend political bias and that *all of them are concerned with the concept of making the world work through competent design.* In much investigation and inquiry I have had no negative response to the program of organization of the student capability to the upping of the performance of the world resources to serve 100 per cent of humanity by peaceful, com-

prehensive laboratory experiment and progressive design revolution.

At the present time, in this era of exaggerated specialization, the special knowledge and capabilities thus developed are rapidly drained off from the university into large corporations and into government defense bureaucracies or military bureaucracies. The scientists and inventors are wary under these circumstances, and it is probable that if the students who are potential comprehensive anticipatory design scientists are progressively and adequately disciplined to breadth of capability in chemistry, physics, mathematics, bio-chemistry, psychology, economics, and industrial technology they will swiftly and ably penetrate the most advanced recesses of the scientific minds resident in the university, and as their programs evolute from year to year in improving capability the students will be able to bring the highest integral scientific resources of man to bear upon their solutions of dynamic world town planning and its design instrumentation and operational regeneration.

The comprehensive world resources data now exist in a number of establishments, but are primarily available to all the universities of the world through UNESCO. What UNESCO does not have, it is in a good position to direct the researcher to acquire successfully. Our Geoscope would be dramatic aid in such resource-use planning and its cummunication to world news distributing services.

I have discussed this potential development of a comprehensive world strategy by the students who are potential comprehensive anticipatory design scientists with faculties and students on both sides of the world political curtains and have had unanimously enthusiastic reactions. The project has the extraordinary virtue that it inherently avoids political bias;

therefore, there will be no suggestion of any subversive activity by any participants. It may receive political support from all sides by virtue of the important knowledge that will accrue. I am confident that there are many other human beings who at this moment envision analogous developments, all of which are symptomatic of a maturely emergent world trending whose exact modes of realization are unpredictable. But we may assume that the great, looming, man-favoring events of tomorrow will occur as the result of man's adoption of comprehensive anticipatory design science within the universities.

I told your architect, Mr. Obata, the other day that I think you can break down your comprehensive educational undertaking into two main categories: one, all the *subjective disciplines*, and two, all the *objective disciplines*. Phrases like the College of Fine Arts really have no meaning any more. These would be objective disciplines in contradistinction to the subjective "pure" science data-gathering disciplines. It is very appropriate to have all kinds of subjective disciplines where men learn how to gather data faithfully and how to analyze their data, but they don't have to comprehend the data; they are not asked to comprehend. There is often not enough pattern to warrant having suspicion or intuition as to the significance of the considered pattern—or *lack* of describable pattern. Those are the subjective disciplines. It is only after the subjective that we get the objective.

I think that one of the most important events of the educational revolution is the present realization that we are going to discover that the child is born comprehensively competent and co-ordinate and that it is capable of treating with large quantities of data and families of variables right from the start.

When parents make babies they don't know what they are

making. They don't know how to make what they make. All they do is "press a button." Ours and our babies' brains have a quadrillion times a quadrillion atoms already operative in co-ordinate patterning operation utterly transcendental to our conscious control. A quadrillion times a quadrillion atoms operative subconsciously in most extraordinary co-ordination make it possible, for example, for me to be communicating with you. We don't have anything consciously to do with the fundamentals of our communicating capability. Nor do we have anything to do consciously with pushing a million hairs out of our heads at preferred rates, colors, and shapes. We don't know how to consciously co-ordinate our heart beating and our breathing. We don't know at all how we charge energies back into the various glands of our systems. We really don't know what is going on at all, but we do co-ordinate it all subconsciously. What we do have in the brain is an extraordinary, orderly pattern manipulating capability to deal with that quadrillion times a quadrillion invisible atoms. This is all born into the child. The parent doesn't consciously put it there. Men may take no credit for the fundamentals of their relative success upon earth.

I will say that it is very clear to me that when a child stands up, breathing and co-ordinating all these complex patterns by himself and gets his own balance and starts drinking in the patterns of cosmos and earth he is apparently spontaneously interested in co-ordinating the total information—the total stimulation. He craves to understand—to comprehend. That is why he asks his myriad questions.

I am quite confident we are going to find ways of helping the child to co-ordinate his spontaneous comprehension of the *whole* instead of becoming a specialist without losing any of the advantages gained by yesterday's exclusive specialization.

With general comprehension there will also come an entirely new way of looking at our mutual problems around the earth. We will not be easily influenced by ignorant persuasion and propaganda, such as pronouncements that "we are against this man and that man," and so forth. We are going to look at our problems quite differently than we do now. There will be a co-ordinated comprehensive continuation of development of the child in appreciation of the subconsciously co-ordinate design of humans not forcing them into prolonged special focus, yet accomplishing with automated tools and instruments far greater probing than was accomplished by the utter specialist while conserving the comprehensive comprehension of the significance to society of the increasing flow of discovered data.

Next, let us think carefully and daringly of the equipment we will need and that we won't need for the large, new research establishments for students staying longer and longer at the university, as the new major industry of mankind. At M.I.T., for instance, where I visited as lecturer for eight years, there are rooms full of special and expensive apparatus which everyone thought would put M.I.T. at the top of the heap. Room after room of this equipment is now obsolete—at best these collections of machinery make a dull museum.

The first time I met Harold Cohen, now Director of Southern Illinois University's Design Research Department, was at the Institute of Design in Chicago. Chermayeff, its head, had his carpenter spend practically all his summer making drawing boards for my room, assuming without asking that I would need them. I did not. Harold will remember that the first thing we did in that room was to put the drawing boards up along the wall to use them only as shelves. Why were those drawing boards obsolete? In the world of designing today, such as in the great

aircraft companies, you don't make drawings as in the past, which drawings are handed over to a carpenter, who in turn scales them off and makes from them a physical reality device or structure. Today we make only *schematics* and *schedules* of *data*, because the tolerances involved are subvisible—nobody could "lay it out." The machines have to index it. You don't need a detailed drawing; we do not make that kind of communication to a craftsman anymore; but all the schools go on teaching that we do. The data no longer goes to the craftsman; it goes to the tools. The idea of drafting measured details is going to become obsolete. We don't want any more measured detail drafting. What we want is the man who gets the fundamental concept, the information significance and can do some comprehensive thinking regarding that information. He will put the data into the information machines, and it will be processed by automation into physical realization of his effective thinking. We don't need many of the myriad of "things" we have had in schools.

I would counsel you in your deliberation regarding getting campuses ready now to get general comprehensive environment controls that are suitable to all-purposes like a circus. A circus is a transformable environment. You get an enclosure against "weather" that you can put up in a hurry, within which you can put up all kinds of apparatus—high trapezes, platforms, rings, nets, etc. You can knock it down in a few minutes. That is the way the modern laboratory goes. In laboratories you can get the generalized pipette or whatever it is, the crucible, and the furnace. You can put the right things together very fast, rig them up, get through the experiment, knock it down. It's one clean space again. You want clean spaces. The circus concept is very important for you. I would get buildings where it is

possible for many to meet. On the Carbondale campus you have succeeded in getting some good auditoriums—but we need more auditoriums and more auditoriums time and time again. We want places where there is just a beautiful blank floor and beautiful blank walls upon which to cast our pictures or apply crayons. You don't have to put any "architecture" there at all. You don't have to build any sculptured architecture—use the ephemeral. Work from the visible to the invisible very rapidly.

I would not waste dollars on great, heavy, stone masonry and any kind of Georgian architecture, and I would forget all the old architecture and even the curricula patterns of any schools before this moment. You might better consider putting up one big one-half-mile-diameter geodesic dome over your whole campus and thereafter subdivide off local areas temporarily for various activities.

Anything that is static, forget it. Work entirely toward the dynamic. Get yourself the tools and ways of enclosing enormous amounts of space, and make it possible for large numbers of human beings to come together under more preferred conditions than have ever before come together. Then give them large clear spaces so that their privacy results from having sufficient distance between people or groups of people. Get over the ideas of partitions. Partitions are like socialism. They came out of living and working in fortresses where there wasn't enough room to go around, so they put up partitions—really making cells. Partitions simply say you shall not pass. That's all they do. They are improvised to make that which is fundamentally inadequate work "after a fashion."

There are four kinds of privacy: if I can't touch you, we're *tactilely* private; if I can't smell you, we are *olfactorily* private; if I can't hear you, we're *aurally* private; and if I can't see you,

we are *visually* private. Just a little space will take care of the first three. For the fourth—since we can see a great distance—all we need are delicate occulting membranes, possibly rose bushes or soap bubbles or smoke screens.

These are the devices you will have to get to handle emergency after emergency of swift transformations. You should get plenty of good real estate, which you, President Morris, have a proclivity for. I continually admire your intuitions in getting the countryside organized so that it can be of service to vast numbers of people without ruining that countryside.

As examples of the kind of environment controlling facility to which I have been referring think of the fifty-five-foot-diameter Marine Corps geodesic domes. We began flying them around by helicopter in 1954. Last year we sold to the Ford Motor Company, from my office in Raleigh, North Carolina, two domes, not 55-footers but 114-footers. That is, each had 10,000 square feet of floor space. Each was an auditorium with a dark skin. One helicopter picked each one up. Ford started one of the domes in Alabama and one in Texas and moved them north. They didn't fly them most of the time; they disassembled and reassembled them, but they discovered they could fly them. One helicopter could pick up 10,000 square feet of floor space—that's quite a lot—and move it from place to place at a mile a minute. Considering the rate at which the helicopters are now increasing the loads they can carry and the rate at which I'm finding I can make lighter and lighter buildings, I can tell you with within five years I will be able to fly the clear-span cover for a baseball stadium (14½ acres) fully assembled, delivering it to its site at 60 knots. This is what is coming. Get yourselves the right geographical bases; you're very smart in getting your airplanes. Get lots of real estate and lots of airplanes

and helicopters—get mobility. Get the most comprehensive generalized computer setup with network connections to process the documentaries that your faculty and graduate-student teams will manufacture objectively from the subjective gleanings of your vast new world- and universe-ranging student probers. Get ready the greatest new educational facility at the approximate dynamic population center of the North American continent, assuming that any dreamable vision of technical advance will be a reality and that man is about to demonstrate competence beyond our estimates of yesterday and today. "Shoot for the moon"—yesterday a statement of lunacy—only a lunatic would now deny that this is the most evidently "next" practical objective of man.

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