

earning and contemplation) as part of the daily routine at each level. I think we can find a meaningful way of doing this provided we do not segregate the population groups. It is through both the horizontal control system of the peer group as well as the vertical control system of the elders that you reach a balanced society. We should reexamine the problem of education in terms of a social structure of an interacting human group in a "dynamic equilibrium" with its own internal consistency.

● There are forms of communication that have very few dimensions, such as a TV picture, which is something that you cannot taste, you cannot touch, you cannot smell, you cannot make your own. The literature of social unrest in the 19th century was very rich in pictures of poor children pressing their noses to the glass panes of show-windows, looking only at the goods which they could not reach. TV and the mass media have multiplied this show-window effect. The riot areas in our ghettos are studded with television antennas. There are no feedbacks and few dimensions involved in mass media communication; there are very many impersonal contacts, and the full range are involved in living and working in a milieu. The thing that makes the average modern man richer than king Croesus is not that he can get images of many things but that modern mobility enables him to touch and make very many more things directly his own. The TV set is not a

substitute for a city. Acquisition of an environment can be defined in terms of multidimensionality of communication and richness in feedbacks. Mass media are not now, and probably will not be for many years, a substitute for a concentration of contact choices in cities on the one hand, and increased mobility on the other.

● I am convinced that we do have the resources and know-how, but what we lack is the will. This accounts for the time-lag and there seems an amazing correlation between the time something will take and the time of an individual's retirement from active life. If the man is 40, it's going to take 25 years; if he is 50 it's going to take 15 years; so that there is a divorcing from the responsibility the change is going to cause. There is a great disparity between those of us who are the managers of the system and those who are its victims. We live in the tomorrow, the victims exist in today, and I am not sure they are going to be willing to adjust to our time span in terms of the resolution of some of these problems. This returns me to the question of will. What can we come up with that will motivate people to derive an equal satisfaction from being altruistic and generous and compassionate as they are now satisfied by holding onto certain types of control and greed. The present attitude is: how can we give up a minimum to bring about peace and stability and order? But what is the maximum we can give up without losing all control.

THE WORLD GAME

R. Buckminster Fuller

Underlying Key Theme. The World Game idea forsakes the political expedient of attempting to reform man and commits man to reforming his environment. This is to be achieved in such a manner as to "up" the performance per each unit of invested world resources until so much more is accomplished with so much less that an even higher standard of living will be effected for 100% of humanity than is now realized by the 40% of humanity who may now be classified as economically and physically successful. The possibility of setting up a large-scale "gaming" format would allow for various types of participating "simulations" on "How to make the total system work more efficiently". The World Game will, then, explore for, and experiment with, grand strategies for making the world work by continu-

ally assessing the design science revolution which would provide ever more effective tools and services with ever less, real resource investment per each unit of end performance. For example, a communication satellite weighing only one-quarter of a ton is now out-performing the transoceanic communication capabilities of 175 thousand tons of copper cable. Continual search for such effort reducing, more-for-less uses of our resources would eventually lead to a time when all of humanity could be taken care of at an even higher standard of living than man has as yet conceived of or even yet experienced. "Peace" will then be not just a catch-word, but an experienced reality, which has been assimilated and chosen as the best of all possible alternatives open to human design experience.

THE WORLD GAME

A Game That Has No Losers

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

S.I.U. Takes the Initiative

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

The Infra World

Humanity has a very limited optical spectrum, wherefore man can see today only one-millionth of the total physical "reality", as the latter is evidenced by the full range of the electromagnetic

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

Integration of Sensory Input

In addition to the *electromagnetic frequencies spectrum* we have also a *motion spectrum*. The sense of motion is produced by an overlapping continuity of after-images of a plurality of optically tunable separate and sequentially occurring electromagnetic frequency events just as music is produced for the hearing by a metrically momentumated sequence of both separate and resonantly overlapped sound frequency notes. Motion is visual music made possible by the spontaneous retention in the brain of a series of separate still picture frames of our separate sense experiences scanned and reviewed in the brain at a vastly accelerated sequence rate. Our brain discovers that each successive electromagnetic picture is just a little different from the ones before and our dawning awareness of that increasing difference constitutes our *motion sense*.

Indeterminate Causes and Perceived Effects

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

New Frontiers of Resource Explorations

As the general system of vital trends becomes visible and its components are seen to integrate *synergetically*, we also will begin to discern ways of using the world's resources to ever higher and more universal human advantage. We will soon

learn popularly how to play the game to explore for ways in which we may use the world's resources so that we may be able to make our whole planet successfully enjoyable by all humanity without any human profiting at the expense of another and without interfering with one another, and how to do so in the shortest possible time.

Enough Oxygen for All

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

Vivid Awareness of Neighbors

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

Military Technology's Diverging Course

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

only for military purposes.

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

WEALTH

Wealth Is Not Merely a Survival Bank Account

I find man utterly unaware of what his wealth is or what his fundamental capability is. He says time and again, "We can't afford it." For instance, we are saying now that we can't afford to do anything about pollution but after the costs of not doing something about pollution have multiplied many fold beyond what it would cost us to correct it now, we will spend many fold what it would cost us now to correct it. That is a geometrical compounding of inevitable expenditures (originally side-stepped because we believed erroneously that we "couldn't afford" their correction). For this reason I find that in satisfying humanity's vital needs, highest social priority must be assigned to the development of world-around common knowledge of what wealth is. We have no difficulty discovering troubles but we fail to demonstrate intelligent search for the means of coping with the troubles. This is primarily due to our misconditioned reflex which says that "we can't" afford to do the intelligent things. We discover with scientific integrity that wealth is simply the measurable degree to which we have rearranged the physical constituents of the scenery so that they are able to support more lives, for more days at such-and-such standards of health and nourishment, while specifically decreasing restraints on human thought and action, while also multiplying the per capita means of communication and travel all accomplished without increased privation for any human. Wealth has nothing to do with yesterday, but only with forward days. How many forward days, for how many lives are we now technically organized to cope? The numerical answer is the present state of our true *wealth*.

Physical Wealth

I find that our wealth consists exclusively of two fundamental phenomena: the physical and the metaphysical. The physical in turn consists of two subdivisions. One is the *physical/energy associative as matter* and the other is *energy disassociative as radiation*. After science discovered the speed of light it went on to discover that when

energy was lost from one system it was gained by another local system. It is never lost from the universe. Energy is inherently conserved so the *energy component of wealth cannot be depleted.*

Metaphysical Wealth

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

SCIENCE AS TECHNOLOGY'S DOGMA

Eternity of Meaning Versus Empiricism

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

Eternity of Elements

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

Order Was Always There

These scientists point out therefore that there never could have been chaos. There had perforce always to have been the orderly fundamental complementarity. All the legendary ways of looking at universe as having had a beginning in disorder have for the three last years been completely upset by the astrophysical inventorying of the relative abundance of the fundamental atomic isotopes and their intertransformational accounting on a cosmic scale. We find we are now confronted with an apparently eternal a priori order. The idea of probability gradually converting a disorder to order is invalidated. There is an a priori synergetic integrity of universe which has allowed humanity to be born ignorant. That is

manifest. It is not then a derogatory statement to say man is ignorant. He also is born utterly helpless. It is part of the equation of universe that "utter helplessness" be complemented by an a priori competence of universe to "care for" the helpless. Mothers do not have to invent a mammary gland and a breast to feed their babies. The mother doesn't invent the oxygen for the baby to breathe. These essentials were invented by the a priori competence of the universe. Therefore I find man ignorantly pretentious in assuming that he is responsible for either yesterday's or tomorrow's success.

EVOLUTION - THE FULFILLMENT MODEL FOR HUMAN DESTINY

The Enthusiasm of Evolution

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

Fundamental Complementarity

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

From Entropy to Antientropy

We look at all the stars and find that we "see" them only because they are giving off energies in increasing disorder. We call this radiation. We find only one place in the universe where we know energies are converging, collecting and being stored and that is our own space ship Earth... our planet. In the International Geophysical Year, world-around measurements indicated that approximately 100,000 tons of star dust are accumulated daily aboard Earth from other stars. Thus energy is being collected here as matter. We also are col-

lecting an enormous amount of radiation from the other stars, primarily from the sun but also as cosmic radiation from myriads of other stars. The energy either as or radiated increments arrives in a very random frequency pattern. We may state it to be experimentally proven that our special space vehicle Earth is at least one mobile energy collecting center in contradiction to the stars which are energy distributors. The sun's energy radiation is not being reflected off Earth as from a mirrored ball. It is refracted, or angularly deflected, by the atmosphere. Thus the sun energy as heat is impounded in the atmosphere to produce weather changes. Thus, also, are the waters refractionally heated by the sun's radiation. Thus, by a series of relay stages is energy impounded aboard our space ship Earth to regenerate life by the photo-synthesis of the vegetation which is a beautiful process whereby the random energy receipts are transformed chemically into beautiful, orderly molecules which are beautiful structures. Here you see the turn-around from disorder to order—from entropy to antientropy.

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

Integrative Potential of the Human Mind

Of all the disorder to order converters, the human mind is by far the most impressive. The human's most powerful metaphysical drive is to understand, to order, to sort-out and rearrange in ever more orderly and constructive ways. You find then that man's true function is metaphysical. Man's physical function is the same as that of all other biological life; to impound and regenerate physical life which means inherently to produce reconstructive order of every variety. The metaphysical, absolutely weightless function in universe, unique to humans, is that of continually looking for the generalized principles which are operative in all the special case experiences. Thus has humanity discovered that it could move and constructively rearrange multi-ton rocks that man's individual muscle could not move. He succeeded by his weightless mind's discovery of the generalized principle of leverage. Thus also did mind discover the principles of electron conductivity, whatever that may be, for electromagnetics, though discovered and used by man, it is as yet a fundamental enigma. These generalized principles were all found to be operating a priori to man. Man simply finds and employs. He does not put anything into the universe. We must realize that technology was not put into the universe by man. The universe is the comprehensive system of technology. Humanity is discovering and beginning to employ it. The human mind invented the computer as an extension of humanity's integral computer, information storing and retrieving system, the brain. The computer and the

automated technologies it commands are about to take over all specialized tasks from humans, thus saving humanity from becoming extinct, for biological science and anthropology have learned incontrovertibly that extinction is always the consequence of overspecialization. Our World Game will be in effect a World Brain. It will free world mind from occupations of brain slavery. Human minds employ the World Brain to solve the problems of all humanity thus escaping the previous recourse only to the individual opinions of too myopically preoccupied ill-informed men. The human mind, as Einstein's metaphysical, weightless intellect, discovered and noted in written symbols the equation of the physical portion of universe, — that physical portion of universe which consists entirely of energy; — energy in two diametrically opposed, intercomplementing and intertransformable behavioral conditions. The one phase is energy associated as matter symbolized as M—and the other phase is energy dis-associative as radiation—symbolized as C—and the rate of the associative phase is in terms of second power of the Michelson, Morely measured speed of light which is scientifically notated as C^2 which equals the rate of growth of a radiation "bubble's" spherical surface growth. $E = Mc^2$. In Einstein's perceptivity and initiative we have the metaphysical mind taking the measure of the physical. This relationship is irreversible. We have no suggestion that energy will ever conceive of and write the equation of intellect. The Nobel Prize in physics was given in 1956 for discovery of this irreversibility principle of the complementarity but non-mirror-imaged balancing of positive-negative events. Evolution thus became recognized as irreversible. We find here the clue to the coherence and integrity of the universe which can never lose its energy quanta. Universe is the minimum perpetual energy conserving complex of technological intratransformings. Metaphysical intellect and its ability to comprehend and master the intertransformative technology of universe and to reconvene and reconcentrate the physical disorder into conserved order is possibly the highest, separately discernible function in universe. Mortal, physical human bodies have the function of providing a regenerative succession of fresh physical vehicles for the mortal—because entropic-articulation of metaphysical immortality. The long-held popular conception of the existence of two kinds of physical substances—one called *animate* and the other *inanimate*—the first rather mystically maintained and the other subject to stark chemical analysis, was altogether invalidated as science closed in on the assumed threshold between the animate and inanimate at the virus level only to find that there is no threshold and that all the phenomena followed strictly inanimate physical laws. So we find the real separation of the life

and the inanimate when humans die and no weight is lost. Life is metaphysical and antientropic. The inanimate is physical and entropic.

MAN AND HIS CHOICE OF DESTINY— THE SELF FULFILLING PROPHECY

Life is Metaphysical and Antientropic

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

The Myopic View

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

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

Regenerative Spontaneity

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

Tolerable Limits for Life

I may have sounded optimistic; I did not mean to be so. I did not mean to be one way or the other. I am interested in whatever the complementarity and irreversibility balance may be. I am interested

to learn if evolution requires that we be destroyed. If we were living on the sun, physical we, as incineratable organisms, would be destroyed. But I observe that we are functioning in a region of the universe where everything has been made tolerable for our specific technological model of regenerative life to go on.

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

SOCIAL INVENTIONS

John Platt*

I never give a speech these days without showing the S-curve of change in the last century (Fig.). Some of the changes have been very sudden—step functions. We have increased our rates of communication by a factor of ten to the seventh. This was a step function, and we are now at the limit which is the speed of light. We have increased our travel speed in the last century by a factor of over a hundred but, again, we are now at the limit which is the speed at which one goes into orbit. With nuclear energy we have increased resources of the world by a factor of ten to the third, possibly even more if fission power can be made to work, and we are in sight of the limit, which will be set by the thermo-pollution of the atmosphere. We cannot afford to have the world heat up by more than a couple of degrees and this is about what will happen if all the world used energy at the American rate. With the hundred megaton bombs we have increased our power of weapons by a factor of ten to the sixth. We are at the limit of overkill and there is no point for going further in that direction.

So, in many cases we have already stepped up into a plateau of the S-curve and this is also true for things that you cannot give numbers to so easily. We have reached the limits of exploration of the earth, although we are just beginning the solar system. The three billion years of evolution of plants and animals by natural selection is at an end. We are now beginning the era of evolution by human selection because our population, our pollution, our predation, our breeding, our protection, now determine the numbers of plants and animals all over the globe—even very far from human settlements. We may do this wisely or we may do it stupidly; we may do it deliberately or by accident, but it is human activity now which determines the directions of evolution of all plant and animal life.

Similarly, we are at other kinds of limits which affect the social structures and organizations of the

TECHNOLOGICAL LIMITS:

- COMMUNICATION: 10^7 [LIGHT]
- TRAVEL SPEED: 10^2 [ORBIT]
- ENERGY RESOURCES: 10^3 [THERMAL]
- WEAPONS: 10^6 [OVERKILL]



world of the future as far ahead as we can see, maybe for thousands of years. It is like the domestication of the horse: once the horse had been domesticated, his speed and power determined the speed and power that humans could apply in traveling across the earth or in ploughing their farms for thousands of years. We have now domesticated a certain number of technological advances that will determine our speed and power interactions for thousands of years to come. These are natural limits.

Karl Deutsch and I have recently been working on Social Inventions since 1900 and some of these may give some concrete notions about what can be done in the way of inventing new arrangements in society. We have made a list of about forty changes since about the year 1900 that we call Social Inventions. This list includes things which are, so to speak theoretical, Keynesian economics, Operations Analysis, Theory of Games and Planned Program Budgeting. It also includes things which are essentially political/legislative: the New Deal, Pay-as-you-go Income Tax, the Test Ban Treaty, the Hot Line from Washington to Moscow. One can add other devices which are commercial or industrial, such as the Assembly Line, the Credit Card, Rent-a-car; one might list several others of this sort.

The questions that we asked about these inventions were: Who made them? Where were they made? How long did it take for them to be effective?