

BOSTON ARCHITECTURAL CENTER DESIGN FOR SURVIVAL, --PLUS

A talk given by Buckminster Fuller on January 26, 1949: being the occasion of the first formal meeting at the Illinois Institute of Technology to consider the inauguration of a program to convene the abilities of Science, Engineering and Design in the realization of single family dwelling units through the augmented advantage of the Industrial Complex, --an advantage heretofore uniquely avoided by the proclivities of the housing tradition.

Mr. Prestini, chairman of the Housing Research organizing committee of the Illinois Institute of Technology, affirmed Mr. Fuller's assumption that (a) group housing for centralized activities and single family dwellings for deployed activities are equally valid, --and (b) that this research program concerns only the latter, -- since Mr. Mies van der Rohe's Architectural School at Illinois Institute of Technology covers the former.

The talk constituted an outline of suggestions as to method of setting up the program. Mr. Fuller urged the adoption of a comprehensive family of assumptions. "Comprehensive assumptions," he said, "constitute the scaffolding within which all original technical gains are systematically contrived." This scaffolding may be removed after the technical advantage is established. First assumption in an effective methodology he pointed out is that "a problem competently stated is a problem solved: ergo, --success of the I. I. T. dwelling research program depends upon adequate definition of the problem at the outset."*

Without further interruption, the following is a presentation of his talk:

SCOPE OF PROBLEM

In substantiation of the assumption that the problem must be adequately stated at outset, it is noted that many plausible prefabricated house designs have been tendered to the public through the press as allegedly suitable for mass production. The public credit has been repeatedly short circuited and the new fuse of design initiative blown out. It is seen that the original presentations included but meager or no means at all for the distribution, erection, movability, maintenance and minimum economic occupancy, --as inherent components of the design and as direct responsibility of the producers.

Every time the total logistic involvement of the prefabricated house designs have been put to economic test appropriate to the respective prototypes, the original design concept of these houses has been found to be inadequate. Deficit financing has been required in after thought or as an emergency measure to offset original inadequacy of concept, for instance the significant scope, magnitude and nature of the project in the historical scheme of events.

To avoid bankruptcy of the projects, the deficit financing had either to be provided by the original private backers, --a diminishing credit resource, or most recently by federalized angel, if possible, i.e. government finance by reconstruction loans.

When government finance is invoked the vital factors affecting survival of the project pass into the realm of politics and out of the area of scientific measurement. Application of the vast social credit to prenatal design of industrial embryos constitutes short circuit just as thoroughly as if there had been "private failure."

*See "Universal Requirements"

Political hedging of "social" finance requires the administration of the funds by compromises inherent in bureaucracy reflecting the enactors reelection dependence upon the favorable probabilities in the direction of preponderant incredulity, boredom, ignorance, inertia and mediocrity.

First flight by man could not have been the product of socialized development. Would-be flying devices suitable for political credit prior to first flight by man must of necessity exploit irrelevant monopolies in inertia, --too heavy for flight. So important an evolutionary event (as successful flight by man) may only be won in principle from the potentials of universe through a complex interaction of a plurality of initiatives daringly taken by individuals. Self sustained directional control of airborne man represents the integrated product of a fabulous history of personal investment by innumerable individuals in daring sequences of single-handed and necessary failures, --attendant upon undertakings only warrantable to the individual himself.

Integration of a complex of series of failures represents the only means of attaining from nature the original data essential to realization of evolutionarily tactical events. Not even the most benevolently motivated private or public accrediting can circumvent the vital events of acquisition of knowledge by man regarding critical factors and limits of variables governing his self determinable evolutionary mutations.

In retrospect it is easy for all to see how the myriad historical events of individual initiative in mathematics, chemistry, physics, mechanics, semantics, good faith et al have led up to a realization of all the components of the complex invention airplane. Historians and parents teach to children as though it had always been obvious that yesterday would lead to today. But we, the living, are always in tomorrow's yesterday, and in our tomorrow's-yesterday percolate remotely all the vital undertakings of individual initiative destined to series of failures out of which will emerge the vital data on critical limits and variables the which trickling, then running to many confluences, flowing ultimately to merger with the ocean of obvious environment into which the new life, continuously taking all that has gone before for granted, is born. It is a corollary of course that the tendency of man to speculate on "sure" things constitutes economic suicide. This is the direction to the prohibited return to yesterday. Compoundingly, --it is evidenced that social reinvestment of earned evolutionary advantage in "sure" things constitute systematic suicide of whole socio-economic systems.

Prefabricated house undertakings have to date been analogous to the designing of a telephone as constituting only a desk accessory independent of a communication network, --wired or wireless, and the network's generating and maintenance services. The "toy" concept expanded into industrial economics reveals irresponsibility and incompetence at the research and design level.

Housing is inherently the last and largest physical preoccupation of industrial expansion because it represents the sum of all historical advantages integrated into a new magnitude of extension of the dimensions of the process man. Why have the prefabricated designs been irresponsible and incompetent? It is because consideration of the total logistic involvement was initially deferred or ignored, or ignorantly missed in the "gold rush" attempts to exploit rather than to scientifically process the potentials of the greatest historical realization of the principles of the industrial complex.

Logistics are concerned with the total energy involvements. In the language of the most eminent spokesman for the pure science aspects of logistics, total energy in-

volvement is stated as $E = mc^2$. $E = mc^2$ reads: The physical universe is energy and total energy is disposed in inseparable yet reciprocal transformations of principle as for instance mass and velocity (of light). The reciprocals of velocity are further interpolated by man into time and space and matter interactions. The science of logistics converts all its energy formulas to ultimate range and frequency of hitting power at earth crust or immediate vicinity. Pure science as represented by Dr. Einstein, although dealing in the identical components of an all-energy universe as applied to astronomy did not originally contemplate the conversion of the formula to "hitting power."

Now the same original data regarding transformation of all-energy universe may be translated into a third equation, that of everyday economics. We are familiar with this potential in the language of capital and income investment in the myriad economic factors of man hours, kilowatts, tonnage and machines. But it should be an obvious requirement of scientific integrity that the formula cannot be effectively applied except in the terms of a comprehensive design which holds all reciprocal factors in continuous review.

The original Einstein formula expanded into its everyday industrial-social applications must of necessity involve breakdown into a multiplicity of reciprocal components. Of course business men and industrialists have not thought of their undertakings as attempts to "expand the Einstein formula into everyday economics" and would vehemently deny the "possibility." But translated expansion of the fundamental formula of Physical Universe is nonetheless inherent in the scientific pacing of industrial evolution.

It is common fallacy to attempt simplification of the total formula by dropping out seemingly minor components of the expanded expressions. It is a theory of management to "thin out" the comprehensive into seaming discontinuities where isolation breeds quick familiarity by simplified occupation. It is an inevitable hazard inherent in the advantage of industrial specialization that the specialists in remote components tend to offset the overall advantage by appraising the function of one another as irrelevant. The challenge which we are taking up at this meeting is that of competent reintegration in design of the expanded fundamental energy equation. If technologists now lack confidence in scientific method as applied to man's housing that too is a component of the "original adequate statement of the problem."

After original statement of a priori general principles of methodology comes the establishment of a comprehensive family of working assumptions unique to the specific problem. For example, we may assume as a most comprehensive statement of the negative aspect of the problem housing, the assertion of Mr. Edward Stettenius, written immediately after serving as Secretary of State of the United States, and as Chief of the U.S. Delegation to the charter convention of the United Nations and contained in a letter to Mr. Fuller, to wit: One-third of the human family ($1/3 \times 2,300,000,000 = 800,000,000$) are now doomed to premature death due to causes arising directly from inadequate solution of the housing problem. This statement is pointed up by the latest U. N. report: i.e., there was a net catastrophic war loss of fourteen million homes the families for which still exist. There were additional millions of homes demolished by war but the families were lost with them. This "catastrophic loss" is in addition to the evaporation of housing capacity in Europe as a result of rate of population increase greater than new building velocity, aggravated by obsolescence and deterioration of pre-industrial crafts, etc. It is authoritatively stated that there is no means of solving this "catastrophic" problem within the life span of the people involved. This one European category of "unsolvable" housing problems alone accounts for one hundred million of the eight hundred doomed millions of the world as indicated by Stettenius. When this and

other appropriate comprehensive assumptions of controlling factors and objectives of the program have been adopted, we next define the governing principles, as for instance the functions of: (1) THE INDUSTRIAL COMPLEX, (2) SCIENCE, (3) ENGINEERING, (4) DESIGN, each predicated on measured behavior and not upon wishful theory.

(1) FUNCTIONS OF INDUSTRY

The following is typical of the family of definitions of principles which together comprise the Industrial Complex: "Industry means schematic organization of effort into teamwork of specialized functions which interact to provide total survival means and values for man superior to the sum derivable from individual effort." For example, if each of the fifty million employed citizens of the U. S. attempted to budget his time today in such a manner as to personally produce his family's needs in foods, nuts, bolts, clothing, education, news, transportation and communication et al, without lowering the performance standards of his living condition, he would have but an ultra split second to apportion to any one item. It is seen that if the individual found it necessary to support his family single-handedly he would be forced to lower the standards of required performance to a minimum so as to allow continuity of effort within any one category adequate to fulfillment of the natural processes of each category. This obviously precludes the availability of the ever higher standards of survival performance that accrues to the coordinated patterns of ever more deeply penetrating special knowledge and continuity of experimentation and production in the industrial advance.

It is quickly seen that industrialization is not to be considered here in the light of arbitrary commercial exploitation but as a mathematical principle inherent in the universe. This principle which we have singled out as typical may be categorically identified as the principle of Synergy (cooperative action of discrete agencies such that the total effect is greater than the sum of two or more effects taken independently, Merriam Webster). The functioning of Industry is inclusive.

(2) FUNCTION OF SCIENCE

Typical of our assumed definitions regarding Science is that: "the function of Science is to prospect for total society by taking the universe apart, i. e., resolve it into primary factors and elements by progressive isolation and subsequently to effect precise measurements of the behavior characteristics of the isolated events or components."

For example, Science isolated the phenomenon fire from extraneous factors and by isolating the constituent events and the product of events discovered that fire is not in itself an element but an accelerated combining process of a newly recognized primary element, i.e. oxygen, combining with carbohydrates in ever constant arithmetical proportion. Thus the isolation of the "fire" caused the subsequent isolation, recognition and naming of the new elements "oxygen" and "hydrogen," and provided behavior measurements of the latter by which man could predict events of combustion in such a way as to make combustion an accurate tool of technical advantage. As water and water vapor are H₂O events the comprehensive event was a precise mathematical process. This was the beginning of purposefully-produced steam as a tool. It was essentially a victory of chemical sciences and not of mechanics as we have popularly supposed. However the functions of Science ended with the separating-out of the newly discovered chemical elements from the universal matrix and with the measurement of the unique behavior characteristics of the respective elements, (it being the unique behavior that constitutes elementality). It is readily seen that the present invocation of Science to put together again the world it has taken apart, is futile in principle. Summarizing, it is the essential function of Science to take the universe apart and measure the parts and sort them into usable categories. The functioning of Science is exclusive.

(3) FUNCTIONS OF DESIGN

It has been demonstrated that the function of Design in society is to make original assumptions for the schematic employment of the appropriate behavior characteristics of selected items of the by-Science-separated constituents of the universe and to apply the new degrees of technical advantage to the evolutionary problems of the process broadly defined as "Man." This combining of the potential and the problem by Design is possible because the many events of the process "Man" have also been separated out and measured by Science. Though Man's ego claimed a permanence exempt from all natural processes of his environment, he has come to an embryonic realization of the inter-penetrating extent of the psycho-physiological processes with the dynamics of the organic and inorganic environment. Rather than being a purposeful static "thing," he is now a purposeful dynamic "process." In summary, Design puts together combinations of special behavior elements to arrive at special advantages for the special process "Man." It is through Design that man has evolved to his present extended manipulation of environment. The functioning of Design is comprehensive.

For example, of Design initiative we discover that while chromium has one set of behavior characteristics and nickel and iron still others, the association of the three in unique mathematical proportions provides a combined behavior pattern of superior performance in resistance to tension and impact in contrast to the behavior of any of its constituent parts (while also preventing oxidization of the iron, i.e. its combustion). It can be seen that the principle of association of special categories of behavior to effectuate desirable Synergisms is indicated not only in the definition of our principle "Industry" as human teamwork but also as a principle in itself governing both organic and inorganic factors. This is why we define Synergy as a Universal Principle. Design must imagine and discern, assume, purpose and attempt articulation, in as informed a manner as possible. Design, however, cannot guarantee its results. Borderline or failure point activity provides pivotal data for the efficient designer.

Failure in Design is honourable, in Science and Engineering it is found to be a mark of incompetence and failure in Politics and Finance is ruinous. It can be seen that when Finance and politics have authority with the management of Design, they continually want to terminate progress because in applying self-perpetuating traditional standards they disqualify the designer in the very practice of the qualifying phenomena that might measurably increase total human wealth. In short, Design represents the point where man sticks his neck out and first attempts to use his scientific potential.

In connection with the concept of the designer's sticking his neck out on behalf of society to increase commonwealth we are in need of a clear definition of wealth,-- for we do not mean that the designer should stick his neck out by issuing his own coinage. We define "wealth" as the measurable degree of predictable command of forward conditions of environment and process requirement,--control of man by man. Housing considered as a multiple-purpose tool embraces the major wealth factors. As housing is comprehensive to wealth, the deterioration of systematic means of housing constitutes deterioration of wealth and signals termination of predictable controls of forwardly necessary circumstance and event--ergo, chaos.

(4) The behavior pattern of Engineering indicates that it functions not at the original Design level but as an inverted phase of Science. Engineering, is the judicial authority that never assumes the initiative but decides and proves the assertions of Science and Design. Engineering thus establishes reliable data on the failure limits of complex associations and also measures the new compounded behavior characteristics discovered by Design initiative. Thus, Engineering rapidly places on inventory comprehensive data pertaining to the known behavior characteristics of complex

associations previously undertaken by Design. These complex associations may be broadly defined as alloys, structures, mechanics, processes and services. It is a function of Engineering to provide society with reliable predictions as to the behavior characteristics of complex designs predicated on competent experience. Engineering, then, consolidates the net gains of Science and Design within the Industrial Complex.

THE PSYCHOLOGICAL WEATHER IS FAVORABLE

It must be emphasized that there need not be any inferiority complex in tackling housing in highest principles, i.e. inferiority regarding popular, financial or political support. In fact, there ought not be any inferiority at all. We might go further, and say, "If any inferiority is in evidence, failure is certain." Only the most daring elevation of the sights can possibly hit the vastly ranging target.

The target is vast ranging because it involves upping the standards of living for people all over the world with such acceleration as to avoid world disaster inherent in the general chaos self-eroding to effect a premature death for one-third of the human family. Like the controlled missile, it is better to launch the projectile vertically until it gains enough altitude to be directed with minimum effort and maximum precision to its omnidirectional target.

In support of this admonition it is to be noted that the next war will be the first in all history in which there will be no front,--it is total, i.e. controlled from anywhere, missiles may be remotely launched and guided to any target. The man controlling the missile will be located alongside the man making the missile and alongside the men who are feeding and housing the men making and guiding the missile. Front, home and factory are one!

Because Science is universally permeative, the probability indicates offensive parity in a total war of controlled long-distance missiles. Therefore, it is mathematically probable that the winner will be that side which has the most effective defense. Effective defense is spelled out in terms of superior degrees of deployment ability,--from "vulnerable" magnitudes of population concentrations. (For instance, as stated February 9, 1949 by U. S. National Resources Planning Commission, cities of 50,000 and under are too small for economic expenditure of enemy hitting power.)

When the population concentrations of animate and inanimate components of the Industrial Complex are reduced below "payoff" magnitudes in offensive strategy, the battle is won (temporarily, for we now know life to be dynamic and progressive), i.e. "checkmate" is called. At which tactical event, the checkmated, while racing to uncheck through adequate degrees of decentralization, may cover with a counter-offensive by calling out, "I have a new missile available in far larger numbers which may be expended economically on hitherto invulnerable population concentrations." Obviously the progression, checkmating and countercheckmating, will be one of increased technical ability to fire economically at smaller and smaller population concentrations. And, inasmuch as the defensive tactics represent "the upper hand" to be maintained in the dynamic equilibrium of ever-impending shooting totality, the winning technique must devolve upon ever superior deployment of ever superior deployment of ever higher standards of living facility.

These principles of the strategy are well known to both sides. For the first time in history, housing has been tacitly advanced to the front ranks of logistic priorities. In all past wars, housing has been the one item with no priorities. Housing has never had priority even in the peace-time offensives of exploitation of the land.

Housing has always been bulked up from the residual and unwanted surpluses, i.e. of low performance residues, for example, farm-housing was built of the wood and stone first cleared from the land for the priority event of planting of seed to impound the sun wealth increment as food energy for the annual needs. The agricultural sun energy increments constituted the essential wealth augmentation of man in the past with frequent excesses to be traded for participation in the Industrial Complex. In every instance, war or peace, housing involved "making the best of a poor deal." The wood though valuable as a chemical resource for high performance constituents such as alcohol, pulp, rayon, made a poor housing material in its performance against fire, termites, bacterial rot, etc. The uses for which wood was specifically needed in housing represented wood's performance characteristics at the lowest order of magnitude.

It is not known what the case is in Russia as of February 1949, regarding housing, but in the case of America, it is evident that as a result of the entirely new emphasis on defensive supremacy inherent in housing, the latter has been advanced to the top priority brackets. Accelerated production of housing is, of course, needed for obvious peace-time function, i.e. to augment the population increase and to replace the annual losses (in addition to floods, earthquakes, fire tornado, etc.) the total velocities of which known practices have now proven inadequate to solve. However, beyond its historical function, housing is now required to deploy the Whole of the population and instantly, --not just to the outskirts of present cities but is deep decentralization upon the unbroken land, far beyond the practical limits of extension of the grouped, piped and wired supply systems. Rehousing of the whole world or additional housing for the peoples of the world is implicit in the trends to accommodate accelerating range and frequency of oscillations by man between the interacting functions of deployment and concentration characterizing the evolving Industrial Complex. This means new housing for 2,300,000,000 within decades. Yet, the largest production of single family or deployed dwellings ever produced in one year by the U. S. was 280,000 houses in 1925.

Obviously an entirely new use of the scientific potential must be made by the designers to amplify at least one-hundred-fold the velocity of the cubage to be annually put under control.

This advance of housing to military priority is augmented by its concomitant advance in political strategy. The unique result of the first four post-war years during which man has given himself realistically to total thinking, is that, the political will of the majority as expressed by the U. S. has been resolved into one paragraph and surfaced through the political mechanics to eventual announcement by Truman under the slogan of "a fair deal for all the world" and specifically to be realized by "converting the scientific potential to upping the living standards of the world through Technology." This was immediately echoed by Bevin. The significance of its intent may be detected by the fact of its announcement in the face of the epochal reorientation of approximately one-third of the human family to alignment with communism in the China scene.

This epochal event was resultant to the expiration of the theory of the absolute power of money. In the total scene with a third of the human family doomed through the inadequacies of housing, it was discovered that it is senseless to dump billions of dollars into Europe or China. These sums of money are merely digits stripped of immediate survival reality. The fact that 5,000 people died in Shanghai during January 1949, from exposure alone, not counting those dying of starvation, negates any help sent in the form of food or money. They needed a shield from the ravages of the elements. People are corrupt only when no emergency threatens. They will not dive for gold or jewels when the ship is sinking mid-ocean.

They abandon intrinsics for functionals in the supreme test. They will only dive for buoyant objects. In the present world emergency the advantages of the Industrial Complex represent the only buoyant object which the people of the world know may effect their rescue within their durable limits, i.e. they know there exist accelerating factors of technical advantage within the present potential of the Industrial Complex adequate to cope with their plight. But, they know the Industrial Complex must be harnessed to world-wide advancement of living standards and at the logistic magnitude and velocity of total war,--if their rescue is to be effected.

The military reconnaissance party has taught the peoples of the world how the vast potential of the Industrial Complex may be employed to effectuate specific advantages and also how dramatically effective its logistics can be under emergency requirements. As for instance, it clambered out of the sea as giant metallic monsters to climb the beaches of the amazed inhabitants of Pacific Islands, laying flat the trees and lands of those unconsulted world citizens, and layed out magic mile-long carpets in the jungle upon which descended metal birds larger than whales in unending flow, from all of which emerged simple human beings who took the little jungle boy for a ride and gave him a coke and sandwich. This, said the jungle boy and the people of the world, is the way to handle affairs.

Through the Truman proclamation "fair deal for all the world," democracy then puts the world on notice that it is reorienting individual initiative and enterprise as well as the sum total Industrial Complex toward fulfillment of the doctrine of Universal Right to Survive. This constitutes a complete reorientation of democratic precedent. It removes primary survival from the laissez-faire doctrine of "survival only for the fittest."

Russia has in the past, in conformity with broad historic precedent, continued its housing in the non-priority category and has focused all priority on technical requirements of the offensive. Russian engineers, though early interested in the potential commonwealth gains of the Dymaxion House, could not utilize its benefits because housing had no priority in any of Russia's first five of the successive five-year plans. Everything pertaining to industrial supremacy was on high priority and the upping of housing standards was continually deferred until the completion of the ever expected "next" military conflict. It was reasoned by them that sixteen million people were in excess of any food or work accommodation and were unavoidably scheduled to die. "We have an over abundance of people and trees." Therefore, the surplus people, too old and ignorant to reform, were doomed and treated as national heroes. If they willed, they could live out their lives in contrivances of the surplus wood designed in the most ignorantly satisfying traditional architecture, despite the latter's incongruity to modern engineering and science which pervaded Russia's industrial frontiers. In the race for worldwide industrial supremacy, and with the education of necessity on top priority, Russia upped literacy percentage of its total population from the world's lowest in 1917 to its highest by 1940: But, to do so, also wiped out sixteen million aged or hopeless illiterate.

At the present junction of events, the Soviets have been tactically surprised by the U. S. peoples announcement of a "Fair deal for all the world" to be realized through technology and applied to upping living standards. (Supplanting U. S. "dollar diplomacy.") It is to be noted that this tactical notice to the world was voiced by the now Democratic "outs," who for centuries had ruled the heavy majority of world population.

In order to meet such challenge, and counter-attack for the world leadership initiative, Russia has now put the world on notice that it too intends to apply the Industrial Complex to upping the standards of living. However, seeking to avoid in-

ference of luxury, Russian official newspapers demand that Soviet industry produce more household gadgets for the housewife in order to free her time, energy and intellectual initiative for augmented factory output. There had always been a need for this greater efficiency in Russia, but political priority had hitherto focused such efficiency only upon the direct needs of "the next war" and its immediately supporting heavy industry.

This first concession by the U. S. S. R. to a higher popular living standard,--to be effected through investment of the high industrial potential was followed up a week later by the further Russian announcement of general reductions in all major living costs ranging from 25% to 30%. This latter move in the world chess game was to offset the effect upon the world family of the news regarding general price recession in the U. S. A. effected without lowering of wages. This recession constituted a trend so contrary to Russian expectation as long proclaimed in their official propaganda line, as to occasion public censure by Russia of its economic scientists for having foretold economic chaos for the U.S.A. as inherent in runaway inflation.

Thus the tide of the cold war has swung to a battle for popular conviction on the part of world peoples that: the practical objectives of the warring factions each holds greater promise of realization of economic salvation and subsequent advancement inherent in the principle industrialization as uniquely fostered by their respective political systems. Biggest guns of this cold war exchange, eventually must be a barrage of production of scientific dwelling machines as constituting the comprehensive package of higher standards promotion. Ergo,--world economic preoccupation with competitive fostering of the new phase of worldwide industry,--housing. Upshot of this new preoccupation is progressive reduction of probability of further shooting wars.

During World War II, the entire Russian industrial organization was removed twice and over great distances. Since World War II, it has been moved once more. The exact location of Russia is no longer known. Without precise knowledge of geographical location, the expenditure of long-distance controlled missiles cannot be afforded. This works both ways.

As Russia has already incepted the third deployment of industry, it will have to deploy its population to serve the deployed industry, while at the same time eliminating its vulnerable population densities. Russia will need high standard housing and housing mechanics on a vast scale to effect this deployment. Therefore, for the first time in history it is evidenced that housing has been advanced from a non-priority status either in war or peace to first priority position in both. As the New York Times states, Sunday, January 23, 1949, "It is now evident that no known practices of the construction art can cope with the housing problem." The sights for scientific research and housing cannot be set too high. We need one-quarter of a billion houses of high standard mechanics at once!

As we proof these notes, Walter Reuther, President of the CIO-UAW, urged the U.S.A. Congress and the nation in general to inaugurate the production of 20,000,000 houses within the country's aircraft plants. Though an enormous advance of the target magnitude in housing production (from the annual craft record of 280,000), Reuther's figure represents but 8% of the total world rehousing program implicit in the now visible trend. The generation of these facilities from out the universal potential involves a magnitude of wealth-making not only hitherto undreamed of, but quite adequate to the total world commonwealth needs for centuries to come.

To the many, such an acceleration in building velocity would seem impractical,--incredulous. However, during the last week (March 1 to 7, 1949) the following are among the technical accelerations which have occurred: Our children's toy auto speed record was upped from 148 miles per hour to 310 miles per hour; as a six-year old child with walkie-talkie relayed his commands by remote control to his mechanically propelled airplane model, while the grown-ups circumvented the globe in non-stop flight in 94 hours. And the species, man, jumped twice as high. We do not mean that he increased his high-jump record from the six foot range to the twelve foot range, but that he jumped his advanced vehicle, the rocket, from a 120 mile height to a 250 mile height. In keeping with the new stride, the astronomers announced that the inspectable range of universe had been doubled, i.e. to a distance of one billion light years,--an eight-fold volumetric increase.

Only these research and development activities which can effectively employ billions of dollars can possibly engage the public credit. Q. E. D.