



Professor Buckminster Fuller lecturing.

## SUPPLEMENTARY PAPERS

### 1. THE PROSPECTS OF HUMANITY: 1965-1985\*

R. Buckminster Fuller

The scriptures were right and now the meek *have* inherited the Earth. But they don't know it. Though irrevocable, the will has not as yet been finally probated in the court of public comprehension. The will says «The prospects for humanity are metabolically excellent, intensely interesting, culturally fabulous and of ever greater intellectual challenge».

The will, it must be noted however, makes «all

of humanity» its beneficiary. It does not favour and does not promise unique prosperity for any exclusive blocs of humanity. For the professional secretariat of the Daughters of the Punic Wars; for political spoils systems; for national sovereignties; for annual trade balancing with gold and its concomitant monetary exchange depressions and resultant human wage and purchasing power inequities; for any negative social, economic or psychological differentiations of human origins or colour; for might-makes-right; for purchasable accoutrements, architecture, equipment, and

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gadgets of *distinction*; and for the plethora of behavioral obnoxiousness imposed, or induced by the supposed inexorability of the Malthus-Darwin theorem of «survival only for the slickest fittest» it is «curtains».

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

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

If you have an anatomical or mental disorder the chances of repair will be enhanced greatly but will not be certifiable for instant cure. You and many another may remain in physical pain and mental anguish for some time to come.

It is an easy matter to foresee the trend of physically dramatic events of the next twenty one year generation. Of course we will go to the moon and start communicating with humans in other parts of universe and open up entirely unexpected new realisations of the significance of man in universe. We will probably learn that Darwin was wrong and that man came to Earth from another planet and that monkeys are hybrids degenerated by over long local inbreeding of humans. We will penetrate the ocean depths thus enlarging our world threefold. We will be floating large colonies of humans around the world in tensegrity geodesic cloud-island spheres taxi-serviced by helicopters. And, because every action has its reaction, as we accomplish new magnitude capabilities, million-folding our forward undertakings in time, so will we million-fold our knowledge backward in time. The archaeological, anthropological and ecological findings will be as stimulating to mankind as will the forwardly planable time capability and the micro macro cosmic expansion of knowledge and its realized technology.

Within the next twenty years «Anything Buck (Rogers) can do, we will do better», whether it be strapping on our jet-stilts knap-sack and jumping Peter Pan-wise to our office window ledge (properly dressed of course) and winging outward and homeward by automatically steered, collision

avoiding, beam controls as we converse over satellite relayed, private-beam television with anyone, anywhere around the world or in space.

If you don't credit this forecasting, witness the startling rate of contracture between man's successive historical advances in circumnavigation of the earth, in progressively developed controlled environments which most effectively manifest his technical evolution as progressively realized from his original pure science gains. His first known circumnavigation of Earth is in a wooden sailing ship, circa 1500. His second advance circumnavigation is by steel steam ship in the mid-nineteenth century. His third break-through circumnavigation is by aluminium airplane in the late nineteen thirties. His fourth circumnavigation break-through is in a super alloy rocket capsule in 1958. The respective circumnavigations elapsed time records of (approximately) 3 years by sailing ship, 3 months by steel steamship, 3 days by aluminium airplane, and an hour by rocket capsule, altogether clearly show that by 1985 anything of which you can dream can and will have happened and that man will be living in an entirely new and responsibly conscious relationship to universe. I could go on to put meat and muscle on the bones of such forecasting but since the comics and science fiction have made the coming actualities physically anti-climatic I find it much more rewarding to consider how we may be getting from here to there in the familiar terms of day-to-day economic, political and cultural reorientations and to speculate on how the latter may come about. To do this I must take inventory of emerging trends which seem significant.

*Trend No. 1.* Medical science, through development of interchangeable human parts, both organic and inorganic, may be about to develop the continuous or deathless man. Medical science is concerned with rendering the integral, mostly *internal*, corporeal *organisms* of man ever more successfully adequate to the evolving life environment. The architectural scientist now has become concerned with rendering the extra corporeal, *external organisms of man*—the world network of industrialization—evermore successfully adequate to the evolving environment. This is being accomplished through a ten year programme of five two year, priority ordered, design phase increments which will accomplish comprehensively re-designed use of the total world resources in such a manner that the continually decreasing per-capita, physical resources of the earth, which now serve only 44% of humanity with high industrial network advantage will be made to serve 100% of humanity at a higher standard of living than has ever been known anywhere by anybody. This is to be done by broad introduction of higher performance techniques per units of invested resources, for simple instances, by substituting

wireless for wire in communicating systems, or by scrapping all the two ton prestige automobiles and producing out of the recovered metals twice as many one ton cars of higher operating economy and closer parking capability.

Most importantly it is to be realized that in response to the automation engendered unemployment problem this design science revolution may be acceleratingly accomplished by paying everyone to go back to school, college, university and research and development laboratories, leaving physical production to ever increasing automation. This is what will finally be done anyway by emergency measures to cope with unemployment, poverty, earnings and buying power problems. The architectural scientists' initiative will so accelerate the rate of wealth augmentation as to realize the full service to 100% of humanity by world industrialization, at the advanced standards of living by 1985. This is 15 years faster than it would inevitably have become accomplished through the roundabout method of applying design science first, and only to the armaments programme and waiting for the improved standards of living, for increased percentages of the population, to accrue only, as at present, as a bi-product of the armaments development wherein as weapons become progressively obsolete and their industrial producers look into the domestic field for chances to exploit their no longer government wanted relatively high performance, tooled-up technical capability.

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

Logically the students become exasperated and say «why can't we make the world work? All the negative nonsense is the consequence of outworn, ignorant biases of the old-timers. Let's join forces and set things to rights». Parading in multitudes the students demand that their respective political leaders take steps to bring about peace and plenty. The fallacy of this lies in their mistaken, age-old assumption that the problem is a political reform matter. The fact is that the politicians are faced with a vacuum and you can't reform a vacuum. The vacuum is the basic world condition of not enough to go around—not enough for even a

majority of mankind to survive more than half of its potential life span of years. It is a «you or me to the death» situation which from a political viewpoint of experience leads from impasse to ultimate show-down by arms with present politics firmly supported with ready armaments on both sides. Shooting revolutions will not produce goods, they destroy resources. More and more students around the world are learning of the new and surprising alternative to politics—the *design science revolution* which alone can solve the problem. The students are thrilled to realize that it is themselves they must turn to to make the world work, through practical use of their university science and technology resources and their laboratory supported design science efforts. The students know that they need no more license to invent the tools which will make the world work than did the Wright brothers need a license to invent the airplane. The student design science invention task is clear-cut. It is to up the overall mechanical efficiency of the world's present structures and mechanics as a network system from a present over efficiency of 4% to an overall of twelve percent which will take care of all humanity instead of only 40% of humanity. This is easy since overall efficiencies up to 80% are now practically feasible. The students know that if they invent the right tools and reduce them to practice that the tools will be used, «come» the right emergency. The students know that their design science revolution is bound to work because the emergencies which will foster its realization are already here. Their revolution is a bloodless revolution which brings peace in the only way it may ever become effective which is by elimination of the physical «wants» that have always hitherto underlain war.

*Trend No. 3.* There are now in the world several thousand powerful, high capacity, information storage, electronic computers. The number of them approximately doubles yearly. That means a quarter million of them by 1960, 250 million by 1980 and 8 billion by 1985, more than 2 per each world human. The computers both large and small are mathematical pattern cognition and recognition storage, retrieval and coordination machines of which the human brain is the prototype. As with the human brain all pattern processing consists of two main classes: *differentiation* and *integration*, i.e., *specialization* vs. *generalization*. Differentiation identifies, evaluates, selects, and separates out the uniquely developing patterns. Integration ratiocinates comprehensively the coordination rates and magnitudes of complex interactions, developments or transformations.

In the swiftly evolving computer world there are a few scientists who are both well informed concerning their art and have at the same time both the philosophic competence and intuitive inclination to write for us concerning the overall

significance of the brain-machine advances as they relate to the general scheme of life. I follow their literature closely. At the present moment the following constitutes the net cosmological and epistemological state of computer affairs.

To appreciate our state-of-computer-affairs digest we first must be aware that throughout the last fifteen years of computer development many philosophers have been disturbed by the claims of some cyberneticians that computers are soon to displace the human intellect's functioning in Universe. If instead of designating the intellect for obsolescence they had confined their prediction to the relative effectiveness of the complex functioning of the human brain, in respect to the computer, some of their claims might in time prove valid. For a long time the philosophers assumed that the computer could not ask original questions. They said that the computer can re-ask over and over again, in various ways, a question which man has taught it to ask.

Despite the philosophers' wishful predictions the computer has now demonstrated its ability to ask an original question—and it did so without being instructed to do so. Otherwise the question could not be assessed as «original». The surprise demonstration came about approximately as follows. You can teach a computer to play games, for instance—to play checkers. You can also teach a computer to play backgammon. You also can build a computer with enough parts to permit it to play both backgammon and checkers, at the same time,—as two separate game developments. Computers are actuated electronically at certain fundamental, cyclic-event, interval frequencies, wave-lengths and time rates. Computers are electro-magnetic oscillation systems each having its uniquely highest operation frequency. Computer frequency intervals are akin to wave-lengths.

Now, both backgammon and checkers are played at inherently different rates. The checker «man» moves are simple and direct. Backgammon is complex. You have to shake and roll the dice before you make the complicated backgammon «man» moves, and «exchanges». Therefore the same computer, playing both games concurrently, completes the checkers moves far more rapidly than the backgammon moves. The backgammon rate is not an even wave-length multiple of the checker rate. Therefore as with disynchronous, high frequency, twin motors there develops a secondary low frequency, intermittent recurrence of coincident phase cycles, or interferences. Suddenly the machine has to make both the checkers and backgammon moves at the same time. Because the computer has a given wave-length interval within which to make moves and the latter is too short to accommodate both moves simultaneously the machine has to decide which it will play first. In order to answer that question it

must ask itself and then decide «which is most important, checkers or backgammon?» The machine has to make the decision so, if it has stored enough information on variable factors including previous decisions data, it may soliloquise;—«Poor people play checkers and rich people play backgammon. I'd better cast my vote for the priority of backgammon because my memory storage also tells me that all the poor people are becoming rich and will emulate their conditioned reflex image of «being rich». From this moment onwards, rightly or wrongly, the machine's storage contains this prospero-proletarian predilection.

«Which is more important checkers or backgammon?» is an original question which had never been asked by man of himself or of the machine. We find that *original question asking is a consequence of interferences*, whether in the computer or the human brain. We find then that original questions are second derivative events in the computer life. Instruction to ask an original question is not entered into the original computer programming.

In relation to the computer and the present significance of its development, as judged by experts, as far as the machine's differentiating function is concerned it can be said that the *computer is about to make man obsolete as a specialist*, due to the fact that the machine can differentiate and seek out much more accurately, swiftly and persistently than can man. The computer can stay «up» all night, night after night, selecting the blacks from the whites at incredible speeds and under humanly intolerable conditions of heat, cold, smells, etc., yet never tire. That the machine is to replace man as a specialist, either in craft, muscle or brain work, is an epochal event. The computer as super-specialist produces, multiplies and administers «automation». Because man's intellect had inevitably to invent the computer and because the computer is super to man as a specialist—comprehensive world automation has always been developing inexorably and is not inexorably imminent.

When it comes to assessing the integration functioning of the same new, powerful computers I do not refer to several kinds of historically available «integrators» such as those long used by the designers of ships to calculate hull or sail dimensions. This integrating tool is attached to the base line of a drawing board. It has a track and a moving arm with which to trace the outline of a sail or a hull. The machine integrates the complex motions and, upon completion of tracing a perimeter of a ship's sail, you may read the sail area on a tabulator while at the same time a pointer will show the center of pressure on the sail. There have been very few of these useful Swiss integrators. The modern computers can integrate and differentiate, both simultaneously and non-simultaneously occurring, *event data*.

Having disposed of the differentiating, or specializing function of computers, what we next consider is the *function of integration* in an omnipurpose modern computer. The scientist-philosophers dealing in computers point out that inasmuch as original question asking is a consequence of interferences, and interferences in turn are products of time sequences, then it follows that *original questions are both functions and products of time*. There must be a great number of moves and a vast number of computer components before enough time has elapsed to develop new types of secondary or tertiary, etc., interferences which in turn may from time to time provoke original questions. The human brain as a computer mechanism consists of approximately a quadrillion times a quadrillion atoms in co-ordinate inter-patterning. It will be a very long time before man will be able to develop an extra corporeal computer with that many transistors, storage cells, etc. The experts point out also that dealing in integrative complexity, as a function of time, that the human brain always has been dealing in complexity and also has been integrating in a comprehensive historical continuity, due to the relaying of the individual, historical information regarding human experiences which is provided by the respectively different human genes patterns. The cumulative sum of conditioned, mated and progressively integrated reflexes developed in all men are carried on throughout the total adoptive evolution of man whereby a child cries or stands «instinctively» by inherited genes command. Therefore, the experts say, we would have to have man-made, machine computers running for a million years or so in order for them to develop an equivalently integrated complexity to that with which the human brain now copes,—integratively and sum totally,—as the (astronomical quantity) inventory of original-question-and-answer derived concepts which compound non-simultaneously to constitute human awareness of the ephemeral entity «Universe». In other words the experts do not see any immediate, or even far distant competition by the machine computer with the human brain in the functions of complex integration, ergo of generalized, comprehensive, coordination abilities. We can—and do,—have some very good, limited, and therefore secondary complexity, mechanical integrators but they are and will continue to be only secondarily resourceful «specialists». We can have an integrator calculating, designing and automatically manufacturing and putting together all sizes of our geodesic domes from children's playdomes to baseball park enclosures, assembling them in giant jigs, whence automated «sky-tug» helicopters will carry the domes away to install them and prepare them for instant human occupancy. But that would be a very low order of computer controlled complexity.

One important aspect of this automated geodesic-tensegrity dome service industry however is that it also will make possible a telephone, *service maintained* industry which will be able to provide telephone ordered, instant delivery, controlled environments for man-on-earth activities at one percent of the weight, time and energy resources per unit volume of specified standards of controlled space now involved in conventional suburbia and Park Avenue skyscraper building techniques.

All tools are externalizations and bodily detachments of originally integral functions of human being organisms. But externalized functions such as that of the cupped hand to hold water are capable when translated into ceramic cups, of holding hotter or more acid liquids than could the human hand. This is to say that the *limits of capability* of the externalized integral functioning are extended but are not unique.

Whereas the craft tools developed by man operated independently, the industrial tools develop interdependently. Realization of the machine lathe requires the blast furnace at some point and vice-versa. The industrial tools' regenerative development is coordinate. Industrialisation is organic. As the individual craft tools are the externalized counterpart of the individual's separate functions so too are the integrated functioning industrial tool net works the *organic externalization* of men's integral, metabolic regenerative functioning.

Man's internal organics are entirely automated. The whole process of life from conception through gestation to birth is entirely automated. After birth, despite parental ignorance of the process the child grows without knowing how from seven to seventy pounds and then as a youth often goes on from seventy to one hundred and seventy pounds. Biological growth is entirely automated. Man consciously loads the food into his mouth and from there on the subconscious processes of life are entirely automated. For at least two million years, millions of men have been reproducing and multiplying on a little wireless radiation supplied automated space ship called Earth, in an automated continual transformation process universe in which the entire process is so successfully designed that men did not even know that they were automated by regenerative passengers on a space ship and were so naive as to think that they had invented their own success.

Both the universal and the local ecological automation is so successfully designed as to allow man the luxury of thinking and acting «consciously» only in meager and often perverse degree and even of meddling with the evolutionary mechanism without putting the mechanism's multi degrees of freedom of action into jeopardy. Knot patterns (in rope) are fundamental mathematical principles and man can tie his affairs into local knots without in any way embarrassing his evolutionary and

subconscious metabolic regeneration, of which he knows approximately zero.

We, with our human-computer brains, will now consciously compound the previously related expert assessments of the mechanical computers' dual trend significances with other concurrent and important information.

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

What we now easily can see, also, is that men in our industrial and educational systems have become more and more specialized. Everyone, wanting economic security, has seemed to think that as a specialist he could command the toll gate of an expressway to unique and essential information. He thought: «A great many people will have to go through my specialization toll gate and I'll have a special education guaranteed economic security».

*Trend No. 5.* When we combine (a) the major trend of industrial society to increasing specialization, with (b) our knowledge that over-specialization leads to *extinction* we realize that an unwitting human trend to extinction was about to be realized as a consequence of our developed ability, through hyper-specialization in mathematical physics, to take the storm apart and thereafter to develop fission and fusion which the military specialist and political specialists automatically seized upon as rocket deliverable super bombs. The scientists as specializations victims knew naught of how to control the military, commercial, or political evolution of their special discoveries. The scientists have not known how to stop political man from developing or using the atomic bomb. Just as we are about to blow ourselves up we discover that *nature*—as the *a priori*, invention-inventor-total *universe*—had not only invented man but had invented man with a built-in safety factor, an automated self-destruction-arrester. The safety factor is the built in propensity not only to invent and develop tools of destruction but also inadvertently to invent constructive tools which render the destructive inventions obsolete, in this case the computer,

which was immediately adopted by the military specialist to control the interior and exterior performance of rocket weapons. Here comes the surprise. *The computer is now making man (approximately) obsolete as a specialist*. Therefore since it was *over-specialization* which was leading us towards self-extinction man had inadvertently invented his own anti-self-extinction device. First diverting man from becoming extinct through over-specialization the computer and its automation will go on to produce enough metabolic capability wealth to provide lavishly for all humanity thus eliminating the you-or-me-must-die corollary of the Malthus-Darwin quasi theorem of: *survival only-of-the-fittest* which precept underlay the modern *defensive war* rationale of all major nations and their weaponry development.

This means that the computers will soon eliminate war by providing enough wealth to supply all mankind, through the automation which they manage. To give man adequate «purchasing power» to keep industrialization in accelerated regeneration we will pay all of humanity to go back to the schools—to the universities—to the advanced scholar laboratories wherein they will generate the successive waves of progressively higher standards of living for humanity at ever less resource per function involvement permitting more and more of humanity to explore larger and larger ecological domains in universe.

*Trend No. 6.* Displaced as a specialist or differentiator, man is now being forced to become preoccupied exclusively with integrative patterning considerations. This means an epochal re-orientation. All the universities, all the educational systems from now on must forego specialization and cultivate powerful generalization. Everybody will be taught to be comprehensivists. Fortunately that will come naturally because man is born to be comprehensive. It is his most unique biological characteristic. As he cross-breeds he becomes more comprehensively adaptive. Only in-breeding brings specialized capability and then only at the cost of breeding-out, or loss of general adaptability.

Architects constitute the last species of professional comprehensivists for they try to put things together while the vast majority, who are specialists, have been concentrating on taking things apart. The trend of world students will henceforth be toward becoming architects that is comprehensive and cooperative design-science artists. Despite the cooperative development of universal comprehensivity individual men will remain inherently different by mathematical principles of evolution.

The historical turnabout of industrial society from specialization to comprehensivity is going to be difficult—even in our best universities and despite intuitive realization of the coming re-orientation already manifest here and there and

the consequent starting attempts to accommodate it by some of the world's intellectual leaders. The theory of education is as yet preoccupied with an even greater trend to specialization. The tenured and therefore non-dismissable professionals are almost incurably monofixed and committed to specialization.

A brand new type of university will force the old ones either to reorganize or become obsolete. The conditioned reflex disease of «Categoryitis» with which world society and its bureaucracy are now chronically infected is going to make the university's renaissance difficult. Universities will be vulnerable to displacement by the up-coming superior educational enterprises; e.g.—the U.S.A. and other major world governments will probably adjust the regenerative scheme of their disarming economies by giving multi-billion dollar contracts to the former armaments prime contractors such as Boeing, Douglas, Lockheed and General Dynamics which contracts will call for these super technology organizations and their top scientific staffs to apply their powerful problem solving capability to the new educational and communications problems of an exploding one-world and space-age society. To rationalize this strategy the prime contractor's lobbyists will make it evident that the prime armaments contractors now have all those brightest students graduated from the universities who in the past would have stayed on in the universities to become the regenerative teachers making the universities the supreme centers of knowledge. The big armaments contractors have become in effect the «super Graduate Schools» and have sequestered all the «classified» and unclassified advance information and are therefore, with their staffs, laboratories, computers, and young super executives in a preferable position to handle «Education» which now is destined to become history's largest and most durable industry. Today's universities must compete or die on the battle field of highest technological *staff, equipment, experience, concept, vision and realization capabilities.*

*Trend No. 7.* In order to understand the transition hazards of these compounding orientations we may also compound the computer catalyzed reorientation of man with another major trend. In the trends to disarmament mankind already has disclosed its joy at the accomplishment of only a token reversal of the weaponry race. Man now hopes his politicians can go further in the disarmament. The politicians feel that urge and though they are supposed to look out exclusively for their own respective sides, and not to look out for all men, the total world compulsion to disarm (and therefore to despise those who oppose or delay disarmament) is felt with increasing force. As a consequence the U.S.A. and the major world

powers will probably cut down, slowly, on their armaments.

Russia in her forty years of successive five and three year plans gave first-things-first priorities to all of the heavy industries and then to the lighter industries essential to war. Sixteen million deaths by starvation was the price Russia paid initially for the priorities disciplines without which she could not attain industrialization. Russia until the last has deferred turning the high productivity capability upon the direct raising of her people's standard of living. She is now determined to do so but is frustrated in so doing by the necessity to focus all the high productivity and product increments upon the continuing arms race with the U.S.A. Therefore Russia needs disarmament else she will not be able to continue to stall off the people's demand for the higher standard enjoyed by the Western world which latter standards seem to arouse Russian people and communists in general to ask whether their system is as proletarianly beneficial as the western world's system. But disarmament is stalled because the U.S.A. cannot keep its economy going through the prime and secondary «irrigation system» now fed at the top through the annual weaponry undertakings in general, without seemingly subscribing to «socialism». In wartime emergencies U.S.A. national takeover and management of all property and industrial economics activity is exempt from charges of «socialism», but by custom and law such centralized authority and appropriation is forbidden in peacetime, as constituting outright socialism. To avoid this embarrassment and to keep our U.S.A. economy, now far too large and too complex for private enterprise management without adoption of, or yielding to, out-and-out fascism, as a commercial monopolies autocracy, the war-time emergency powers were and are extended to the administration *to meet the threat of the war* and to «fight communism» because you cannot justify «next-war» war-emergency powers without an obviously «dangerous» and threatening enemy. This extension is called «cold war». The U.S.A. economy knows that the world needs and wants disarmament and that its U.S.A. «socialism» avoiding subterfuge becomes increasingly more evident to the rest of the world and ergo ever less tenable. The U.S.A. government and powerful Washington lobbies of the armaments contractors—supported by the labour unions in order to keep both capital and labour employment going—are seeking ways in which to keep the economic irrigation system fed from the federal top while also attaining progressive disarmament and avoidance of «socialism».

What is necessary to attain the foregoing conditions is to keep the 50-60 billion dollars annual expenditure in new rounds of technology (which we now call armaments) flowing to the prime

contractors. Thereafter the 50-60 billion dollars flows successively through the wages and dividends sluice-ways ten to twelve times annually. They irrigate all industries and business in succession, coming out as  $10-12 \times 50-60$  billion = the G.N.P. or gross national product of 600 billion-plus dollars whereafter we take out the original 50-60 billion in taxes and pour it in at the top again thus continually augmenting the total tooling-up of the metabolic regenerative system of industrial wealth augmentation. Every time the paper dollars run through the system the inventory of tooled-up capability to handle any production is improved and more energy is piped into the system.

Each time the dollars go through we get vastly richer. The «old timers» call this «spending». They need a course in semantics or better yet to learn to understand what industrial age *wealth* means. The major nations of the Earth invested *two and one half trillion dollars* in the development of the airplane during the fifty years following the Wright brothers invention. Since there is only forty billion dollars worth of minted gold in all the world, the wealth that developed the airplane was not the bankers' gold of yesterday. There is less than a gram of gold metal in any airplane assembly. The wealth employed by all the industrial nations of the earth is the ORGANIZED AND OPERATIVE METABOLIC CAPABILITY WEALTH. IT CONSISTS OF TWO BASIC INGREDIENTS, ENERGY AND INTELLIGENCE. The energy itself consists of two sub-ingredients—energy as electro-chemical «matter» and energy as electro-magnetic radiation. The physicists' law of conservation of energy states that «Energy may be neither created nor lost». The physicists are the authority for the irrefutable fact that *wealth cannot be lost*, ergo it cannot be spent which means lost. If any old timers want to argue send them to the physicists. Remember Einstein? Remember  $E = MC^2$ ? Remember fission and fusion which proved Einstein to be right? And the second ingredient of O.C.W. (operational capability wealth) is INTELLIGENCE. Every time intellect makes a physical experiment—INTELLECT LEARNS MORE. THE INTELLIGENCE INGREDIENT OF WEALTH CAN ONLY INCREASE. There you are—The Energy cannot be lost and *Intelligence* can only increase, therefore WEALTH IS IRREVERSIBLY AND INEXORABLY MULTIPLICATIVE. Invested O.C.W. regenerates multiplicatively. WEALTH CAN ONLY INCREASE.

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

*Trend No. 8.* Science having been employed almost exclusively in weapon development will find its scientists progressively unemployed both

by disarmament and phasing-out of all weaponry except the rocket delivered bombs. The weapons producing companies and the weapons support industries, direct and indirect, having high tool capabilities but dwindling contracts are going to struggle ruthlessly to find other profitable enterprises. They will move,—overnight,—into the livingry (vs. killingry) arts. We have already noted their probable move into «Education». Another most probable move of the prime armaments contractors is into the general domestic livingry arts and services usually and mistakenly spoken of as «housing», or sometimes as the «prefabricated house» and sometimes as the «industrialized autonomous housing service».

All you have to do is have a meeting with advanced industrial technology management to realize their inherent ineptitude in respect to the art and science governing the potentially evolving super standard, livingry service industry.

Talk about a «house» and the industrialists immediately think about stamping out an aluminium or plastic replica of a Cotswold Cottage, or they think of stamping out curtain walls or partitions. «You have to *stamp out* SOMETHING». That is as far as their advertisement and traditions conditioned brain patterning will permit them to reflex in the byways of categoryitis. The scientists' «house» catalyzed concept-reflexes are even less imaginative and useful. The carriage, railway and steamship industries of 1904 and their financial backers, directors and top industrial managements did not invent the airplane nor did the university professors, or the scientific societies invent the flying machine nor conceive of its vast world around ramifications in collateral electronics, in production and transport operations, etc. There is nothing in the present craft pattern of building and shelter contracting and materials manufacture that gives a clue to the ramifications of the up-coming world habitat service industry.

Just as prototype inventions were the keys to the establishment of the aeronautical industry so will prototype inventions be the key to the vast, new, world around, dynamic habitats, service industry. Many of the prototype inventions have already occurred. Others are developing in the U.S. and Russian man-in-space programs. What is most needed now is a clean *definition* of the functions of the world service industry that must be established to accommodate the up-coming *world-citizen*, requiring at times living facilities in culture university centres around the world, and at other times rest and nest facilities in remote places located all the way from the tropics to the poles, which permit man to be intimate to nature's every phase without being punished by the intimacy. A vast computer run, hotelling-dwelling service is involved.

If the «world's professional architects and

their professional societies are too slow in supporting their architectural students initiative in undertaking the scientific redesign of the world's facilities and *in defining the problem* then both industry and science will begin to panic and stumble into the livingry field and it will become an historical fiasco. That could easily happen within the next five years.

The world architectural profession has just about five years to get the architectural students and design-science students in general to develop the capabilities that they are going to have to take hold and maintain the world's industrial-economics' design-science initiative. Architects are going to have to give themselves powerful mathematical abilities. Fortunately our research discovery of the omni-rational arithmetic of the tetrahedrally coordinate, comprehensive, mathematical system employed by nature in all of her transformative inter accommodations has now become confirmed by many scientific events. It provides a ready-made and readily comprehensible mathematical means which is adequate to the historical design-science task of redesigning the world's tools and services. This coordinate mathematics will also close the C.P. Snow gap between the sciences and the humanities.

*Trend No. 9.* We must now consider other powerfully favourable historical factors. Between Russia and the United States six billion dollars have been appropriated to develop the little scientific house in which man will dwell in space or upon the moon. In this connection we note that though architects profess to be master solvers of space problems that they are not, however, commonly acknowledged as being sufficient masters of space problems to be called in either by the governmental space technology administrations or by the space contract industries nor by the political administrations representing the public and the public's opinion. Architects thus far have not been called into any part of the U.S.A. space programme. The professionals who have been called in are doctors for space medicine, physicists, mathematicians, geologists, psychologists, chemists, engineers, biologists; but no architects.

I am confident, from my direct experiments, exploration, invention and development in the scientific service industry's inception, that architects can be trained quickly enough and in such a way as to be much more effective in the space programme than are those scientists and businessmen who are now handling the programme. The new «architectural scientists» will be especially effective in defining the world embracing ecological problem and its industrial service solution, thus forestalling the fiasco implicit in the scientists', technologists' and Industrialists' pseudo-aesthetics weighed, mis-preconceptions.

I have familiarity with the space programme

in the United States and have found that the big contracts given out so far have gone only to large corporations who have dressed themselves up with large staffs of scientists in order to fortify their competitive lobbying versus the universities for awards of the «way-out» contracts. The space scientists, of the successful bidders for space contracts, are given the problem of how to develop the space dwelling. They are not design scientists—they are subjective scientists. Design science must be objective.

Scientists are inherently subjective operators; they are trained to make faithful observations and to theorize about the schemes of nature into which their data may fit, and thereafter to evolve experiments which either confirm or invalidate their theories. They are not trained to consider the significance of their findings, as objectively employable.

They are too specialized to comprehend complex integration potentials and industrial realizations. Alone amongst scientists the medical man is objective. Chemical engineers but not chemists are objective. Because of the majority of scientists' lack of objective and useful inventiveness, and competently designed reduction of inventions to useful practice I find that the space contracting corporations depending on their scientists to invent on demand are as yet groping futilely for solutions to a locally confined autonomous ecology's sustainable metabolic regeneration. When I have been called in by the big corporations as a consultant I have been amazed to discover how little they understand of what seems to me to be the critical need for a proper statement of both the scientific, structural, chemical and mechanical aspects of the scientific sky-dwelling problem, its effective solution and moreover of its implications in respect to subsequent low cost sewerage and water supply solutions for dwellings and human settlement of man right here on earth. The man-residing-in-space-problem is: To reduce the dimensions of the ecological energy exchange pattern of the man process of input-output, energy-matter-energy transformations from a multi-mile diameter tree - air - earth - worm - bird - bee - rain-wind, etc., relay system to a three-foot diameter closed circuit system of less than 500 pounds total—a thermo-electro-chemical process by which man will be able to sustain high health for twelve months without either «garbage» or «sewerage» disposal or without further supply input.

In his 1926 introduction «The Brave New World» Aldous Huxley discussed briefly a possible exception to the theme which his book developed of an intellect-void, romance vitiated, atheistic a humanity which in the near future probably would be promulgated only by computer decisions, regenerated in test tubes and identified only by robot numbers. However in his brief introduction

to his first editions Huxley hinted briefly at one possible, forlorn hope alternative to that unattractive fate for humanity. His hints inferred to me that a few leaders with powerful and power-giving conviction might arise to inspire mankind to recognize the a priori existence in universe of an intellect greater than that of man and a universally operative integrity guarding and guiding with comprehensive anticipation all the inadequacies of man. Mankind thus led would work through many crises to attain physical success in universe without any cost to the manifold human freedoms, or cost of individual joy in creative participation in the universal evolution. In his post-World War Two second edition of «Brave New World» Huxley revised the introduction. Almost a quarter century after the original publication, Aldous said that he tended to have a little more hope that his alternatively hinted but originally dismissed theme might be realizable. Again in his succeeding «Brave New World Revisited» his introduction disclosed an even greater hope that the happy alternative hint could occur and could become supreme. To me his hint inferred the rendering of the technological revolution to be as subconsciously and subsensorially subservient to our unified being and personality as are our present internal organisms, metabolic patternings invisible to the healthy human gestalt.

To me it is probable that if the world's architects do gain and maintain the world's design-science initiative Huxley's desirable alternative may be realized. If on the other hand the architects or the architectural students fail to gain the world's design-science initiative within the next five years through the students' world redesign activity—then the unemployed, world weaponry industry's overwhelming invasion of the education and livingry fields will occur, thereafter, trending swiftly to evolve into Huxley's awful dream. Such a nightmare would last several painful generations of man but I predict nonetheless that man will eventually sublimate his externalized organics (the world industrial network) as he now spontaneously sublimates, and renders both sub-subconscious and invisible his internal metabolic regeneration and its organic complex. Man usually forgets that he has an eye until he gets a cinder in it.

Why is it likely that if the weaponry industry and its scientist «slaves» take over the livingry industry that life will trend toward Huxley's unhappy dream? And why is it conversally probable that if the world's architectural toward Huxley's happy, but to him improbable dream? To start off with, industrial corporations, preoccupied with birds-in-the-hand, are too nearsighted while scientists with their long range, beam focused specialization are usually too farsighted. Industrial corporations and their advertising-company-develop-

ed, forward policies trend toward a plastic-flowered-heaven with sex-scented, automated, giggle and gasp, warm, moist, plastic, call-girl «angels». The scientistst tend toward test tube babies and deflation of the reproductive urge on the psychiatrist's couch. On the other hand architectural students are realistically idealistic. Through research, invention and development activities in which I have had a part the world's architectural students have a well-coordinated vision and a third of a century running start in bringing forth «what is needed». Political leaders are preoccupied exclusively with *their side's* advantage. Industrial corporations are preoccupied with immediate profits and not with total man's success. Corporations are interested only in «making money» while world students and especially architectural students are primarily interested in making world man a total physical, cultural and moral success.

Architectural students will in due course realize that they are designing an entire family of complementary instruments of livingry—similar in comprehensive functioning to the whole family of musical instruments. They will insist through design capability in providing man with the privilege of playing his own instruments and of composing his own symphonies for the whole family of livingry instruments. The new world architect will be wise enough to confine his design science to augmenting the integral organic functioning of man so well that the external organics may be coordinated to operate as unselfconsciously as do healthy men's internal organisms. The design-science artist (new world architect) will leave man free to articulate the promptings of his soul in such a manner that each individual may enjoy his newly won and ever-increasing degrees of the human individuals' exploratory and creative freedoms without inadvertently trespassing on one another and thus inter frustrating one another.

Optimism is usually thought of as constituting a mildly unwarranted hopefulness in respect to the future. But there is a reverse projection of optimism operative in the nostalgia-generated myths which extract only the rare and sublime moments of yesterday from their lowgrade ore matrix of negatives. Forgetting the negative matrix reverse optimism over-emphasizes the rare sublimities of yesterday and thus deliberately shuts its eyes to reality and is therefore unable to see the values immediatly present and everywhere extensive from now.

I, myself, am convinced that we are swiftly emerging from the abyssmal conformities of yesterday's illiterate, spit-punctuated profanity and monosyllabic verbalism wherein old age began at 20 and death *probably* came at 27. Where rags, filth, diseased bodies, prevalent stench, devastating superstition and local bias reigned supreme and ignorant conformity persisted in the concept

that individualism is attainable only through acquisition of physical distinctions and self-prestige acclaiming superficialities ergo purchasable if you are rich, grabbable if you are strong and quick, and extortable if you have either superior weapons or ruthless cunning in the use of blackmail and kidnapping.

Beginning with World War I, Science, Technology and high priority industry began the epochal and ever-accelerating shift of field from track to trackless, from wire to wireless, and from visible to invisible and from Newton's Norm of «at rest» and changelessness to Einstein's norm of constant, disynchronous, evolutionary transformations. Man entered into the vast ranges of the physical realities of the electro-magnetic spectrum. Within the electro-magnetic spectrum the to *man visible* light frequency band is exquisitely minute. At the present moment in history 99.9% of all of humanity's important physical evolution—scientific, technical, industrial and biological—as an extension of its communicable and operational consciousness, occurs in that major portion of universe with which man has had no direct sensorial tuning. This great evolutionary engagement of man with the non-sensorially apprehensible yet physical universe is achieved only through instrumental hook-up as an extension of man's faculties. Integrity of the instrumental functioning and integrity of recording of the four-year-old child whereof Christopher Morley wrote in 1922:

«The greatest poem ever known  
Is one all poets have outgrown  
The poetry, innate, untold,  
Of being only four years old.  
Still young enough to be a part  
Of nature's great impulsive heart,  
Born comrade of bird, beast and tree  
and unconscious as the bee—

And yet with lovely reason skilled  
Each day new paradise to build.  
Elate explorer of each sense,  
Without dismay, without pretence,  
In your unstained, transparent eyes  
There is no conscience, no surprise,  
Life's queer conundrums you accept  
Your strange divinity still kept.  
Being that now enthrals you,  
All harmonious, unit, integral,  
Will shed into perplexing bits,—  
Oh contradiction of the wits—  
And life that puts all things in rhyme  
May make you poet too, in time,  
But there were days, oh tender elf  
When you were poetry itself».

By my calculations there is mathematical probability that progressive mastery by man of the physical coordinates of nature and their progressive sublimation by man as separate categories, and subordination to total abstract concepts, may indeed be trending historically to permit the integral being of the child to remain unfractionated throughout the total life span. For instance, we are unaware of our own tongues until we bite them. When in health and «good form» the total myriad component functions of our physical-organic being are entirely subordinated to sub-consciously coordinated functions as commanded by the regenerative pattern integrity of the individual life. When life has departed both the radiant heat, the brain propagated energy waves, the radiance of being are alike gone. The full physical apparatus inventory the corpse remains—useless, reminiscent, but that is all. That is the way I read the data of man's significant exploring. I am convinced that creativity is not a man function and that it is a priori to the integrity of the non-simultaneously transformative universe and that life is both subjectively and objectively regenerative.