

The Fourth
Vikram Sarabhai Memorial Lectures

on

HUMANS IN UNIVERSE
[A 4000-word digest of the
20000-word presentation]

by

DR. R. BUCKMINSTER FULLER

on

15-16 December 1978

DR. VIKRAM A. SARABHAI AMA MEMORIAL TRUST
C/o Ahmedabad Management Association
Bank of India Building (third floor)
Bhadra, Ahmedabad 380 001, India

Dr. Vikram A. Sarabhai demonstrated in his life his conviction that the end of all scientific endeavour was peace, prosperity, and creativity. His vision of human society complemented his concept of holistic science. He used the tools of physical sciences but spoke the language of social sciences. Every activity he chose to initiate and every institution he created was of profound significance for a developing society and into every one of his endeavours, he breathed the rigour of a dedicated scientist and the sensitivity of a humanist. That his laboratory enveloped the entire community was amply demonstrated in his pioneering the management movement and applied industrial research.

One of the many institutions which had the good fortune to be touched by Dr. Sarabhai's dedicated spirit was Ahmedabad Management Association. He provided inspired leadership to AMA for the first four years as the President. AMA in its gratitude elected him as the first Honorary Member of the Association.

Today, to bring into the lives of Indian men and women the light of his spirit, the message of his life and fuller understanding of the nature of human existence, the Dr. Vikram A. Sarabhai Memorial Lecture is dedicated to his memory.

Objectives

- To perpetuate the memory of the late Dr. Vikram A. Sarabhai.
- To encourage Indian men and women to emulate in their own lives his dedication and perseverance towards human betterment.
- To honour men and women who, by their own efforts and application, make significant contribution to society, combining with a far-reaching humanist vision the rigour of the scientific method with the skills of organization and implementation.
- To promote by the awards the management movement in the country.

Board of Trustees : 1978-79

Mr. Nanubhai Amin

Mr. Prafull Anubhai

Dr. Umashankar Joshi

Mr. Harshavadan Mangaldas

Professor Ravi J. Matthai

Dr. P. C. Mehta

Dr. K. R. Ramanathan

Professor D. D. Trivedi (*Ex-Officio Chairman*)

Manager : Mr. K. S. B. Nayar

HUMANS IN UNIVERSE

Dr. R. Buckminster Fuller

The great intellectual integrity of universe saw fit to bless me with the friendship of Vikram Sarabhai. I am sure that this blessing occurred because of my life long concern with, study of and attempts of effectively instrument realisation of the potential, unique functionings of humans in universe. No one could have been more concerned with this comprehensive subject than Vikram. Many times he listened to me at length as in response to his questioning I inventoried what I have learned to date regarding humans in universe. Having honoured to deliver the Fourth Vikram Sarabhai Lecture, I am going to speak to you now as I spoke to him on that subject.

Thought of only as a flat world universe, seemingly stretching away to infinity in all lateral directions, the combined land areas of Europe, Asia, and the northern half of Africa embrace within their regional perimeters great bodies of water - the Mediterranean, Black, Caspian, Aral, Red, China, North, Arabian and Baltic Seas. The total area of this flat world constitutes less than 17% of the, only subsequently discovered to be spherical, planet Earth's surface.

All the great empires of Pre-1500 A.D.'s written history lay well within that "known" flat world. Starting with the surprisingly informative second century B.C. world map of Ptolemy all the pre-1500 A.D. comprehensive maps show the

world as just such a flat-out system surrounded by an infinite planar wilderness. This flat concept was and is as yet the theatre, of spontaneous popular historical conceptioning. This is manifest right now in such everyday expressions as "the wide wide world", "the four corners of the earth." "Up" and "down" are the parallel perpendiculars impinging upon this flatout world.

Scientifically speaking (which is truthfully speaking) there are no directions of up and down in Universe; there are only the angularly specifiable directions of "IN," "OUT" and "Around." Cut from Earth and into the Moon. Or into Mars. **IN** is always a specific direction. **OUT** is any direction. Don't let these facts give you a personal inferiority complex. Direct questioning of many large scientific audiences prove that all scientists as yet realistically "see" the sun going "down" in the evening though they have known for 500 years that this is untrue. Around the world nothing has ever been formally instituted in our educational systems to gear the human senses into spontaneous accord with our scientific knowledge. In fact much has been done fearfully by great world institutions to prevent such comprehension.

What changed this comprehensive and omni-pervading cosmic structure misconceptioning on the part of the world's power structure tacticians themselves? When the archaeologists artifact proven history of mathematics opens 4000 years ago in Babylon and Mesopotamia, that science was already a very sophisticated omni dimensional art. Mathematics may well have had its beginning much earlier in India, Indo-China or South-East Asia's water people for it is an art and science which has travelled consistently westward while also losing much of its earlier comprehensivity. Three thousand years ago the Greeks made many additional mathematical contributions but almost exclusively in plane geometry. Two thousand years ago the Holy Roman Empire all but obliterated mathematics thus producing the dark ages. A little more than a thousand years ago Arab and Hindu scientists travelling westward through North Africa began to restore some of the

mathematics to westwardly trending and progressively evolving new world cultures.

The ancient calculating device known today as the abacus is as yet a very practically useful tool. It consists of a number of vertical rods mounted in parallel in an open faced quadrangular frame. It has uniform increments of sliding beads premounted on the vertical rods. Very often the bead sets consist of five beads per rod mounted below an horizontal bar with two more beads mounted on each of the columns above the horizontal bar. This arrangement is suitable for decimal system calculations. Each bead above the bar on the same vertical rod equals five beads below the bar.

The beads in the first right hand column each equal one integer while each bead in the next leftward column equals ten. When reaching ten in the first column all beads in that column are cleared and one bead is moved into operation in the next leftward column. The single beads in the third leftward column each equal one hundred. In the next leftward each single bead equals one thousand and so it goes leftward column for as many powers of ten as is convenient for any known calculation requirement.

To enter the number seven you first elevate all five beads in the first right hand column to the horizontal bar. Since five beads below the bar equal one bead above the bar you now elevate one bead above the bar and clear the column below by lowering all five beads in that most rightward column. Because you want to express the number seven and now have the increment five manifest above the horizontal bar as one bead you now elevate two of the beads below the horizontal bar in that same righthand-most column you now have seven beads displayed.

If you now want to multiply the first column's seven by the number two you will elevate the remaining three beads in the lower righthand column which fills the lower righthand

column for a total of five. This causes you to elevate the second bead above the bar and to clear all five beads downward in the first column. Having ten above the bar in the righthand column causes you to elevate one bead in the next leftward column having a value of ten and to lower the two beads above the horizontal bar in the rightmost column. So far you have only accounted for three out of the second seven you are required to express so you elevate four beads in the lower righthand column. Your abacus now reads one in the ten's column and four in the one's column i.e. "fourteen".

The abacus thus provides a facile means of accumulating progressive products of multiplication by moving the products leftward.

Obviously products of even tens (SUCH AS TWENTY) leave the first righthand column empty. When the abacus user later developed symbols to express the contents of each column he had to invent a symbol for the empty column, that symbol became known to the Arabs as the sifr, to the Romans as cifra and to the English as cipher (our modern zero).

The Roman numerals were invented to enable completely illiterate servants to keep *SCORES* of one-by-one occurring events. Such would be standing by a gate and making a mark every time a lamb was driven through the lamb size gate. The more complex Roman numerals were those used by the supervisors keeping count by their fingers, a V for five and X for ten. Since one cannot see "no sheep" and cannot eat "no sheep" the Roman world seemingly had no need for a symbol for nothing. Only an abacus empty column could produce the experience that called for the invention of the ciphra.

Publication in Latin, in Carthage, North Africa, in 1200 A.D. of Al Kowarisai's 800 A.D. text elucidated the function of the ciphra (sere). It required two hundred more years for

this critical information to be diffused into Italy's and Southern Germany's University educational system. The ciphra made possible the positioning of numbers, which in turn facilitated enumeration of the products of "long" division and multiplication. Imagine multiplying or dividing with Roman numerals; impossible!

The calculating facility introduced by the ciphra empowered Copernicus', Kepler's, Galileo's, and Newton's work, but also occasioned the earlier reconceptioning by Columbus of terrestrial navigation concepts. The ciphering went on to instrument the structural and mechanical leverage calculation capabilities of Leonardo and thereafter the birth of structural and mechanical engineering and its intertensioning and compressioning calculations of the vessel's ribbed structural strength as well as of its vast wind energy driven complex of compression and tension spars, sails and rigging. Ship and land building had therefore been arrived at only by trial and error guesswork. This mathematical multiplication and division capability opened the whole new field of safely anticipated structural engineering and navigation. But this efficient anticipatory science, which made large engineering projects possible, became known to and employed only by the world's richest schemers, monarchs, nations and pirate enterprisers. No others could afford to buy great ships. The Leonardos were shunted by their powerful patrons from dryland architecture into naval architecture. With more powerfully engineered ships, humans emerged westward through Gibraltar, explored the Atlantic, rounded Africa, reached the Orient and the Pacific by water, then circumnavigated the globe. It became learned people's knowledge that the open edged infinite world system had closed back on itself in all circumferential directions to become a finite system — a closed sphere. Within that closed system the monarchs realized that whoever commanded the line of most efficient high seas supply became the masters of world wealth, ships could carry cargoes impossible for overland caravaning.

In 1600 the East India Company was founded as a private enterprise by Queen Elizabeth the First and a small group of her intimates. Their limited legal liability enterprise advantage was accomplished arbitrarily by royal decree and thereafter militarily sustained and protected by Great Britain's Royal Navy and colonial troops. In England the East India Company College was established to train the enterprise's world around deployed personnel. That East India Company College and its handsome campus are as yet in operation right now in 1978. Following the sea battle of Tratagra in 1805 the British Empire became the first supreme empire in history upon which it was said "the sun never set".

As Professor of Economics of the East India Company College, in 1800, Thomas Malthus was the first economic authority ever to receive in toto the world-embracing, spherical empire's vital statistics. In 1810, he confirmed and republished his 1800 discovery that humanity was indeed multiplying its numbers at a geometrical (exponential) rate of gain and increasing life support production only at an arithmetical rate of gain and since the Earth is—a closed system sphere—it was seemingly scientifically manifest that there is a fundamental inadequacy of human life support on our planet. Until then all opinions on such matters were pure guesses.

A third of a century after Malthus, Darwin attributed biological evolution to "survival only of the fittest species and of the individuals within the species". Though he denied any economic significance in his evolutionary theory, the economists insisted that superior physical fitness obviously governed economic survival as well. Karl Marx accepted both Malthus' and Darwin's scientific view-points and also said, "Clearly the working class is the fittest to survive. They know how to use the tools and cultivate the fields—the wealthy are parasites". This inaugurated the concept of two world around political classes and two dominant political system theories. (See footnote on the author's "No Race No Class" scientific findings of last 15 years.)

As a consequence of Malthus' and Darwin's discoveries, all the great political ideologies have ever since adopted a prime philosophy which says, "You may not like our political system but we are convinced that we have the fairest, most logical and ingenious method of coping with inherent terrestrial inadequacy of life support, but because there are others who disagree diametrically regarding the method of coping, it can only be determined by trial of armed might which political system is fittest to survive". Survival of the physically fittest became the basis for national departments of defense with the latter given prior access to the latest and most advanced science and technology in the use of all highest performance materials, brains, instruments, and production tools. This is the reason Russia and the United States for the last thirty years have jointly appropriated over 200 billion dollars annually, sum totally six trillion dollars, to buy ever more effective potential destruction of one another. Now the great abstract corporate power structures of big politics, big business, and big religion finding the geographical limitations of nations intolerable to their development have all exercised their non-corporeal advantage and vanishing abstractly through the national barriers have become supra national bodies. Meanwhile all the people have been made specialists and are being exploited by the supra national power organizations as the human individuals flounder bodily bound within the involuntarily existent passport, conscription, taxing, etc. restrictions of their respective 150 national pens.

Up to the 20th century, reality was everything humans could see, smell, touch and hear. Then at entry into the 20th century the electron was discovered. A century after Malthus' time, electronics, atomics, macro and micro exploring instruments, metallic alloying and chemical structuring by inter atomic repositionings introduced an era of invisible science which through structural rearranging of invisible atoms, produced ever greater, more powerful and incisive performances per each pound of the thus alloyed physical matter employed.

Structures are complexes of physical events, visible or invisible, interacting to produce stable patterns. Structural systems divide all universe into all the universe outside the structural systems — the macrocosm, and into all the universe inside the structural systems the microcosm. Newton's discovery of systems' interattractions showed that the interattraction force of atoms, planets, stars or galaxies increases exponentially as the interdistances decrease arithmetically and vice versa—halve the inter-distances and fourfold the inter-attractive integrity of the remotely bodies structural systems. That is the law of gravity.

Gravity is the tensively embracing, omni cohering force acting integratively on all systems. Radiation is the outwardly disintegrating force acting divisively upon all systems.

All structural systems always consist of tension and compression components. Stone masonry has a high compression resisting strength of 50,000 pound per square inch ultimate. Masonry has low tensional coherence. It can withstand only 50 pounds per square inch tensing. Masonry is 1000 times more effective in its resistance to compression than to tension.

Throughout the three million known Stone Age years of humanity, only gravity held human's vertical stone walls together until, as often, they were shaken apart by earthquakes against which they had almost no tensionally cohering resistance. Gravity pushed humanity's stone structures inward toward the Earth's centre. Humans had to build their structures on bedrock "shoes" to prevent their sinking vertically. Stone buildings could not float on water. Nature invented low weight wood of high self cohering tensile strength approximately 10,000 p.s.i. and of relatively low compression resistive capability i.e. approximately 10,000 p.s.i. also. Wood floated on water and could support and move useful light weight loads horizontally wood made good rafts for humans, but could not float heavy cargoes. High tensile strength per weight wood averaging 10,000 p.s.i. plus human discovery of structural inter-trussing

principles and the low overall displacement weights of air enclosing vessels, -lead to the development of highly successful, wooden cargo vessels of the sea.

In 1851 mass production steel - an alloy of iron, carbon and manganese - was accomplished which has a tensile strength of 50,000 pounds per square inch as well as a compression resisting capability of 50,000 p.s.i. Steel has the same compression resistance capability as masonry but had also 1000 times greater tensile capability than masonry and 5 times the tensile or compressive strength of wood. This brought mankind's structural tension capability to match steel and stone's previous millions of years of exclusive compressional supremacy. With far higher tensile strength per weight than wood, steel made possible even more powerful watertight air containing vessels than those of wood, even though steel by itself won't float.

Finally the metal producing science and technology began developing metal alloys of ever higher strength-per-weight ratios. Out of this came aluminium production at the opening of the 20th century. In 1930 aluminium alloys as well as stainless, unrustable steel were developed. Pure aluminium has a tensile strength of only 18,000 p.s.i. Alloys of the same weight doubled that strength in the 1930's and doubled it again in the 1940's. Out of alloys came the engine powered all metal airplanes (non floating structural vessels) pulling themselves angularly above the horizontal and ever more steeply aloft. With the accomplishment of successively ever higher strength per weight ratios of metal alloys and glass reinforced plastic materials, ever more heavily laden airplanes were designed which could climb ever more steeply and faster. Finally humans developed so much strength per weight of materials capability that they accomplished "vertol" jet plane flight and vertical space vehicle "blast-offs." Since then human scientists and machinists have developed ever greater useful load vehicles capable of vertical take-off at ever more accelerated rates of ascent.

As of 1978, human mind has developed alloys of one million pounds square inch tensile strength in laboratory, quantities and practical tensile capability in structuring space vehicles, of 600,000 p.s.i. The means of accomplishing this new and overwhelming structural strength reality has become entirely invisible. 99% of humanity has no idea that it has come about or how it had come about or why it works. While humans cannot see the ever lessening interatomic proximity rearrangement of atoms and electrons of electromagnetic events they can witness the ever more vertical take-off angle capabilities manifesting human comprehension on the part of "experts" concerning fundamental structuring principles and their profitable military and commercial development. But only vast money commending enterprises or governments can afford to exploit these capabilities.

Until the airplane humans said, "You cannot lift yourself by your bootstraps." Today we are lifting our ever lighter, stronger structural vessel "selves" by ever less effort of our scientific "know-how" boot straps. No economists know this. It is the most highly classified of military and private enterprise secrets. Both the latter convert the ever increasing work capacity per pound of materials invested to produce exclusive profit for the producers of the, killingly subsidized arts.

In 1978 we can state indisputably what is not even thought of by the opposed world power structures, i.e. that as a consequence of the myriad of more-with-less invisible technology gains of the 20th century, employing only well-proven technology and already mined and recirculated materials, it is technically feasible to retool and redirect world industry in such a manner that within ten years of design revolution we can have all humanity enjoying a sustainably higher living standard—with vastly increased degrees of freedom—than has ever been enjoyed by anyone in all history—during which ten year period we can also phase out all further use of fossil fuels and atomic energy, since the retooled world industry and individual energy needs will have

become completely supplied by our combined harvests of electromagnetic, photosynthetic, chemical and biologic products of the initially sun-and-gravity produced daily energy income.

The retooled world weaponry industry will rehouse the deployed phases of world humans by single family, air deliverable, energy harvesting, only rentable, dwelling machines. When humans are convergent, they will dwell in single domed over cities of the type known as the moon crater, "Old Man River" cities, these cities will be energy harvesting and exporting centres rather than energy sink holes.

All the foregoing makes it possible to say that since we now know that there is a sustainable abundance of life support and accommodation for all. It follows that all politics and warring are obsolete and invalid. We no longer need to rationalise selfishness. No one need ever again "earn a living." Further living for all humanity is cosmically prepaid.

Budyard Kipling, the late 19th and early 20th century artist-poet, lived and labored under the only-you-or-me philosophy but was intuitively inspired by thoughts that life might someday be otherwise.

'When Earth's last picture is painted
And the tubes are all twisted and dried
When the oldest of colors has faded
And the youngest of critics has died
He shall rest
And well we shall need to
Lie down for an eon or two
Till the master of all good workmen
Shall put us to work anew
Then only the master shall praise us
And only the master shall blame

And no one will work for money
And no one will work for fame
But all for the LOVE OF THE WORKING
And each in his separate star
Shall draw the thing as HE SEES IT —
For the God of things as they are”.

Why don't we exercise our epochal option? Governments are financed through taxation and would have no way of putting meters between the people and their directly received, individual, cosmic incomes. So, too, for private enterprise. All of Earthians' present power structures, political, religious, or private enterprise find their interests disastrously threatened by total human success. They are founded upon, organized, and supported by the lethal problems imposed by the assumption of fundamental inadequacies of life support.

Why does not the public itself demand realization of its design science revolution option? Firstly less than one percent of humanity's four billion population know of the option's existence.

99% of humanity cannot understand the mathematical language of science. The 99% do not know that all science has ever found out is that the physical universe consists technology of the most exquisitely reliable technology. 99% of humanity think of technology as something new. They identify technology only with modern weaponry and mechanical competition for their life sustaining jobs, ergo, humanity thinks it is against technology and thinks itself adverse to exercising its option.

Thus we learn that the prime barrier to 99% of humanity's discovery, comprehension, and spontaneous exercising of its option to attain universally sustainable physical success is the mathematical language of science. **Fortunately**, nature is **not** using the strictly imaginary and awkwardly unrealistic

coordinate system adopted by and taught by present day academic science.

Neither gaining nor losing any energy, nature's continuous self-regeneration is 100% efficient. Nature is not employing academic science's three dimensional, omni inter-perpendicular, parallel frame of X Y Z, coordinate axis references, including sciences subsequently adopted unique centimeter, gram, second and temperature qualifications. Nature does not operate in parallel. She operates in radiational divergence and gravitational convergence. She **grows** outwardly by omni-intertriangulated structuring from nuclei. Nature is inherently eight dimensional, the first four of which dimensions are the four planes of symmetry of the minimum structure of universe, the omni-triangulated, equi-vector edged tetrahedron. In respect to the conceptual pre-time-size tetrahedron's volume taken as **unity**, 1, with its six unit vector edge structuring, the always conceptual, independent of size, **family** of primitive, pre-time-size, least complex polyhedra have the following exact volumes: the vector triangulated cube 3, the octahedron 4, rhombic triacontrahedron 5, rhombic dodecabedron 6. When the size information is introduced it occurs only as frequency of modular subdivision of each unit vector structuring of the primitive family's respective 1,2,3,4,5 and 6 volumes. Frequency to the third power (F^3) values then multiply the primitive already four dimensional volumetric values. In real time-size each has therefore $4+3=7$ dimensions, but each system is inherently independent in universe and has spinnability, ergo, one more dimensional factor is required, making a total of eight dimensions in all for all experientially evidencible physical reality.

Nature is using this completely conceptual coordinate system which can be comprehended by anyone. Fortunately, the TV is spontaneously attractive and can be used to teach all the world's people nature's coordinating system, and do so in time to accommodate all humanity's favourably compre-

hending and exercising of its option to attain universal physical success and thereby to eliminate for evermore all world politics and competition for the right to live. The hydrogen atom does not have to compromise its function potential by first "earning a living" before functioning directly as an hydrogen atom.

Nature's coordinate system is called Synergetics — synergy means behaviour of whole systems unpredicted by any part of the system when considered only separately. There are two volumes published on the subject by Macmillan titled Synergetics Vol. One and Vol. Two. The eternally regenerative universe is synergetic. Humans have been included in this cosmic design as local universe information gathering and local problem solvers in support of the integrity of the eternal, 100% efficient, self regenerative system of universe. In support of their cosmic functioning humans were given their minds with which to discover and employ the generalised laws governing all the physical and metaphysical, omni-interaccommodative, ceaseless inter-transformings of universe. At present minds have been misused to develop personal and partisan advantages. Intellectual cunning and selfishness have discovered, how firstly to divorce money from true life support wealth and secondly how to make money with money by making it scarce. As of 1978 muscle, guns, and intellectual cunning are ruling world affairs and keeping them competitive on the false premise of universal inadequacy of life support. If mind comes into supreme power within a decade, humanity will exercise its option of a design revolution and will enter a new and lasting epoch of physical success for all. If not it will be curtains for all humanity within this century.

To know that all humanity has the option to become sustainably successful on this planet is not to be optimistic. The possibility of realising that success is 50-50, "touch and go." Every human is involved. It is a matter of all humanity using its mind and breaking through the fear of failure barriers.

Greatest hope that we may "make it" lies in our world around youth. Every successively born child is born in the presence of less misinformation and in the presence of vastly greater quantities of readily accessible reliable information.

Nature seems to be trying very hard to make humanity a comprehensive success. This is most powerfully manifest in the fact that the young world is doing its own thinking. And this young world abhors hypocrisy while loving passionately the truth wherever it may lead them — and truth now leads to comprehensive success of all Earthians.