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Vertical Is to Live—Horizontal Is to Die

R. BUCKMINSTER FULLER

MEMORIES OF BEING CRADLE-SONGED CIRCA 1896—Rock-a-Baby . . . tree top . . . wind blow . . . cradle fall . . . down come baby . . . cradle all—at which critical moment the baby was zoomed at arms' length to above the grown-up's head and thence swung almost to the floor for a thrill ride often to shock-stop its crying. A popular 1920s song was titled "Baby fa down and go boom." Babies live horizontally for months before they spontaneously take the initiative and, coordinating their own complex of control facilities, stand vertically. Vertical is objective. Horizontal is subjective, yielding. In extreme, the vertical characterizes life and the horizontal characterizes death.

From a continuous multiplicity of inadvertent bodily falling and deliberately dropped objects, children learn from birth onward that no one force operating in their lives is so constant, unforgiving and relentless as gravity. Verticality opposes gravity. Behavioral science finds that fear is most powerfully inculcated in children by unexpectedly punishing falls. Horizontal travel is easy and relatively safe. Vertical ascent by tree or mountain climbing is arduous. Gravity clings at the climber. Vertical descent yielding to gravity is hazardous and tends to accelerate to an uncontrollable degree. Horizontal collisions can be painful but, if visually anticipatable, are easily avoided—by putting on the muscular leg brakes. There are no brakes the child, falling vertically from a height, can use. Because their early walk-and-fall "sit-downs" shock their rumps and communicate important informa-

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tion to the children, their rumps are instinctively employed by the punitive type of parents for spank-shocking the child into learning additional lessons. The rumpshock admonishes the brain to signal the mind to discern what it may be that Universe is trying to induce the child to comprehend—not in words, but as a pure abstract, subconsciously recognized principle. Early experiments teach the child that he can't walk on water. Getting water in their noses when they put their heads under, plus their sinkability, arouses fear of deep water in many, but not all, children. Discovery of their ability to swim converts the fear into thoughtful respect for great waters. The data of experience make it scientifically demonstrable that the more dramatically conceptual and imaginatively feelable are both the threat of death, for self or others, and the experience-informed means for avoiding death or serious injury, the more integrity of thought and action humanity invests in its explorations, experiments, inventions and design science. Most powerful of all the subconscious factors unwittingly dominating humanity's teleological invention and design of vehicles of the land, sea and sky is its sense of relentless gravity.

Automobiles operate most frequently on horizontal surfaces or are oriented at approximately ninety degrees to gravity; when there is a "blowout" the vehicle can fall to the roadway no farther than the few inches of its maximum pneumatic tire elevation. Having little preconditioning experience with bad brakes, man operates horizontally without apprehension even though he always drives his autos within the linear "tubes" formed by the highway, roadside trees, bushes and buildings. Within these "tubes" his automobiles move in opposite directions at speeds often compounding diametrically to 150 m.p.h., while spaced only a few horizontal feet apart. No single behavior of man, including his sum total killing during eighty centuries of known warfaring, has taken as great a toll of human lives as has his automobile in its only two-thirds of one century existence. Unheeding potential accidents, hour after hour, day after day, around the clock and around the world, hundreds of millions of human beings hand-guide their automobiles in the lethally dangerous diametric proximity. With common labor now earning three dollars an hour in

the United States, and rating humanity's auto driving time at that level, three hundred billion annual dollars' worth of time is being invested by humanity in the nerve-disciplined concentration on death-dodging steering. This concentrated human effort properly directed could produce a more desirable means of getting privately from here to there than by automobile.

The lesson we are being taught by experience is that man does not act with spontaneous wisdom when the gravitationally imposed hazards are not dramatically obvious. On the other hand, he becomes ever more comprehensively responsible and capable as the degree of gravitational hazard is visually evidenced. Suddenly confronted with a precipitous descent of the road, man quickly heeds the highway danger sign to put his car in low gear—although he will speed by a danger sign on horizontal pavement. When his auto tire deflates, however, there is only a four-inch fall—"that's nothing," says man, "I can brake my car swiftly and safely to a roadside stop." It is also the lack of dramatic gravitational hazard that leaves people in trouble parked beside the highway unaided by thousands of passersby. The passerby autoist sees them standing safely on the ground and excuses his nonsolicitude by assuming that some official will soon come along and attend to their needs.

Men in ships traveling at sea behave quite differently from automobilists. With watery depths below, sometimes as great as five miles, humanity is constantly reminded by many dramatic factors that it can fall into the sea at any moment and thence from the rough and hazardous water's surface into the multi-fathomed, lethally suffocating depths. Frequently surfaced with vertically cresting mountainous waves, the sea is gravitationally unforgiving. Consequently, men have designed their ships with continually increasing competence. Men also navigate their ships on a vast almost totally unoccupied surface, instead of within the one-dimensional tubes of the high speed, exclusively linear, land travel. Ships at sea can maneuver in any lateral direction and any two ships in a given vicinity usually allow great distances to separate their respectively steered courses. The fog hazards of sea traffic are great but nowhere nearly so great as are the fog hazards

of man traveling diametrically only a few feet apart in the "tubular" highways on dry land.

The ever-present, subconscious hazard-awareness affecting the conception of humans in the design of ships of the sea relates most prominently to the gravitational pull inward toward Earth's center. When a great ship's ends are elevated by two separate mountain waves, the ship acts as a beam between two end supports and the ship's tonnage at center is pulled by gravity with enormous force. When a moment later one great wave supports the ship at midpoint, then gravity reverses the stresses by pulling the cantilevered bow and stern toward the Earth's center. Thus ships get wracked by ever-alternating stresses as they roll and pitch complexedly. While big buildings on land may and do sometimes, but very rarely, experience the wave motions of earthquakes, the latter are so rare as to have been unanticipated by building designers. Most of the ruination of the great B. C. Greek architecture was caused by centuries-apart earthquakes. Seaquakes occur daily and the designers of ships have to anticipate them. Thus great engineering had its beginning in ships. So great is man's subconscious awareness of gravity as the number one social threat that sailors at sea, distressed by storms, radio-apprieved of the lethal dilemma of another crew whose ship is out of control and sinking, will rush to the aid of that sinking ship despite the peril to themselves. Millenniums of sea experiences demonstrate that this vital concern of sailors of all nations for the peril of others on the same sea holds true from the earliest days of wind- and oar-propelled boats to the present days of the great power-driven steel vessels.

Rising in diametric defiance of gravity, sky ballooning engaged the most thoughtfully anticipatory designing competence of scientists. The Chinese in 400 B.C. invented non-man-carrying hot air balloons. Lighter-than-air gas-filled balloons to carry men intrigued inventors for centuries. Anyone familiar with the tediously long task of filling a balloon with gas knows that with even a large rip it takes a very long time for a balloon to deflate, so it always settles gently to the ground. Because strong fabrics could be used and there were no sharp objects in the sky to pierce them, balloons were what is known in engineering as "fail-safe." Balloons obeyed

the same principle of *displacement* as that discovered by Archimedes to account for ships floating upon water. When an *enveloped mass* weighs less than the mutable liquid or gaseous medium in which it is immersed, gravity pulls center-of-Earthward so mightily upon the heavier liquid or gaseous medium surrounding the lighter enveloped mass that the latter is emitted vertically outward from Earth's center into the ever-lesser pressures, densities and weight of the Earth's liquid and gaseous oceans until the weight of the locally surrounding air or liquid volume displaced by the *enveloped mass* weighs the same as the latter.

Balloons floating in the atmosphere, like wooden rafts on the sea, had to go where the winds and currents floated them. Seeking favoring winds at different altitudes by alternately dumping either sand or gas, the balloonists could maneuver their spherical vehicles only very meagerly and had to yield to their meandering driftings. Lacking the threat of unexpectedly swift vertical descent, neither rafts nor balloons excited public apprehension of *fatal falling*. But airplanes did excite that sense. Airplanes could not float in the air. They were much heavier than the air. They could climb at a gradual angle into the sky but only as their wingfoils were pulled through the air at sufficient speed to produce a negative pressure—or lift—above their wing surfaces. It must be remembered that gasoline engines were notoriously unreliable for many of the automobile's and the airplane's early years. The velocity at which a heavy gasoline engine and its heavy fuel tanks had to pull the wingfoil in order to produce lift was approximately that of a hurricane. Moving such a complex through the air produced enormous drag. All those considerations of the design-scientist-inventor-experimenter meant that the structure must be strong enough to withstand super-to-hurricane and super-to-earthquake stress capabilities yet be light enough to permit the total airframe and power plant ensemble plus the weight of pilot and fuel to be lifted by the wingfoils' maximumly induced lift. The possibility of power plant failure or of a too greatly reduced structural dimension was so great as to invoke not just the pilot's and the engineer's gravity consciousness but also all of humanity's apprehension of the nonrestrainable falling by tailspun aviators.

So constantly present in everybody's imagination were aviation's early fliers and so constantly conscious was society of the unrelenting gravity peril that every aviator of the early days of airplane flying became known intimately by their names and personalities to vast numbers despite there being at that time no radio—let alone tv—broadcasts. Newspapers published telegraphed and cabled news, but the news network was then so meager as to be able to serve less than one-quarter of humanity. So imaginatively stimulating to society was the gravitational hazard ever-present in heavier-than-air flying that the highest engineering and scientific integrity developed theretofore exclusively by the designers of water-borne vessels was greatly sharpened and spontaneously invested by all concerned in any phase of the production, maintenance and flying of the airplanes. Airplane science introduced not only wind tunnel research but a host of new instrumental measurements of every aspect of strength and power requirements, as well as chemical, physical and mathematical means of providing ever greater performance of all parts and of the whole airplane for each fractional ounce of physical chemistry invested into the complex aircraft organism. It was gravity that the aircraft scientists always struggled most strenuously to overcome. Finally we get to multigravity magnitudes of stress to 3 g's, 4, 5 . . . 8 g stresses to be withstood by ever less g's invested in the power plant and airframes. We even get to "g" suits for the high-speed, high-altitude diving and pull-out pilots themselves.

Without knowing of Galileo's discovery of the accelerating-acceleration progressively compounding the velocity of falling bodies, children dropping objects to the floor and later out of windows and catching high-fly baseballs become intuitively aware of the lethally multiplied speed of falling from ever greater heights. As a consequence, the difference in degree of design-science integrity invested by humanity in its design and production of the only four-inch fallable, blowout experiencing automobiles and the multi-thousand foot fallability of the airplane pilot or passenger is illuminatingly disclosed when we review the relative weights per each developed "horsepower" of the automobile's and the airplane's reciprocating engines—which started

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with a mutual weight of seven pounds per horsepower at the outset of World War One. Fifteen years later the automobile's engine still weighed seven pounds per horsepower, but the airplane's had been reduced to one pound per horsepower. This reduction in weight, time and energy units invested in each and every function of the aeronautical airframes, power plants and instruments accelerated compoundingly throughout the first sixty years of the airplane to transform it from a vehicle capable of flying only one man, nonstop, for only one mile in one minute at great risk, to an aeronautical vehicle capable of flying three hundred people non-stop across all major oceans at ten miles per minute at far less risk of life—with but one exception—than by any other historically known mode of locomotion per each accomplished mile, including man's walking on dry land. And whereas in his total record of automobiling man has demonstrated his most horrendously lethal record, his total record of flying has proven it to be—with only that one exception—the most spectacularly safe mode of travel known to us. This safety has also been multiplied by the fact that whereas auto traffic is one-dimensional and the ship of the sea two-dimensional, the airplane is three-dimensional and its flight paths are negotiated at great vertical as well as horizontal distances apart. The airport approach zones are also four-dimensional, for the airplanes are separated by controlled time intervals as well as by the other dimensions of space.

What is that one exception in traveling that is safer than the airplane? It is humanity's extraterrestrial space travel. Up to the time I was born average man in his whole lifetime moved to-and-fro about the surface of Earth for an average total of thirty thousand miles. Historically, average man has seen only about one millionth of the surface of his spherical planet Earth. The year I was born the automobiles were born. When I was nine the first airplane was flown. Both modes of travel have multiplied so fast that at seventy-three years of age I have now covered three and one-half million miles around Earth's surface, which is over one hundredfold the average total lifetime travel of those living before us. And I am only one of ten million human beings who have traveled such a distance. Every air hostess is now out-mileaging

me to a considerable degree. But each of the Gemini astronauts of a few years ago accomplished my three and one-half million miles in only one week. In the short span of only eight years since Yuri Gagarin became the first Earthian human to travel extra-terrestrially, the U.S.A. astronauts, with a group total of approximately two thousand hours of space-travel time—taking off vertically against gravity at a speed two hundred times that of a hurricane's devastating velocity—have traveled in Earth and Moon orbiting terms a total of thirty million miles—without one in-flight loss of life. And, to be realistic, those mileage figures have to be very greatly multiplied because all the while they were orbiting the Earth or the Moon these two great spherical bodies also were flying in formation around the Sun at 60,000 m.p.h. When the astronauts are launched at an additional acceleration of 15,000 m.p.h. to break out of Earth's gravity by speeding 15,000 m.p.h. faster than Earth's 60,000 m.p.h., they are traveling at an independent solar system speed of 75,000 m.p.h., which is just sufficient extra speed to be able to shuttle back and forth between the 60,000 m.p.h. Sun orbiting Moon-Earth, space-vehicle team. This means that the astronauts' two thousand in-space hours have taken them safely through the solar domain a total of one hundred and fifty million miles without one in-flight loss of life and only three preflight deaths.

"Countdown" at Cape Kennedy is not from *ten* to *one*. It is from *ten million* to *one* of tasks that have to be meticulously accomplished in an overall countdown spanning several years—all with such integrity of execution by each of hundreds of thousands of humans participating in the realization of the task that not one fatal flaw has been admitted into the fail-safe designed system.

And so important is the integrity of humanity's investment of its all-time inventory of knowledge and highest mental and physical capability in gravity-mastering, *ergo*, in astro-travel accomplishment, that when three human beings were destroyed before the start of one of its flights, three billion humans around Earth's surface had learned of their deaths in a few minutes and the gravity-invoked imagination of all humanity felt utter anguish for those three unfulfilled astronautical lives. Critical consternation

over the total space system's first and only failure was universal—while on the same day around the world three thousand humans died in auto accidents almost unnoticed. Auto-travel is horizontal. Astro-travel is vertical. Those three were trapped in their horizontal to vertical pre-blast-off transitional state. Countdown had not been completed.

And all the while some of our politicians and many tax-aboring citizens say, "Never mind that space stuff—let's get *down to Earth*? Let's take care of housing the Chinese!" And we reply: "*Where* and *What* is *DOWN TO EARTH*? Where is that non-space, infinitely extensible only one- and two-dimensional horizontality wherein their out of this world, squarely-reflexing brains percolate—in a *specialization* exonerated, socioeconomic realm of utter irresponsibility for anything but this year's exclusively ego-centered profits?"

In which direction of Universe is *DOWN* located? Science has found no such region in our celestial events theater. The *UP* and *DOWN* concepts were invented by yesterday's inadequately informed humans to accommodate their concept of a substantially flat and four-cornered Earth to whose unitary, planar, sea-level surface all perpendiculars had, of geometric necessity, to be parallel to one another, wherefore they were all extendable only in two opposite directions—*UP* and *DOWN*. Spherically operating aero-astronautics recognized that none of the perpendiculars to different points on a sphere are parallel to one another; wherefore, separate verticals lead outwardly into space in an infinity of different directions, all of which orientation becomes progressively changed as the Earth sphere spins and orbits and the solar system shifts its galaxy positioning, and our galaxy travels in respect to other revolutions. Aviators have wisely learned to speak of "coming *IN* for a landing" or "going *OUT*" into circumferential flight.

But the public is not so enlightened. The President of the United States, as most typical of societies' geometrical illiteracy, congratulated the 1968 Christmastime astronauts for going *UP*, to, around the Moon and back *DOWN* to Earth; and even scientists still think they "see" the Sun "going down" at twilight. And everybody goes on thinking and talking *UP* and *DOWN* unreality.

So all humanity's reflexing is as yet so ill-conditioned by years of optical illusion, self-deception and general-education-dispersed misinformation, that it goes right on coddling its own ignorance as well as overwhelming its children with the inventory of formally tolerated errors, thus perpetuating and increasing the polluted information.

In the great Cape Kennedy "countdowns" of ten million un-completed essential tasks to be reduced to one, then to none, then blast-off—the "critical path" controlling of the complexedly overlapping, start-to-finish, time-spans of each of the prelaunch tasks to be faultlessly accomplished—99.9 percent of these tasks must be performed within realms of the electromagnetic spectrum, or within dimensional error-control tolerances, which are completely invisible to humanity's naked eye.

When at Christmastime 1968 the Moon-circuiting Earthian astronauts pointed their television camera at the planet Earth and the "live" picture was electromagnetically transmitted at the speed of light (and of all radiation) of 186,000 miles per second, it took the picture approximately two seconds traveling to come into view in our one billion (approximately) Earth-around tv sets. As the planet Earth's cloud-bewreathed, sapphire-watered blueness was dramatically displayed against the x-trillions of time years of nothingness (whose incredible depths appear to us only as pure no-light, a quality of blackness never before experienced), America's senior tv commentator exclaimed, "There she is—floating there!" Floating in what? Man, unable to see the hands of the clock move or the growth motion of a tree or boy, or the motion of the stars, or the atoms, as yet thinks in exclusively static single frames, isolatingly extracted from his scenario Universe. With no recognized scenery behind it, the Earth seemed motionless "back down there."

In *reality*, of course, which anyone will agree is the "practical" way to think, the astronauts were pointing their camera at a third of a million-miles-away Earth from aboard their seventy-five thousand solar-system miles per hour space-speeding vehicle as it circled the 60,000 m.p.h. speeding space-vehicle Moon and, together with their space-vehicle-team-mate Earth, all three, Earth, Moon and

Cape Kennedy Capsule, zoomed soundlessly, windlessly at a group rate of 60,000 m.p.h around the Sun—their group mass being tethered coheringly by the incredibly great gravitational force of our prime energy-supplying space vehicle—the Sun's massiveness.

Because Universe and its inexorable evolutionary scenario operates everywhere under utterly invisible rules that are 99.9 percent unsensed and unheeded by man, his yesterday's inventory of exclusively "sensible" behaviors is disclosed as being approximately irrelevant to scenario—evolution's real "shooting script," and the heedlessness fortunately has been, thus far, approximately innocuous to Universe. If the irrelevance and misinformation persist, however, and are further multiplied, they are destined to bring about lethal malfunctioning of the complement of human passengers that evolution placed—separately and experimentally—aboard our almost negligible-in-Universe-sized, space-vehicle Earth.

Space-vehicle Earth was so superbly well designed, equipped and supplied as to have been able to sustain human life aboard it for at least two million years—despite humanity's comprehensive ignorance which permitted a fearfully opinionated assumption of an infinitely extensive planar *World*. Humanity also spontaneously misassumed that its local pollution could be dispelled by the world's infinite extensiveness. Humanity also misassumed that an infinite succession of new and pleasing varieties of abundant, vital resources would be disclosed progressively as man exhausted first one and bespoiled another of the as yet known valuable, because vital, resources. Man must learn in a spontaneously self-enlightening manner to discard many, if not most, of yesterday's false premises, and axioms only believingly accepted; and he must, on his own, discard false premises and learn that only the nonsense Universe is reliable and that a lunatic is not a crazy man but one so sane, well informed, well coordinated, self-disciplined, cooperative and fearless as to be the first Earthian human to have been ferried to a physical landing upon the Moon and thereafter to have been returned safely to reboard his mother space-vehicle "Earth."

Long, long ago—little bands of humans seeking fish and fruits,

or following animals, frequently became permanently lost and separated from one another. Endowed with the procreative urge, those of the few males and females surviving in company inbred for generations in their respective remotenesses utterly unaware of one another's tribes and separate tribal evolution—and thus evolved a plurality of superficial differences in appearance through special chromosomic concentration brought about by the special characteristics of the survival adaptation process. Thus have developed hundreds of only superficially different human types, some very numerous and powerful, some successfully monopolizing specific land areas and others as yet wandering. In their ignorance, all of humanity's national governments assume, misinformedly, that there is not and never will be enough of the vital resources to support all or even a large number of humans, *ergo*, that they must automatically fight one another to the death to discover which government might survive. Often to encourage their respective peoples, political leaders evolve partly expedient and partly idealistic ideologies suitable to their viewpoints, but all the ideologies misassume an only-you-or-me—not both—survival premise as having no axiomatic alternative. Because of the invisibility of 99.9 percent of the source information that contradicts the assumption of a fundamental inadequacy of resources, the probability is that if man is left exclusively to political contriving, he will become embroiled in approximately total self-destruction. While the top speed of the intercontinental ballistic rocket is many times that of a bullet, its 20,000 m.p.h. is as nothing beside radar-sight's speed of 70,000,000 m.p.h. The speed of information is now so swift that for the first time in history the lethal missile is no longer faster than man's ability to apprehend both its coming and its specific course—twenty minutes before it can reach him. But the ability to see it coming does not confer the capability to dodge it. Now every one of the opposed political systems' swiftest rocketry attacks can be detected so far in advance that each and every side can dispatch, retaliatorily, not only its full arsenal of atomic warheads but also all its rocket-borne chemical and biological warfare missiles. All opposed sides can and will retaliate automatically *in toto*, thus bringing about approximately total human destruction of

vast millions immediately, with the balance to be destroyed soon thereafter by the radiational, biological and chemical contamination.

Shifting abruptly from consideration of such a negative conclusion and seeking to understand some of the alternative options to such a fate, let us select any two averagely healthy and well-dispositioned young men from among the world's professional airplane-flying and maintenance population. One of the two we will select from among those licensed airplane pilots who have not only qualified to fly their own, land and sea, single and dual engined aircraft but also have gone on to get both their *commercial* and *flying instructor* licenses. The other young man selected will be from among the airport personnel who have qualified under United States regulations to be licensed as an airframe or power plant mechanic. Let us follow through intimately the behavior patterns of both the flying instructor and the mechanic at work and during off-duty waking hours. We find the instructor at work with a student flyer, behaving with the utmost integrity of which he is capable, having in common with all such instructors an overwhelming and spontaneously induced subconscious awareness of the split-second span of time within which a noncorrectable error or situation leading to fatality—if not understood and instantly corrected—could be inadvertently initiated by the student, which could lead to the fearfully imaginable vertical acceleration by gravity inward toward Earth and almost certain death. The airframe or power plant mechanic working on an airplane we find to be inspired by the same imagination-vivified awareness of the fatal predicament of the flyer, were he, the mechanic, to fail to perform his maintenance and repair tasks in the most experience-proven and safety-guaranteeing manner. When the airplane maintenance mechanic certifies in writing, as is routinely required, that he has performed any given structural, mechanical, repair, tuning or testing task, his certification is as reliable as (if not inherently more so than) certification by a great surgeon that he, the surgeon, has performed any given physiological operation. The surgeon cannot certify, as can the mechanic, that the system he has operated on, if supplied with routine fuels and handling, will operate re-

liably for a given period of forward time. There is far more opinion and guess work residual in the human surgery arts than in aeronautical technology.

But let our average flying instructor and his friend the average airplane mechanic check out from the airport and ride into town together in one of their automobiles and their behavioral integrity begins to fall off. One is liable to mutter to the other that the driver of another car who crowded his way is the offspring of a dog, to which the other agrees—although both know that this is biologically impossible. The same mechanic working for an automobile service station may perform a sloppy job or leave some job unattended, for he envisions at worst the auto driver's stopping unexpectedly and having to push his car to the roadside.

Measureable data concerning the relative reliability of the human factors operative throughout the almost *horizontal* (and often glide-recoverable) aeronautical arts—compared with those comprehensively operative throughout the *vertical*, nonglidable, approximately zero-recovery potential art and service of astro-rocketed human travel—disclose a multifold step-up of inherent integrity of spontaneous behavior, as well as of intellectual integrity, of the comprehensively anticipatory design science with which its every undertaking is initiated and maintained, both throughout and retrospectively of every such undertaking. This super-to-previous level of integrity holds true throughout the whole air-space industry's production and delivery of every item of equipment. It is operative in equal degree of relative perfection of behavior and knowledge to that invested in the selection and training of the astronauts, as well as in the launching, flight, control, and advance research design and general administration.

The spontaneous advance of both metaphysical and physical integrity of the astro-art over the already magnificent aeronautical science and technology is inherent in the nature of the minimum standards within either areo-flight or space-flight that could be attained and maintained.

Heisenberg's principle of "indeterminism" prohibits any *exact* measurement or "absolutely exact" physical agreement of mechanical or structural fitting. As a consequence, engineering and

mechanics can only *reduce* the degree of error to be tolerated. Scientists must be content with “relatively elegant agreements.” “All the truth and nothing but the truth,” as pledged under imposed oath-giving in courts of justice in many countries, is vainly pledged, for, contrary to indeterminism, absolute “truth” is assumed to be legally demonstrable in the eyes of the administrators of humanly invented law. Detection of any natural aberration, witting or unwitting, may bring prosecution and conviction for false testimony. For a long time mechanics have known what Heisenberg—and science through him—so recently discovered to be true: that Universe forbids realization of *exactitude*. The Heisenberg indeterminism implies *eternity* to be persistent within the physical and metaphysical, ever-evolving, continuity-finiteness of scenario universe, in which the myriads of nonsimultaneously shaken kaleidoscopes are never either simultaneous or identically repetitious. Having both the *finiteness* discovered by modern physics as well as *eternity* imposes a limitless change, *ergo*, a never repeating and irreversible omnievolution. Although he had never heard of Heisenberg, the skilled machinist could see long ago that the best he could do was to reduce the amount of error he might tolerate and with very surprisingly desirable results.

For instance, when we reduce the tolerance of error in the relative exactitude of the manufacturer’s sizing of individual rivet diameters and of the interpositioning of the holes and the diameter of the holes that are to receive the rivets, with which two metal sheets are to be drawn together to act as one structural piece, the strength of the integral assembly, provided by the riveting, increases rapidly. The human hand guided only by the human eye, unaided by a magnifying glass, cannot interposition the centers of a plurality of rivet holes or visibly discern the magnitude of the spaces lying between the holes, nor observe and thereby control the diameter sizing of the holes to a degree finer than $1/100$ of an inch. By the use of instruments and mechanical tools, such hole interpositioning and diameter dimensioning can be held to a tolerance of error of less than $1/10,000$ of an inch in airplane fabrication and assembly work. In the electromagnetically monitored astronautical technology, however, the error tolerances are

often reduced to a reliability within $1/1,000,000$ of an inch. Using only the automobile industry's relatively crude tool-making tolerances and *reducing* the degree of error to be tolerated from that of the best skilled metalworker's naked-eye layout work, of $1/100$ of an inch, to a machine-tool-controlled $1/1000$ of an inch, I was able to gain much strength increase in the riveted assembly of an aluminum structured ninety-three-foot diameter geodesic dome, to cover the Court of the Ford Motor Company's Dearborn, Michigan, Rotunda Building in 1952. Thereby I was able to produce and install a dome weighing only one-half as much as would the lightest dome of equal strength that could have been produced and assembled at that time—even by a team of history's most skilled sheet metal workers, if they were confined to operating only with the optimum naked-eye tolerance-discerning capability. This is to say that automated, industrial, mass-production controls could produce *two* domes, of equal strength and quality, for every *one* that could be turned out by the best craft manufacturing techniques, and thirty domes for each that could be produced by the tolerance of our present building business. When we *million-fold* the degree of accuracy, the strength and reliability are multiplied to an even more important degree. The astro-vehicle technology operates at so phenomenal an increase of performance per pound of engine and fuel consumed as compared to airplanes, which in themselves are not only sometimes thousandsfold more efficient than automobiles in accomplishing man-miles per units of invested physical resource, that it makes *possible* doing what it was *impossible* for the lesser art *to do at all*. The rocket can go to the Moon whereas the airplane cannot, and the airplane can cross the ocean under its own independent power and controls, which an automobile cannot.

Whereas in the mechanics and structures of autos and airplanes the physical principles employed and the intertiming of cycles are conceptually comprehensible, in the electromagnetic world, where the activity speed is stepped up to seven hundred million miles an hour (which is thirty-five thousand times faster than the fastest rocket, three hundred and fifty thousand times faster than the fastest airplane and three and one-half million times faster than

the fastest automobile), the scientific explorer-inventor has no visualizable concept of how nature does what gets done. In electronics, the designer does his circuitry layout work mathematically, and all opinionated decisions give way to mathematical integrity. In the astro-vehicle technology, dial-read electromagnetically levered needle movements, rather than physical size gauges, take over, and the mathematics of the entirely invisible process-controls are derived from electromagnetically operated computers whose reliability is provided by the invisible, but fantastically reliable, circuitry behaviors of the self-interstructuring and invisible transaction atoms.

In coordinating the ten-million-to-none order of magnitude reduction of essential tasks to be pre-accomplished before each blast-off at Cape Kennedy, a whole new era of industrial intercourse integrity has been established. As a happy but popularly unrealized consequence a new and large section of our economic system has been elevated to an entirely new level of incorruptible reliability. (This is the level of integrity manifest today in our high school youth.) Hence we see the passenger-miles safely accomplished per each pound of astro-engine as well as by each ounce of astro-fuel, ten thousandfold over the airplane's and its fuel's best performance. To demonstrate this fantastic improvement in performance, we witness that one communications-relaying satellite of only one quarter of one ton of material is now outperforming the transoceanic communications message capacity and fidelity capability of 175,000 tons of copper cable. This constitutes a seven hundred thousandfold step-up in communications performance per pound of invested resources. And don't forget that we were already favorably impressed with the sevenfold increase of horsepower per pound accomplished by the manufacturers of the light private-airplane engine over the pounds per horsepower of the auto engine.

As in our industrio-social age we now design everything *except* the astro-vehicle paraphernalia, all the metals that have ever been mined and put to use have an average quarter century recycling, invention-to-obsolescence periodicity which includes the scrap, melt, redesign and re-use cycling time. All the metals ever mined

and so put to use are now invested in structures and machines that, if operated at full capacity, could take care of only forty-four percent of humanity. The rate at which we have been finding and mining new metals is far slower than the rate of increase of human population. This means that if we freeze the world's design standards at their present levels, which are far below the standards of the astro-vehicle technology, fifty-six percent of humanity, which means humanity's political majority, is doomed to premature demise, and to want and suffering enroute to that early death. There is nothing that politics, per se, can do to alter that condition; only a design revolution—such as that which is already “made to order” in the potentially thousandfold performance per pounds, minutes and kilowatts advancement to be realized by the astro-vehicle industry—can change those fundamental conditions of humanity overnight from failure to comprehensive world-around, human success.

Between 1900 and 1969 our space-vehicle Earth's passengers have experienced an increase of from less than one percent of its total population to forty-one percent of total world population now enjoying a standard of living superior to that either experienced or dreamed of by any monarch before 1900. During that time the material resources per each world man were continually decreasing so that the advancement was not accomplished by exploiting more resources. This historical forty-folding of the percentage of humanity's “haves” can only be explained as the fall-out of ever higher performance per pound technology as developed for the ships of the world's water and air oceans. That an overnight advancement from forty to one hundred percent is possible can be understood when we realize that the technological fall-out into our domestic economy of ships of extraterrestrial astrogation have not had time to have important effect on the standard of living because their technological fall-out has not yet had time to occur.

We have discovered that the higher the speed and the more angularly contradictory to gravity humanity's communicating facilities have become, the higher the integrity of total thinking, as well as behavior, and the higher the performance realized per each

unit of resource invested. At the bottom of the technological ladder lies the massive, inert, superstition-corruption-misery-and-strife-ridden, subindustrial, craft-and-graft building activity. No architect, let alone the public and its politicians (who keep their real estate, bank and construction interests rolling along with government financed inefficiency), has the slightest idea what buildings weigh, yet without such weight knowledge humanity cannot possibly start providing more housing with less resources, thereby ultimately to take care of everybody and thus eliminate the fundamental cause of war, which all youth now intuit could be done if the grown-ups would get their sights elevated and forsake preoccupation with this year's profit, this year's election and each with his own special survival intrigues. If the myopia were dispensed with and the whole of humanity were to become cooperatively engaged in learning realistically that we *are* aboard a space vehicle that is not going to get any new equipment yet could be operated successfully for all, we would have to allow the space program to continue and also to accredit it above all other officially sponsored and financed activity. If on the other hand we were to heed the tax-itchy "down to earthier" and confine ourselves to trying to "house the Chinese," as he puts it, we would soon find that his idea of housing couldn't be stretched to take care of the ill-housed balance of humanity. Since the "down to earthier" doesn't know how much houses weigh, he obviously does not know what he is talking about. The kinds of pipes and sewers he now thinks of as constituting adequate housing can't be stretched to accommodate fifty percent of humanity, let alone his disdainfully referred to "Chinese."

While no scientist has ever been retained by any patron to look at the plumbing, no improvement other than colored plumbing fixtures has been realized in the last five thousand years in our five-gallons-to-get-rid-of-one-pint systems for shunting rivers through our toilets and sewers and thence back into our ever more polluted water-supply streams.

Shifting our attention for the moment from our urgent urbanism, we realize that, in order to have humans live for any protracted period of time in space where there are no streams or

sewers in which to flush, nor air to be breathed, nor gardens, nor fish, nor fruit to be eaten, the problems to be solved are far greater than those already frustrating our Earthbound living. To maintain men in space, with four billion people watching them constantly over the soon to be completed world-around satellite relaying communications system, without invoking the consternation and dismay of all humanity, we are going to have to learn, for the first time, all about the chemistry, physics, ecology and metabolics of the total life-regenerating system of our space-vehicle Earth. We are going to have to learn how to pack into a little portable electrochemical system about the size and weight of one large air-travel suitcase all the life-supporting technology necessary to complement man's integral organic processing, with possibly an additional weekly milk bottle-full of metabolic essentials rocketed to each astronaut from his mother-spacecraft Earth. When and if humanity learns how to support human life successfully *anywhere in Universe*, the logistical economics of doing so will become so inherently efficient and satisfactory that then, and then alone, we may for the first time make all humanity a success back here aboard our space-vehicle Earth. The U.S.A. and U.S.S.R. have each appropriated multibillions toward accomplishment of this task. The United States has already had an experimental team operating successfully under semiautonomous conditions in a simulation operation lasting successfully for more than one whole year of such isolation. When that actual, protracted, semiautonomous living has been accomplished in space, the prototype apparatus may easily have cost the United States and Russia a combined fifteen billion dollars. But that fifteen billion dollar prototype can then be mass-reproduced and distributed on board Earth at a cost per person of only a few dollars a year while doing away with sewers, waterlines and approximately all pollution.

Among the most difficult administrative tasks the U. S. Space Administration experienced in initiating the first Cape Canaveral (now Cape Kennedy) space-vehicle launching was the problem of the over-zealousness of its dedicated and inspired scientists and engineers who weren't "going to leave it to the machine to get things done right"—they had to "do it themselves." But these over-dedicated individuals couldn't possibly operate with their

senses and muscles at the magnitudes of precision and velocity essential to the invisible coordination of the computer-monitored electromagnetic relay systems. *All those involved in the space program* had to be convinced that the only place and time in which their personally disciplined options of thought and action could be safely engaged were in improving the original reliability of each and every item that went into the complexedly automated system. They must concentrate anticipatorily in the design, production and installation of the basic tools and leave it to the tools to do man's comprehensive bidding.

It seems eminently clear that we not only must put our space programs on highest priority of attention and resource investment but that all humanity must be accredited and financed to enter into a new re-educational system that is geared to develop our most prominent awareness, that we indeed *are in space* and that all of our concern is with the fact that our space-vehicle Earth and its life-energy-giving Sun, and the tide-pumping Moon can provide ample sustenance and power for all humanity's needs to be derived from our direct energy income without further robbing our fossil fuels energy savings account. In reality, the Sun, the Earth and the Moon are nothing else than a most fantastically well-designed and space-programmed team of vehicles. All of us *are*, always *have been*, and so long as we exist, *always will be—nothing else but—astronauts*. Let's pull our heads out of the brain benumbing, mind frustrating, misinformedly conditioned reflexes. If it is going to be "All ashore who's going ashore," once more intent to return to nonspace DOWN HERE ON EARTH, humanity is doomed.

But there is hope in sight. The young! While the university students are intuitively skeptical of the validity of any and all evolution-blocking establishments, *ergo*, negatives, the high school age youth thinks spontaneously and positively in astro- and electromagnetic technology and their realistic uses. The young of all age levels abhor hypocrisy. They are bored with obsolete UP and DOWN dancing, with bureaucratic inertia, bias of any kind or fear-built security. They disdain white, gray, black and blue lies. The students and school children around the world have idealistic compassion for all humanity. There is a good possibility that they may take over and successfully operate SPACESHIP EARTH.