

THE MUSIC OF THE NEW LIFE

**thoughts
on creativity,
sensorial reality,
and comprehensiveness**

By BUCKMINSTER FULLER

■ Professor C. H. Waddington, geneticist of the University of Edinburgh, identifies a phenomenon which he has named the "Epigenetic Landscape." In the Epigenetic Landscape, man and other life alter the landscape; the trees grow where there had been only pasture; the cattle can no longer graze where once they had done so. The epigenetic landscape is an evolving one. Life alters the landscape, then the landscape alters the life—the inanimate winds and waters alter the land and vice versa. Neither the individual species of life nor the physical components of the inanimate chemistry of the environment, nor the whole landscape ever return exactly to their respective previous conditions. Entropy and evolution are inherent. The inanimate physical complexes become increasingly and superficially random while the biological phenomena regenerate with increasing orderliness of species, and subspecies, regularities.

When, in due course, man invented words and music he altered the soundscape and the soundscape altered man. The epigenetic evolution interacting progressively between humanity and his soundscape has been profound. Whereas the scientists as I have shown earlier have adopted many false premises and axioms and have much to correct, words and music have to our knowledge not made any false starts.

When I was born seventy years ago I was very cross-eyed. When I was four years old the cause was discovered. My eyes were so farsighted that I saw only blurringly colored and outlined objects. The colors were wonderful, but there were no details. I was given glasses that gave me sharp vision. As a consequence my senses of color, sound, touch and smell were most prominently employed. My first sight of a drop of dew, of a strand of hair, of details in general amounted to a second birth at four years old. A whole new sense of pattern coordination, that is, of consciousness occurred.

My memory of socially popular music both secular and religious goes back into the gay nineties—before the days of World Wars—before the days of autos, radios, airplanes, and the like. My heightened sense of hearing has given me a large scale sense of sound patternings. For instance I have tended to correlate popular music with general evolutionary transformations of the dynamic environment. I have been especially aware, for instance, of the correlation of the change of popular and dance music tempo with the changing and accelerating pace of technology and its effect on our modern living pattern. In the dance music of my gay nineties' childhood, the waltzes predominated. This slow music was followed by an ever faster sequence: there came the two-step, the polka, the turkey trot,

the Charleston, Lindy Hop, jitterbug, rock-and-roll, frug. The pace shifted from that of the sedately swaying northerly hemlocks to the swift complex rhythm of the African drums.

The comprehensive science and technology trend chart of the last eight hundred years discloses the basic acceleration curve of that twentieth century compositional evolution.

David Rockefeller's great world-around collection of beatles discloses the epigenetic effect on the coloring, marking, and shaping of the beatles of the various countries of the earth. To those familiar with the art, landscape, and costume history of Japan, Persia, the Congo, Ireland, and other countries, the beatles of those countries quite clearly manifest the color, shape, and cultural characteristics in general of those countries.

Though the relationships are often subtle, there is a comprehensive interrelationship of all science and technology with all music, as well as with the other arts and with the moods and philosophy of world society. The present-day research work in music employing the computers reveals to us many of the subtle interrelationships of mathematics and music, for instance, those which Bach intuitively employed. The very fundamentals of harmonics are now looming into surprisingly discreet niceties in respect to wave mechanics, number theory, and general systems theory.

I will not try to identify music directly with each of the illustrations which I am employing in this discourse. Each of my pictures illustrates a generalized principle which has not yet been effectively integrated into our culture and our spontaneous formulations. But all of them have always been operative in nature. The difference from now on will be that we are consciously employing these principles. This will profoundly affect the kind of music which we compose and produce, and the way in which we discipline ourselves to produce and compose the new music.

This first picture (Figure I) is what I call the Profile of the Industrial Revolution. I found that revolution best portrayed by the chronological rate of humanity's acquisition of the scientific controls over the basic inventory of Cosmic Absolutes—i.e., the 92 regenerative chemical elements.

It is a curve of acceleration reliably portraying the fundamental rate of impingement of science and technology upon man, as referenced to regular calendar clock time. Lists of historical inventions and discoveries are formless because they are inherently open-ended, i.e., *infinite*. However, there is one and only one *closed* or *finite family of pure scientific events*. It is the history of the isolation by man of the 92 regenerative chemical elements. Membership in this family of prime universe patternings requires a family "credit card" identification by specific and uniquely consecutive matching electron-proton numbers. No two members may have the same numbers. There must be a family member for each consecutive number. The family must consist of all 92 unique sets from 1 to 92 electron-proton counts, and no others. That is the curve herewith presented. To it has been added the curve of the rate of isolation of the, thus far, subsequently isolated, non-self-regenerative chemical elements beyond 92. The rate and order of acquisition of the elements of negative universe, numbered beyond the first 92, are shown for comparison only.

The chart covers 800 years. It runs from A.D. 1200 to A.D. 2000. Nine chemical elements (see list at lower left corner of chart) were already known to and isolated by man when recorded history dawned. The first known isolation of a chemical element was that of *arsenic* in 1200 A.D. in Italy. There is a 200-year lag to the next isolation—*antimony*—then another 200-year interval to *phosphorus*, then only a half-century gap to *cobalt*, whereafter, the list takes "off" averaging a climbing rate of one isolation every two years.

The swiftly rising curve is not smooth, however. There are three distinct slow-down "shoulders." These are occasioned by periods of universal warring. Pure science activity, which these isolations represent most truly is frustrated altogether by the atmosphere of war. Because the earlier discoveries of science are often converted to technological advantage in wartime, science has been thought, erroneously, to prosper in wartime. What prospers in hot and cold war times is *applied science* and *production technology* but not *pure science*, not *basic thinking*.

This article is Part II of the author's keynote speech at the National Conference on the Uses of Educational Media in the Teaching of Music, which was held in Washington, D.C. under the co-sponsorship of the U.S. Office of Education and the Music Educators National Conference. Part I appeared in the April-May issue. Dr. Fuller is University Professor (of generalized design science exploration) at Southern Illinois University in Carbondale.

It is seen on this chart that 1932, popularly identified as the "depth of the depression," is, in fact, a moment of epochal success. In 1932 the last of the finite family of 92 regenerative chemical elements—occurring spontaneously in nature—was isolated. For the first time in known history man had in neat "know-how cans" on the "shelf" all the basic ingredients for reassembling the physical universe's basic pattern behaviors in preferred arrangements such as in metallic alloys or organic compounds. This permits greatly increased end performances per units of humanity's discovered, controlled and invested energies. It makes "possible" theretofore undreamed-of physical advantage gains to be realized for all of *humanity*. It is the beginning of man's consciously successful participation in the evolutionary events of nature. This conscious and scientific participation, in turn, leads swiftly to realization of physical, metabolic success of man in universe.

After 1932 and the 92nd *isolation*, there is an important, but temporary, slow-down in further isolations. Scientific man became momentarily preoccupied in taking apart the nuclei of those fundamental chemical elements. Fission and the *theoretical release* of the elemental energy 5 years later, and *realistic release* 12 years later, was inevitable to that 92 and final isolation of the full family of prime elements in 1932.

It is interesting to note that the post-uranium element isolations, starting with 93, occur with extraordinary

regularity. Witness the approximately straight line ascent of the post-92 isolations as well as the direct correspondence of the elemental numbers with the numbers representing the successive order of isolations. This correspondence is unlike the discovery pattern theretofore occurring. For instance, isolation number 97 is *berkelium*—element number 97—with 97 electrons and 97 protons.

In the first 92 isolations, however, the order of isolation does not correspond to the atomic number order. The 28th *isolation* was *zirconium*—element number 40; the 31st *isolation*, *beryllium* was element number 14; the 18th *isolation* was *hydrogen*, which was element number 1, meaning 1 electron, and 1 proton, and so forth. None of the atomic numbers correspond to the number in order of successive isolation within the "first family" of 92 elements.

The extraordinary pattern disclosed by this curve of man's acquisition of fundamental controls over the basic energy patternings of nature portrays only the evolutionary rate of development of pure science. It is *subjective* in that it establishes only a *potential use—advantage* for man. Without discovered use or technical capability to use having been as yet invented by man, this pure knowledge remains only potential.

In view of this curve of development of the high fundamental potential, it is appropriate to ask ourselves: "What is the most comprehensive change in the relationship of man to his Earth and his universe that may be realized physically by the application of this pure (physical) knowledge?"

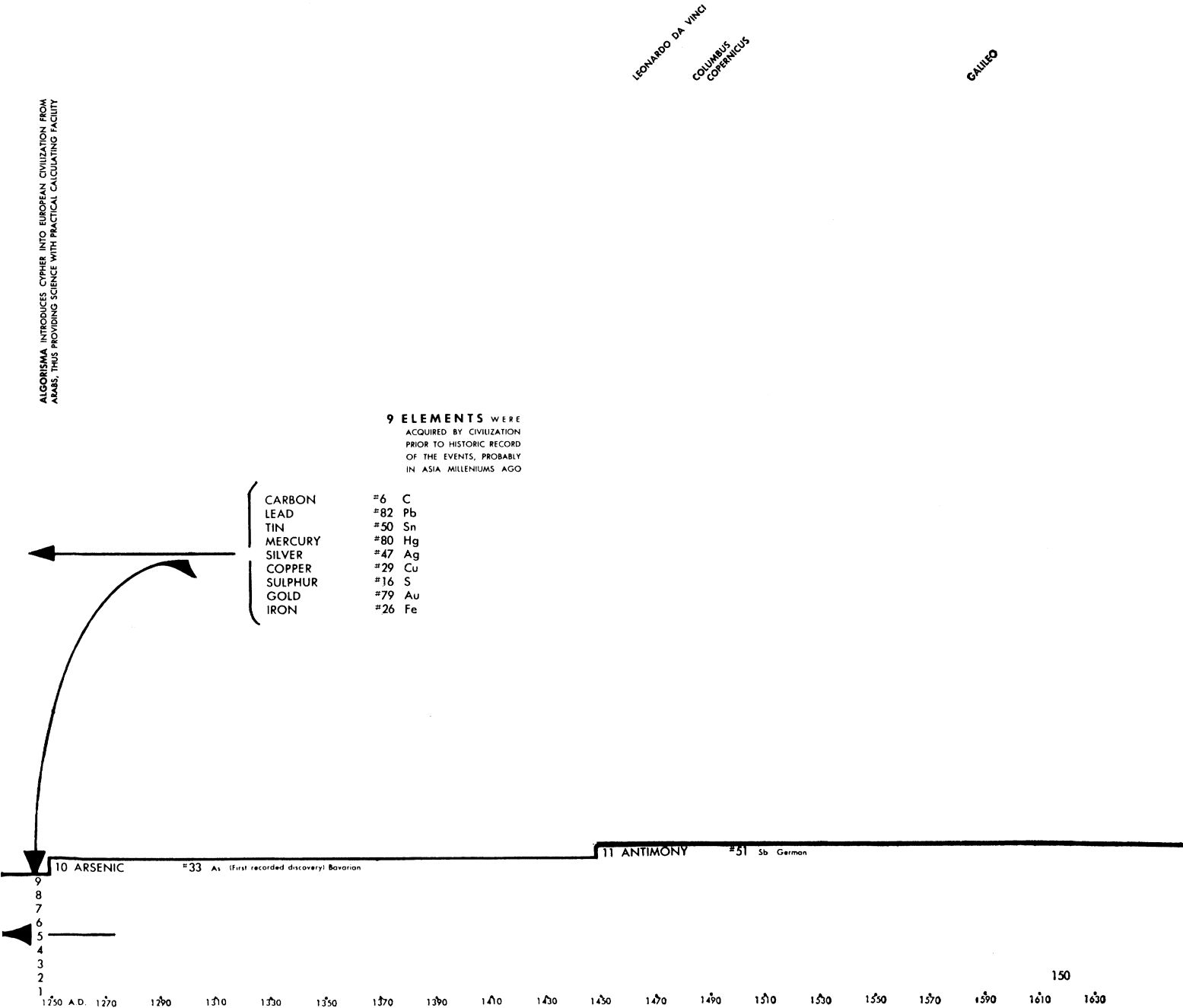
Probably the most significant consequence of the application of this knowledge is man's alteration thereby of his ecological patterning in universe.

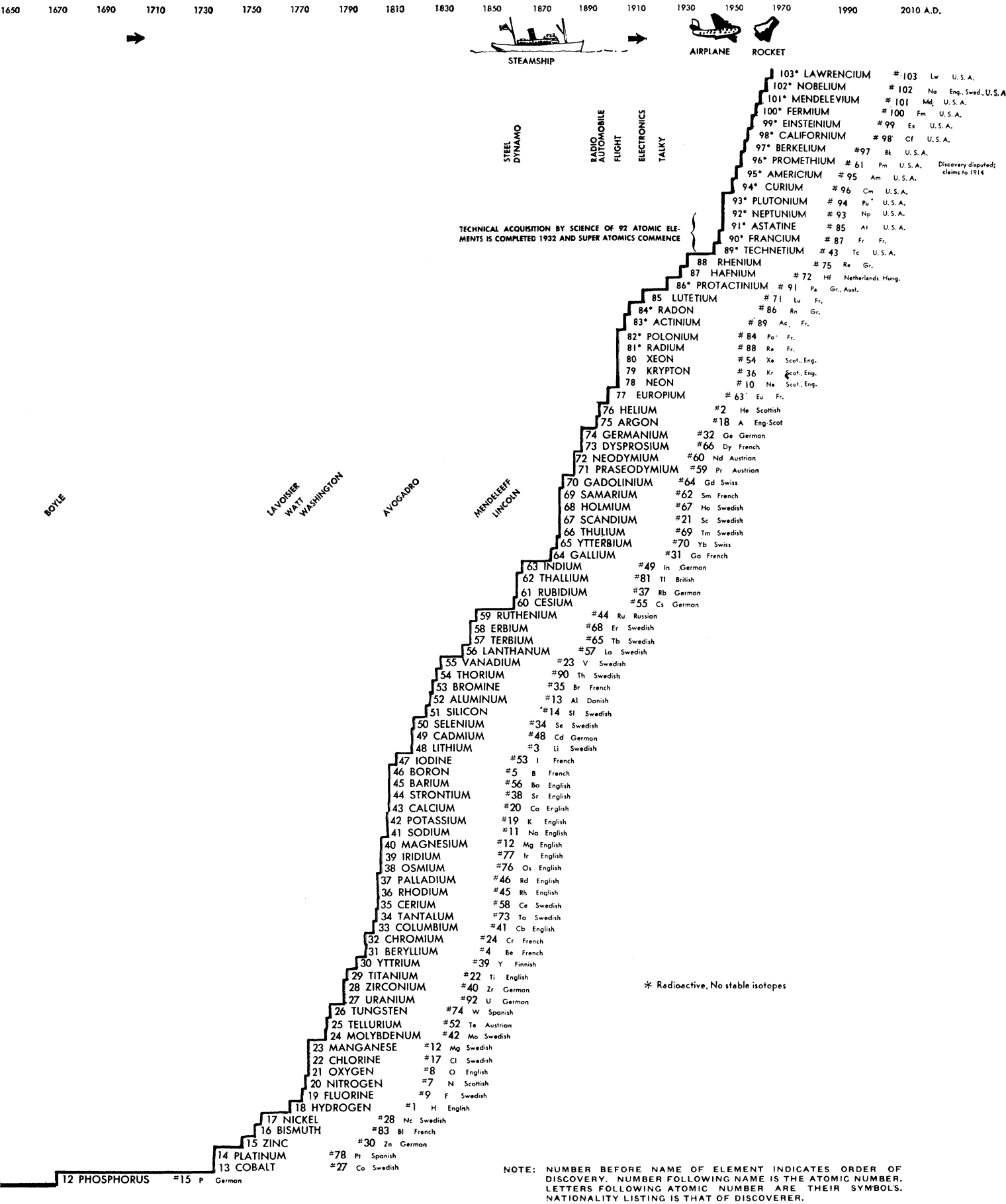
Amongst all the species of life on earth, none of them, other than man, has consciously participated in the fundamental alteration of their overall, lifetime, ecological sweep-out patterning. Eels, plovers, and many other biological species *unconsciously* were forced to alter their total lifetimes' cumulative ecological patterning—by the comprehensive earth surface changes induced by the successive ice ages. As ice receded, cold-area-breeding types of life were forced to ever-larger annual migrations between the most favorable *tropical feeding grounds* and *arctic breeding grounds*, respectively. This was *unconscious* participation in the fundamental alteration of ecological patterns. The designing and building of a hydroelectric dam or development and pro-



EARTH ORBIT IN MAN MADE ENVIRONMENT CONTROL:
PRODUCT OF SUCCESSFUL APPLICATION OF HIGH
PERFORMANCE PER UNIT OF INVESTED RESOURCES

PROFILE OF THE INDUSTRIAL REVOLUTION
AS EXPOSED BY THE CHRONOLOGICAL RATE
OF ACQUISITION OF THE BASIC INVENTORY OF
COSMIC ABSOLUTES—THE 92 ELEMENTS





duction of an antibiotic constitutes *conscious* participation by man in the evolutionary pattern transforming of universe.

Up to, and including, my own father's generation, men were limited essentially to motion accomplished almost exclusively by their own leg motion—mildly increased by horse and vehicular travel. In 1914, American man was averaging 1640 miles per year total travel. Thirteen hundred miles were accomplished by his (integral) legs, and 340 additional miles were accomplished by his (non-integral) "vehicles." This vehicular augmentation was a motion increase of only 25% over his legs-realized motion. As a consequence of mass production of the equipment of mobilization during World War I, in 1919, United States of America, man covered 1600 miles by vehicle alone—in addition to his continued 1300 miles per year walking—a total of 2900 miles per man. By 1942 U.S.A. man was averaging 4500 miles per year by vehicles plus 1300 miles per year by legs or an annual total ecological sweep-out of 5500 miles per year.

In view of the "life expectancy tables" we find that the total miles of an average human's lifetime mileage, to-and-froing, ecological "sweep-out," up to and including my father's lifetime, was only 30,000 miles. However, at 69 years of age, I have already covered three million miles which is one-hundred-fold the lifetime distance accomplished by humans of any previous generations. I am one of a class of several million human beings, who, in their lifetimes, have each covered three million miles or more. The class of senior airline pilots has covered severalfold my three-million-mile "sweep-out." Astronauts equal my three-million-mile "sweep-out" every one hundred circuits of the earth, i.e., in approximately every four days of Earth orbiting. All these dramatic alterations of the ecological pattern of man, as shown on the chart have accrued directly to the inventory of Cosmic Absolutes—"canned" and put on the "potential use shelf" by pure scientists, working like bees to store the "honey" utterly unaware of the value to man of that honey or of what man will do with it.

To realize *ecological pattern transformation* requires that man penetrate environments theretofore intolerably hostile to his naked existence. His invention of hats and clothing first permitted man to penetrate hot and cold regions theretofore intolerable to him. Clothing represented man's first environment-controlling and ecology-transforming tool. When

man built himself a house making possible his existence during external development of hostile conditions, it did not alter, however, his ecological patterning *geographically*—anymore than did his retreat into a cave. To make fundamental alteration of his ecological sweep-out, man must *propel his harm-immunizing, controlled environment into geographical realms of previously intolerable environmental conditions*. He must *propel the environment-controlling device by his control of power systems external to, and greater than, his bodily power system*.

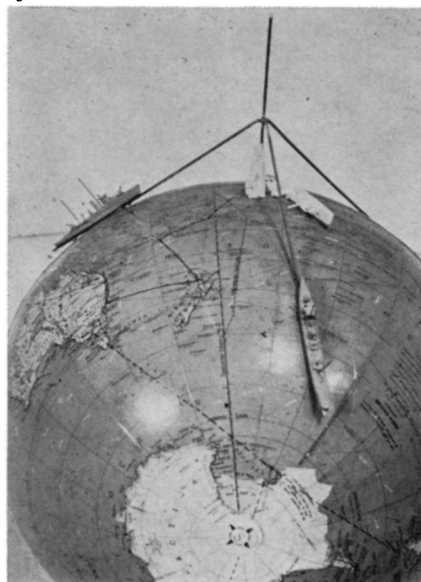


Figure 2.

In order to maintain a *uniform measure of the magnitude of effectiveness* of such (previously intolerable) hostile environment penetrations by man, I have documented *man's circumnavigations of the earth—inside his succession of improved environment-controlling machines, as propelled by energy patterns, which, though indirectly controlled by man, are nonetheless external to and greater than his integral, metabolic energy-conversion, propulsion capabilities*.

As shown by little symbolic pictures along the top area of the chart, the first such circumnavigation of Earth by man was accomplished within the wooden sailing ship, which took approximately three years. About 350 years later man circumnavigated Earth in a steel steamship, taking approximately three weeks. Seventy-five years later he circumnavigated the earth in an aluminum airplane, taking approximately three days total flying time. Thirty-five years later he circumnavigated Earth in an exotic metal structured, rocket capsule, taking a little over an hour for each orbit cycle.

We have in the decreasing intervals between the progressive modes of circumnavigation as well as in the con-

tractions of the successive elapsed times for the circumnavigations both a second and third power acceleration of the original velocity rate of pure science growth as demonstrated by the prime family of 92 chemical element isolations. To be realistic we must now multiply this third power acceleration by a fourth coefficient. The fourth coefficient is the conceptual regeneration induced in the human mind by the concomitant *visual information* circumnavigation of Earth now being accomplished by the team of Telstar satellites whose world-around relayings of the electromagnetic wave-borne TV communications will result in a four-dimensional acceleration of man's teleologic and conscious participation in universal evolution.

The extraordinary fourth power acceleration thus to be realized by man in the distribution of technology-generating information, through computers—electronics in general—and the world-around information relay, will integrate the total acceleration of the rate of human ecology transformation to a fifth power progression. Within ten years anything reasonably "thinkable" by science fiction will probably have been realized.

I know of no device as effective as this chart to generate comprehension of the unprecedented rate of experience acceleration into which man has now entered.

Along the bottom of the chart the numbers 150, 450, 1450, and 10,000 occur in approximation of the cumulative number of key science and technology inventions realized by all men, everywhere, up to the historical dates at which those numbers are posted. I have not yet made accurate check of the 1964 historically cumulative number of inventions, but it is in the magnitude of millions. It can only be measured effectively at a later date.

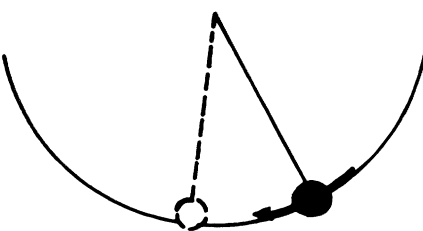
Just go ten years to the right of the first man orbiting of Earth in 1961, and you may safely say that by 1971 anything dreamable can happen. When I stand up here for instance and talk about changing obsolete, ineffective and debilitating school patterns, the established reflexive conditioning of our brains tends to expect that it would take another 100 years to bring about that change. But the rate at which information is being disseminated, integrated, and inhibited into our current decision making regarding the subjects I am discussing comprehensively discloses that my discourse constitutes subconsciously the general atmosphere of our thinking. The changes indicated as desirable are going to happen very, very rapidly. And I would say to you as educators, thinking about what you

may dare to undertake, “don’t hesitate to undertake the most logical solutions. Take the biggest steps right away and you will be just on time!”

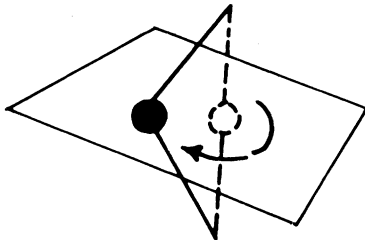
(Figure 2) Change has become recognized now as normal. Just think. Isaac Newton’s first law of motion was “A body persists in a state of *rest*.” Then he said, “or in a line of motion” as a secondary thought, “except as affected by other bodies.” Normal was at *rest*. Change was abnormal. Einstein gave us the opposite concept in which he made the *velocity of light* the *normal speed* and the normal pattern of an all-acceleration universe. Any other lesser velocities or apparent motions were abnormal. We are now in an all-Einstein world. As a consequence of the extraordinary acceleration of technology in World War II, brought about by the technological competition to have airplanes out-perform each other, we suddenly came to the realization that change was realistically normal. Man is now consciously coordinate with evolution as a continual process of change. Most recently business men have been acknowledging change to be normal and most profitable. In the past men felt that (other than fashion) changes would always be too costly and preclude profit making. Yesterday’s businessmen opposed change politically. The 1964 Presidential election saw business supporting change for the first time.

The picture which comprises Figure 2 is of a model of a collision at sea. . . . I was told in school about Gallileo’s parallelogram of forces. It is drawn on a plane where you show one body running at a certain velocity in a given direction. You multiplied its weight times its velocity and that made the length of the line; we called such a force line—a vector. Then we had another body which was on collision course with the first moving body, which we had vectored. And you took the second moving body’s weight times its velocity and that was the length of the second line or vector. And the second body also was going in a unique and discretely identified compass direction. You had these two moving bodies come together and then you made two other lines parallel to the first set of two vectorial lines and they made a parallelogram with the first two vectors. Next you made a long diagonal in that parallelogram from the point of collision to its diagonally opposite corner. Then you extended the long diagonal outwardly from the parallelogram from the point of collision, extending this line to a length equal to the diagonal already constructed inside the parallelogram and that external equidistant ex-

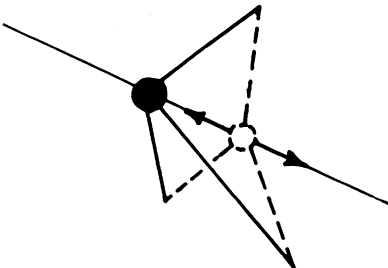
Investigation of requirements for a minimum system within the universe.



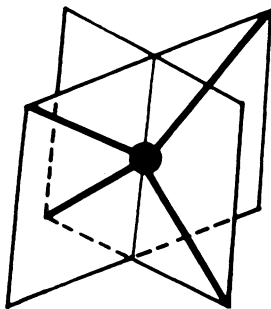
One vector of restraint allows ball to define complete sphere—A 3-dimensional system.



2 Vectors: A plane—A 2-D system



3 Vectors: A line—A 1-D system



4 Vectors: A point—no displacement

Figure 3.

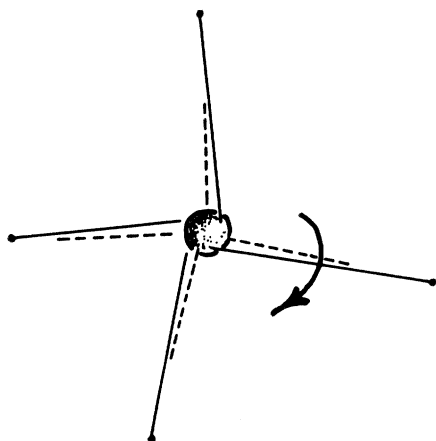
tension of the diagonal of the parallelogram was called the *resultant* of forces. In the Navy I had also been taught Gallileo’s parallelogram of forces—at the Naval Academy. For some reason that I don’t know of it was never considered at the U.S. Naval Academy that when two ships ran into each other, Gallileo’s force diagram told us that following the collision as indicated by the “resultant of forces” the two ships were supposed to waltz north-northeast for 12 miles together. I saw as indeed most all sane men see that such behavior was just what the ships didn’t display after collision. One of them went in towards the center of the earth and that wasn’t in the diagram. I decided that this criticism was typical of my general suspicion that we were not start-

ing with the right set of axioms or simplest concepts, as for instance when we said that “plane” geometry is more fundamental and therefore easier than solid geometry, and that a dynamic geometry was something prohibitively “way out” in relative difficulty of comprehensibility. “Geometry didn’t have qualities of energy!” said the pure mathematicians. All their complete abstraction of pattern from reality of experiences was thought to be simple. I discovered that nothing can be more complicated than “plane” geometry nor a more highly specialized case of “Pure mathematics.” Plane geometry is the most special case of “not true at all.”

So here is a picture of two ships running into each other on the wavy surface of spherical Earth. One of the ships goes towards Earth’s center. One of them does go a few hundred feet in the direction of Gallileo’s resultant of forces but not 12 miles. We find that in reality four forces are operating. Two accelerate conically together, rising from Earth, plus *gravity*, plus the *resultant*. When the ships first ran into each other, they actually rose outwardly from Earth’s center because in acceleration both ships were “trying” to leave the earth. If they could accelerate faster—like rockets—they *could* leave the earth. So, when two ships collide they usually rise outwardly against gravity, as this picture shows, before they subside, and then one or both either go into the bottom of the sea or go a few yards in the direction of the resultant of forces. The pattern of real force lines looks very much like a music stand—three vectorial legs spread out with a fourth vertical vector. And so I began to discover and study what we may call fundamental angular degrees of the vectorial interactions of universal freedoms.

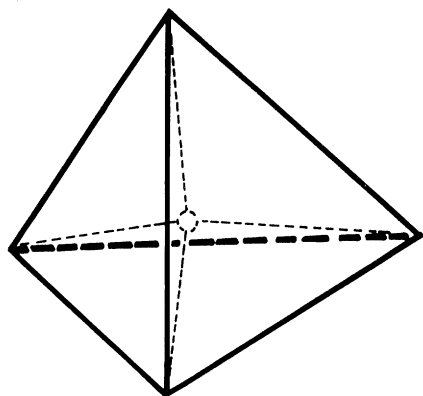
(Figure 3) I’m going to give you a swift but fundamental insight in respect to the fundamental vectors and their degrees of universal freedom. I think that these vectorial and angular degrees of freedom relate mathematically to the fundamentals of music. These are the fundamental generalizations of structure and transformation.

I said to myself back in 1917, “Inasmuch as the planar force diagrams with which we were taught are, to say the least, ‘inadequate’ is it not possible for us to find an adequate model for ourselves—an omnidirectionally interacting, minimum set of vectors?” We have to deal always in the reality of an omnidirectional physical universe. I said, “How many forces are really operating on us?” For instance, there are clusters of stars out

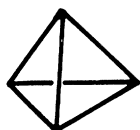


Note the possibility of turbing within the position otherwise fixed by the four vectors of restraint.

The four vectors define the tetrahedron: the first identifiable "system" (a primary or minimum subdivision of universe).



The ball lies at the center of gravity within the tetrahedron.



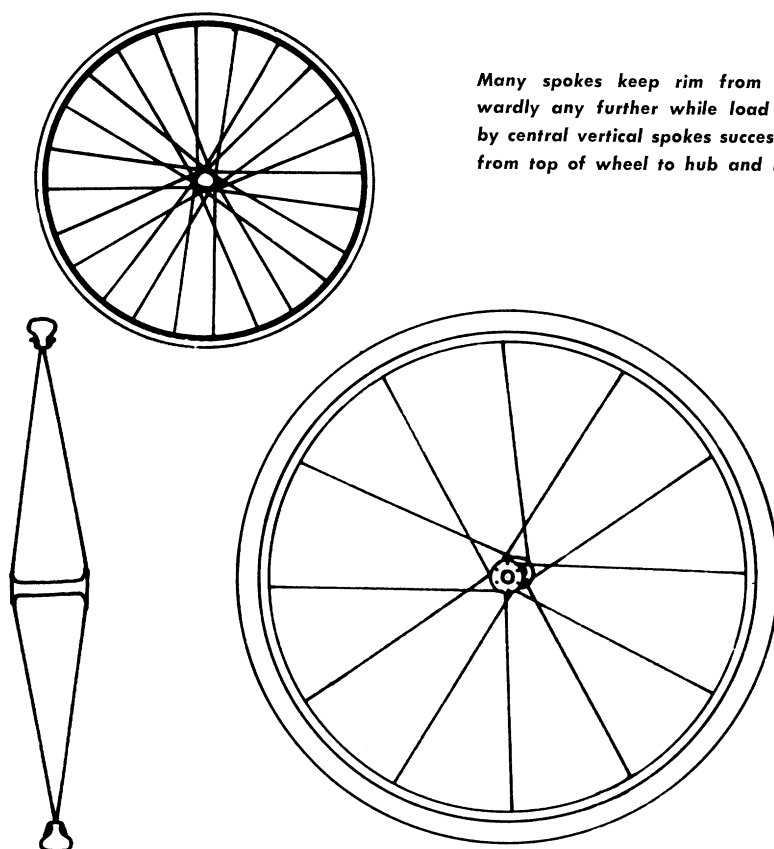
The tetrahedron
Figure 4.

there, millions of stars, that look superficially like just one star, such for instance as the Pleiades. I am sure that the gravitational effect of that group on me is a linear one. "So how many fundamentally separate force lines of universe are there impinging on me? Into how many separate vectors do all the stars' and planets' gravitational pulls on me collect? How many universe lines (like the lines tying a ship to a dock) are pulling constantly on Earth and even on me?" So I contrived an experimental device for exploration of the problem. At the top right-hand side of the picture you see something looking like a ping pong ball on a thread. The ping pong ball represents *me* and the *universe* is the thread whose other end is "fixed." I've found a hole in the stars and I go "zooping" out as far as I can so that all of the stars of universe seem to collect and appear as approximately one. One thing that I can't do is get out of, or

absolutely away from, the universe so the single string representing the gravitational pull of all the remotely bunched stars of universe is always attached to me. With this single restraint I can make omnidirectional patterns like a "tether ball." I can make spherical patterns, waves, any omnidirectional patterning I like. The only freedom that I can't demonstrate is that of getting entirely away from universe. Universe means "towards oneness" and implies a minimum of twoness. I say "universe is plural and at minimum—two." Now, in the second picture below the first I give myself a second restraint, so I have two strings pulling on me. Now I am as though I were in the middle of a violin string. I can still move as though I were a knot tied in the middle of a

restraint then for the first time, I seem to be positionally immobilized in respect to the four relatively "fixed" outer ends of my restraining lines.

(Figure 4) You discover that you are not yet completely immobilized because making a model with four delicate steel wires attached perpendicularly and symmetrically to a steel ball at the center of the modeled system of restraints you'll find that you can put a stilson wrench on that steel ball in the center and you can always torque or rotate it. So I (as the four-foldedly restrained ball) can't move from that localized spot. But I can *twist in place*, and I can twist locally in several different ways. In fact, in order to keep "me"—in the ball—completely immobilized you have to divide each of the four restraints into three



Many spokes keep rim from bending outwardly any further while load is suspended by central vertical spokes successively leading from top of wheel to hub and its load.

Takes minimum of 12 spokes to fix hub position in relation to rim. Six positive diaphragm, six negative of which respectively three each are positive and negative, opposed, turbing or torque members.

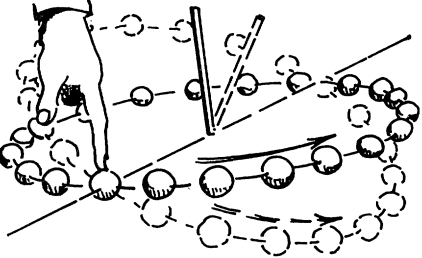
Figure 5.

violin string. I can move now only in a plane. I can make planar figures of eight and planar clover leaves perpendicular to the axis of the violin string, but I can't get out of the plane. I'm going to give myself a third restraint. Now I am as if I were in the middle of a drumhead. I can still move but I can only move in a line perpendicular to the "drumhead" plane described by three convergent lines. I can move vertically to-and-fro to make a positive and negative flat tetrahedral "drumhead." If I give myself a fourth

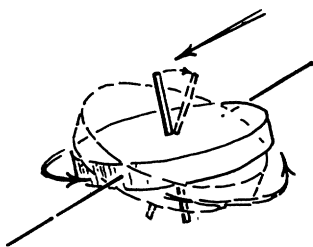
lines each and then they must come in crisscrossing each other tangent to the sphere. Thus it takes a total of 12 restraints for Universe to completely immobilize me—four to localize me and eight more to lock me rigidly into a system.

(Figure 5) Next we find that it takes a minimum of 12 spokes to make a wire wheel—to keep the hub from oscillating as a drumhead or twisting in any way. So we discover that there are always only 12 fundamental vectors which converge as the angular de-

degrees of freedom in the universe: 6 positive vectors and 6 negative, which, when symmetrically interacting, represent the 6 edges of the positive phase of the tetrahedron and the 6 edges of the negative, or vertexially inside-out phase of the same vectorial tetrahedron.



The flywheel of a gyroscope considered as a ring of balls.



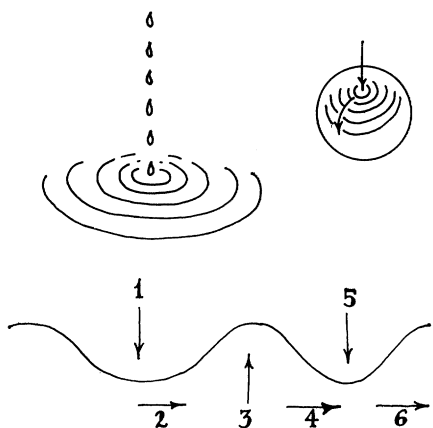
When downward pressure is applied to the edge of a gyro flywheel its plane of rotation tilts along a horizontal axis created at the point of force.

This effect from downward pressure at the edge can be produced by a horizontal force at the axis.

Therefore the axis of the gyroscope tips at right angles to the force exerted. Such a ninety degree reaction is a precessional effect.

Figure 6.

(Figure 6) I'm not going to tell you much about this picture except that it explains *precession*. It shows why a gyroscope does what it does. Children learn a great deal about fundamental motions. Using their own bodies they learn how to (1) *roll*, how to (2) *spin*, how to make a big circle (3) *orbit*, while also spinning (so they can have axial rotation—spin—while in orbit) and they learn how to turn themselves partially (4) *inside out* by sticking their tongues out. They learn (5) to *oscillate*, i.e., how to *converge* and *diverge* by inflating and deflating their lungs. But when you say (6) "*precession*," that is one motion that they do not understand, because they did all those other five motions with their own integral bodies forgetting the reaction motion of the Earth when they rolled and orbited, etc., for the reaction motion of Earth is not visible to them. *Precession is the motion effect of a body in motion upon any other body in motion*. So when the children just take a step they are literally precessing the earth and the earth is constantly precessing them. When your uncle gave you a top and you asked him to ex-



A precessional sequence: illustrated by water waves radiating from a central point, each force producing a reaction at 90°.

Figure 7.

plain its slow secondary wavy axial motion as it spins rapidly, he couldn't seem to explain it to you. The top's complex of motions within motions is precession. After long pondering I found it is quite easy to explain. But

I am not going to have time now because I am pledged to finish this exposition on time. I'll just simply say to you, that in precession, the resultants of forces are never at 180 degrees. It is impossible to throw a "straight" ball. Gravity, the wind your releasing hand and throwing arm precess its flight into a helical pattern—often imperceptible (almost). These 6 motions each have their opposite motion—ergo our (6 positive, 6 negative) or total of 12 fundamental angular degrees and vectors of freedom.

(Figure 7) It is precession when, for instance, you drop a stone into the water. You will always get eccentrically developing waves in beautiful circles. A stone in motion is going towards spinning and orbiting Earth's center and plunges into the Brownian and other movements of water. Out go the circular waves at 90 degrees to the stone's line of motion. And those waves that go horizontally *outwardly* precessionally beget vertical motions.

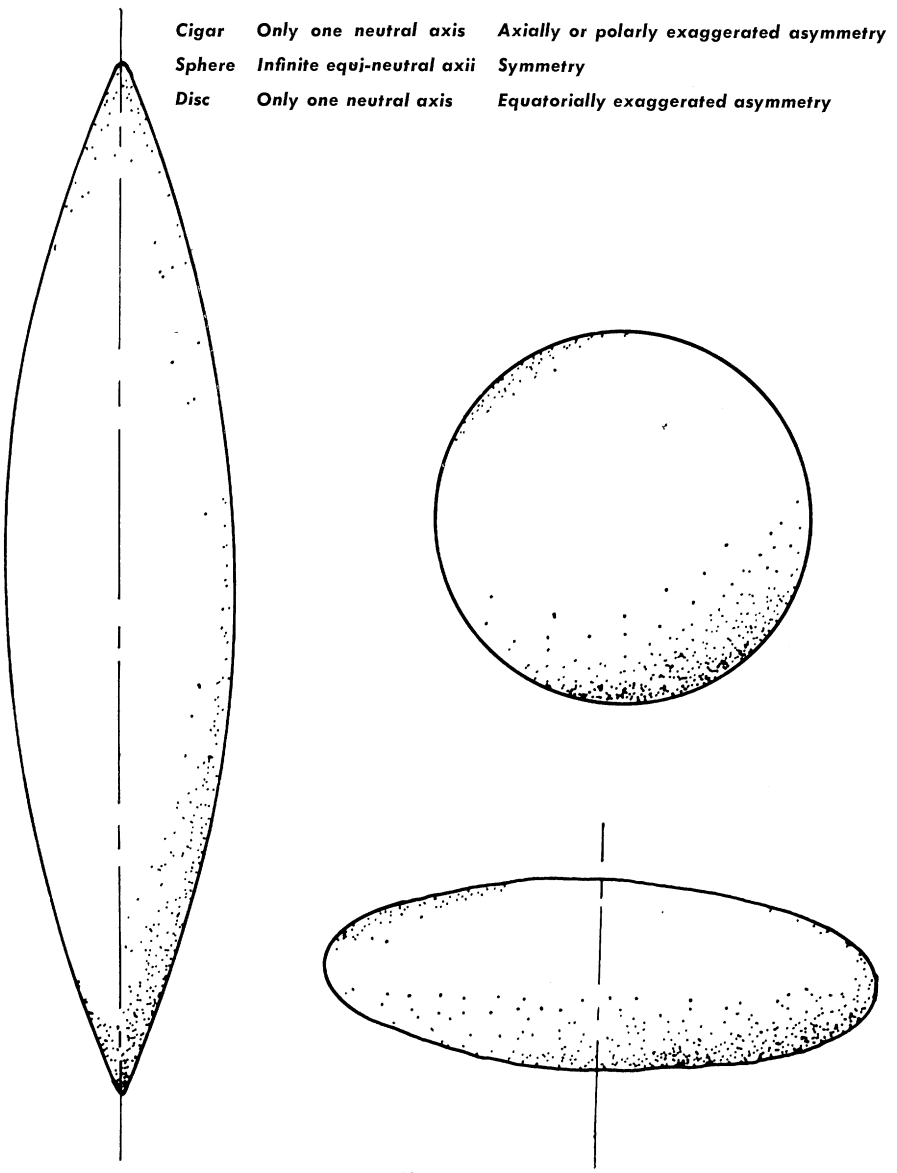


Figure 8.

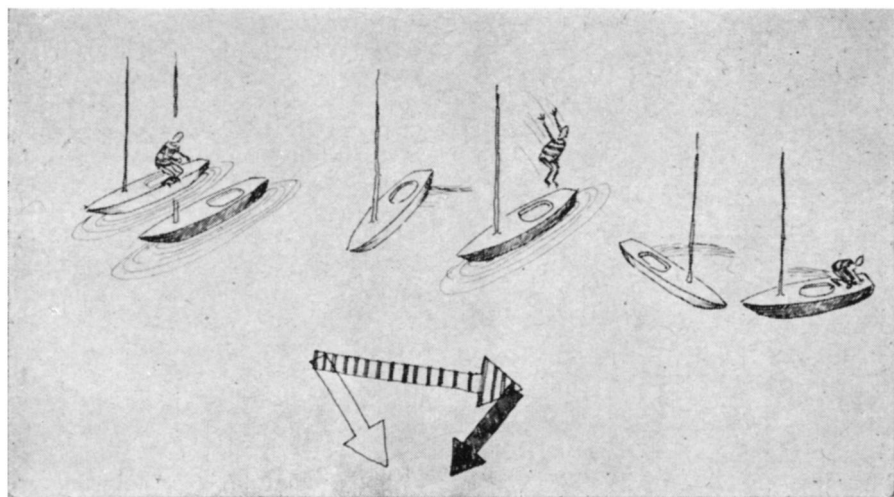
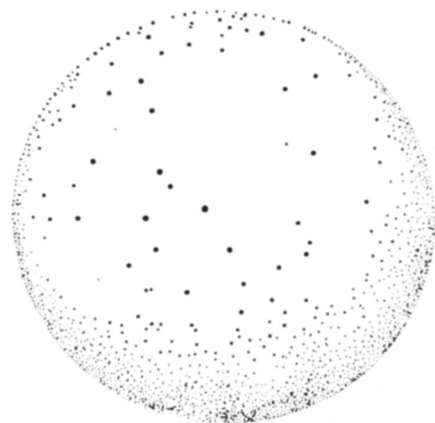


Figure 9.

Then the vertical motion of the waves begets precessionally a further horizontally outward motion. The precessional 90 degree regenerations of motion altogether cause the wave's pattern—as a whole series of precessions. Precession is regenerative.

(Figure 8) When we push on a cigar-shaped column it tries to become a squash. Its girth gets bigger. Therefore, its girth is stretching thinner. Therefore, its girth is in tension in a plane at 90 degrees to the pushed-together axis. While you are pushing on the ends, the cigar column's girth is going into tension at 90 degrees. I pull on the rope, and put it into axial tension. As I do so its girth begins to contract which means that its girth is going into compression in a plane at 90 degrees to the axis of tension. The resultants of compression going 90 degrees into tension and vice-versa are typical of precessional resultants. The sphere precesses positively as it transforms towards a planar disc, and pre-



A sphere is a plurality of events approximately equi-distant in all directions from one event.

Figure 10.

cesses negatively as it transforms toward a line.

(Figure 9) And here is a man jumping from the stern of a boat onto another boat. As a complex of the re-

sultant motions the boats come around and the bows run into each other. This is typical of the non-180 degree-ness of the precessional effect.

(Figure 10) We've been told by the Greeks and we've accepted it for too long that a sphere is a surface equidistant in all directions from a point. What I am going to show you about the sphere may be considered by you as typical of the way axioms are found to be both erroneous and experimentally inadequate. A sphere was defined by the Greeks as:—a surface equidistant in all directions from a point. It could not have holes in it. Because if it had any holes in it, it would turn inwardly as you came to the holes and therefore the surface would no longer be the same distance from the center. So the definition of the Greeks was of some kind of a continuously and absolutely "solid," ergo utterly impervious surface phenomenon that completely surrounded that point. The definition means that the Greek sphere would then divide the whole universe into all of the universe outside the sphere and all the rest of the universe inside the sphere and because there are no holes in it, there could be no traffic of any kind between the two absolutely divided sections of universe. This scheme is a typical perpetual motion machine because it completely defies what physics has found experimentally to be the case. All local systems (and a sphere is a local system) are continuously losing energy to outside universe. This is called *entropy*. It is the famous second law of thermodynamics. All local systems are full of holes; in fact, as physicists have discovered experimentally by probing the atom and its nucleus there are no "solids." As we probe into the "solid surface" of an experimental sphere we come to the atoms as very remotely deployed sets of energy "star" events, and we find we're dealing in a diaphanous milky-

way array of nebulous "abstract" mathematical events in which half of all the component events have negative-weight wherefor altogether their weights average at zero—and there goes the last hope of the "pure" mathematician that his non-solid abstraction "solid" concept had any meaning whatsoever. The best definition that we can have of a sphere is a *plurality of events approximately equidistant in approximately all directions from approximately one event, at approximately the same time*. Thus we tentatively restate our fundamental definitions of *experimentally* encountered systems and their internal and external relationships. They are really just childish descriptions stated in terms of our direct experience.

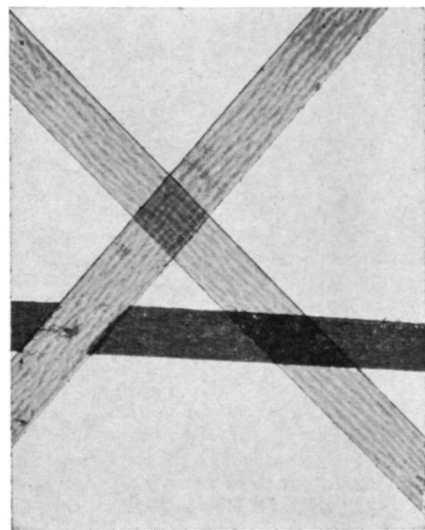


Figure 11.

(Figure 11) Another thing that we are always told, which scientists and engineers as yesterday's schoolboys as yet accept, is that in both Euclidean and non-Euclidean geometries the pure mathematicians say that you can run a plurality of lines through any one point. The engineer puts a point on paper and takes his straight edge and painstakingly draws line after line (approximately) through (approximately) the same point. And he assumes this to be both theoretically and realistically done. But try this with your knitting needles or get the smallest lines you can get. In fact reduce your line to the size of a neutron's diameter. Let your "line" be the trajectory in the cloud chamber of a neutron shot into a plurality of atoms and suddenly there is an interference of the trajectory as the neutron interferes with another nuclear component's linear trajectory and the component separates into further sub-components as all of the individual atomic components now diverge angularly from one another in identifiable angular directions unique to each,

having failed to permit the neutrons simultaneous passage through the one point of interference. Because they can't go through the same point at the same time we get little angles by which cloud-chamber physicists recognize the subatomic particles. If lines, which experimentally are always vectors, are unable to go simultaneously through the same point, then we can't have "planes" which were absurdly thin wafers of solids. Thus we find that we are dealing with a very different kind of a universe from the one that we were told about and the children as yet are "learning" about in the grade schools.

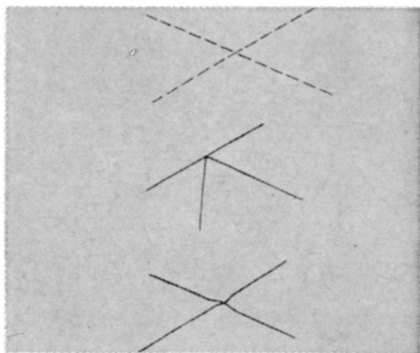


Figure 12.

(Figure 12) Because you can't have two actions going through the same point at the same time, we have the phenomenon of *reflection* with which we are all familiar or we have *refraction*. Those two experimentally reliable *interference* phenomena are direct consequences of the fact that actions cannot take place through the same point at the same time.

(Figure 13) Now, something we are all familiar with. One of the first surprise experiences in each young life is seeing somebody hitting something at a distance and realizing that they, the observers, are hearing the hitting event somewhat after they see it. Up to this time, the children thought that all their faculties were *simultaneously* and *instantly* coordinate and operating at equal velocities. Einstein showed that neither *simultaneous* nor *instant* are valid, i.e., experimentally demonstratable. In World War I with many airplanes in the sky, we began to realize that we were hearing them in this direction and seeing them in that other direction. Then as the planes got bigger and faster and flew higher, we began to experience enormous distances between where we thought we heard them and where we thought we saw them. The highest airplanes we can see with our eyes, as little glintings in the sun, are flying at about 40,000 feet or only about 8 miles out from the surface of the earth, and 4008 miles out from the center of the 8000-

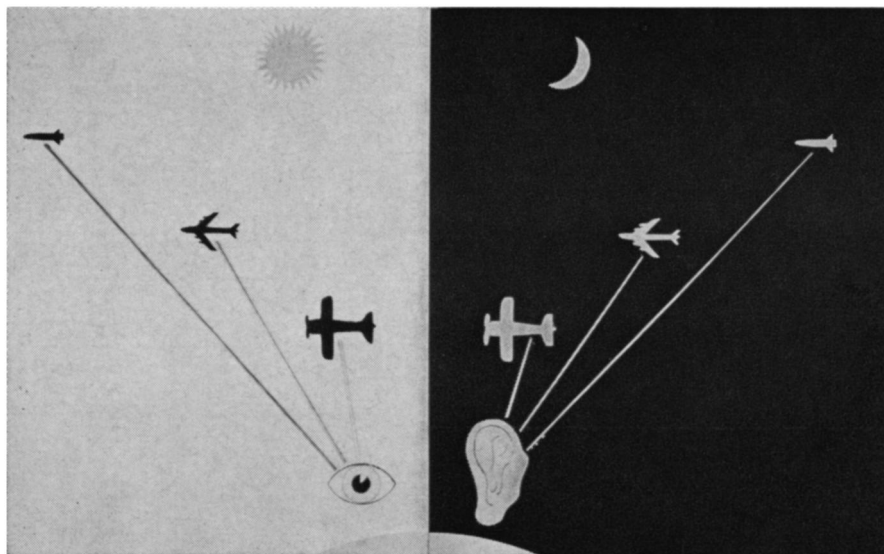


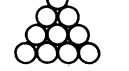
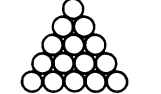
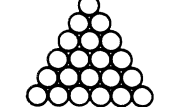
Figure 13.

mile diameter of the earth. The 8 miles is a negligible distance, only one-thousandth the Earth's diameter. The highest orbiting of manned satellites has been at 380 miles outward of the Earth's surface. This is a distance which is only one-twentieth of the Earth's diameter—equal to an inch away from a basketball's surface. Today, man hasn't as yet gone "far out." Our nearest star, the sun, is 92 million miles. And it takes 8 minutes for the light to come from the sun to us. Then the next nearest star is so far away that it takes days for the light to come to us. Our eyes do not tell us the different distances of the stars in the heavens which seem to be in a great spherical bowl array at apparently equal radial distance from us. The stars seem utterly motionless because when objects move at a great distance from us, we cannot see their motions. The stars are all moving at fabulous velocities but the interpositional relationships in respect to our lifetimes seem changeless. We do know but do not sense that we are looking at many stars that haven't been there for sometimes millions and sometimes billions of years. We do not have any conception of what the true geometrical interrelationships of those stars might be to each other. Their most economical interrelationship patterning might be a surprisingly regular geometrical pattern. The chaotic array is the consequence of differentially delayed information from very great distances.

Observe that when we send up four rockets, at $\frac{1}{2}$ second apart, their after-images are approximately simultaneous. So, we say that we see four rockets "at the same time." The illusion of simultaneity is one of the most important illusions for us to consider. Musicians may be able to com-

prehend nonsimultaneity better than do others. Einstein emphasized the importance of attempted spontaneous comprehension of the nonsimultaneity of all the events of universe—a concept akin to our discovery that in our universe none of the lines can ever go simultaneously through the same points. In the realistic concept of the nonsimultaneity of events of universe, we lose forever the conceptual validity of the static pictures which man had assumed in accord with Newton's norm of "at rest." People say, "What is the shape of the universe?" and "What is outside of outside?" The question assumes that everything in the universe is actually in simultaneous static array with no consideration of all the myriads of stars that just aren't there, and haven't been for billions of years. What Einstein is telling you is that none of the events occur at the same time. There is some illusory overlapping of events from special eclipse viewpoints but we are dealing with a universe of completely nonsimultaneous events. There is no inherently composite picture of "May Day in Moscow, 1923" and the inside of a brand new juke box in an Atlantic City hotel in New Jersey, Christmas Day, 1965. There is no inherently logical montage of these nonsimultaneous, unspecified viewpoint concepts. We take the dictionary, all the dictionaries, of all the languages and make them into one great big book. In that book we'd have all the word formulations accruing to all attempts of all men through all history to try to explain all their nonsimultaneous event experiences. We can say that this is one big composite dictionary with only the latest words of the latest year left out. That's like saying the word *universe*. But you cannot put all those words together simul-

UNDERLYING ORDER IN RANDOMNESS

No. of Events	Conceptuality of number of most economical relationships between events or minimum number of inter-connections of all events	No. of Relationships $\frac{n^2 - n}{2}$	Closest packed, symmetrical and most economical conceptual arrangement of number relationships.	Sum of Adjacent Relationships $(n-1)^2$	Conceptuality in closest packed Symmetry Note: This occurs as  "diamonds" and not as  "squares".	Sum of Experiences or of Events Is Always Tetrahedral
1		0				
2		1		$0 + 1 = 1$		
3		3		$1 + 3 = 4$		
4		6		$3 + 6 = 9$		
5		10		$6 + 10 = 16$		
6		15		$10 + 15 = 25$		
7		21		$15 + 21 = 36$		
7	 Same number of events could be in random array but minimum total of relationships are same in number.	21				

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Figure 14.

taneously in one meaningful sentence. Nor can you even open one page and comprehend a coordinate meaning out of all the words. Nor can you read all the words simultaneously. In fact, you can only deal meaningfully—with one word at a time. And by the time you finish reading one you have to begin with another. And so we get a sequence of events. There is no validity in the concept of a universe of non-simultaneous events as a unit and simultaneous shape—with an inside and outside. It becomes exciting to realize that we are not logically required to formulate a simultaneous shape universe. We need not bother any more about what is outside, because what you think that you see outside may now be inside. So there is no inherent inside or outside of the aggregate of universe's ages of non-simultaneous events. We find that the word "in" expresses a direction towards the center of a specific body. "In" is unique to individual bodies but "out" is common to all and "out" has no shape. Inside-outing of nonsimultaneous event relationships from

heterogeneous time viewpoints of universe is inherently shapeless, ergo nonconceptual.

(Figure 14) I find this chart to be one of the most exciting I've been able to put on paper. There is a column on the left-hand side where you just see the numbers 1, 2, 3, 4, 5, 6, 7. In the second column you see first one black spot. Below it you see two black spots and below them are three black spots and some little lines connecting them. Now, those lines connecting them represent the minimum number of telephone wires that we would have to have to connect each of the points privately with each of the other points in its group. The black dots of the second column each represent just one *experience*. In the first row there is only one experience which does not need a telephone relationship. But down below it, there are two experiences and there has to be one telephone wire between the two for each to be able to communicate privately about their respective experiences. We could say that for A to telephone B is different than for B to telephone A (A being

the President of the U.S.A. and B the village barber). We may if we wish say that each telephone wire is worth two because it has two different alternative calling orders. For the purpose of simplicity I will hold consistently to the single mutual value of *one* as the true minimum number of telephone wires necessary to provide private hookup between any two telephone *callers*. These I speak of as *experiences*. In the third row of the second column there are three experiences and we find that there are three private connections. Down below it there are four experiences and we find that there are six connections. You can express these relationships algebraically. In the top one, you have A, and A has no relationship. In the next one, you have AB so you have the relationship AB. So you could say that BA is the negative but it is AB when A is talking with B listening and it is BA when B is talking and A is listening with only one telephone wire necessary to that functioning. A set of negatives and positives do not require more connections because negative



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(Führwahr, Er Trug Uns're Krankheit) Franck
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and positive cannot simultaneously occupy the connecting line. In the third row we have ABC. So you say, AB, AC, BC. There are three relationships. The fourth line has four experiences ABCD. And they could be expressed uniquely as AB, AC, AD, BC, BD, CD. So you get six. Then below that, I have 5 experiences ABCDE and they have 10 relationships, 10 telephone wires. Below that, I have 6 and they have 15 telephone wires. Below that, I have 7 and they have 21 telephone wires. Therefore the number of telephone wires are not the same series of numbers as the series of experiences numbers.

We also note that for three experiences there are three telephone wires and for two experiences one private wire but for four experiences six telephone wires. We can say that in the case of four or more experiences the number of private wire relationships is always greater than the number of experiences. We may also say that the minimum number of "private wire" relationships between any number of experiences is always $\frac{N^2-N}{2} = R$

—where N equals the number of experiences and R the minimum number of relationships. So the third column of our chart gives the number of $\frac{N^2-N}{2}$ telephone wires and reads

1, 3, 6, 10, 15, 21, corresponding to 1, 2, 3, 4, 5, 6, 7 in column 1. Then in column four to the right, I have a series of circles in groups of the most economical and symmetrical arrays possible. The number of circles in these symmetrical clusters show how many telephone connections were necessary for that row's number of experiences. So to come down to the second line reading across, we have two experiences. And we see that one telephone wire and it says "one" and I have one little black line circle in the fourth vertical column. In the row below that we have three experiences and three relationships. So I have three circles in the fourth vertical column and they make a little triangle. On the fourth line there are four experiences and they have six relationships so we count the little circles:—1, 2, 3, 4, 5, 6, also making an equilateral triangle. We come down to the line below where we have 5 experiences and they have 10 relationships, and you count the little circles in the triangle—1, 2, 3, 4, 5, 6, 7, 8, 9, 10. So in the one below, we have 6 experiences and 15 relationships and you count the circles in the triangle and you will find that there are 15. In the row below where there are 7 experiences there are 21 relationships, count

the circles in the symmetrical triangle and you will find that there are just 21. $\frac{N^2 - N}{2} = 7^2, 49 - 7 = 42 \div 2 = 21$. Now it is very interesting that the *picture of the relationship is always a triangle*.

Then I would point out that those numbers 1, 3, 6, 10, 15, 21, are numbers which if associated as any *pair of adjacents* add to a number of the second power, e.g., the 1 with 3 makes the number 4 which is 2 to the second power. If you associate the 3 with the 6, you get the number 9 which is the second power of 3. So that you find in combining any two of those sets of relationships adjacently, they make what we call the second power. We used to call it a "square," but I made a most economical space picture of it and you will find that the circles close pack as *diamonds* and not as *squares*. Then in the right-hand column, we have stacks of those triangles of circles which represent the numbers of fundamental relationships. The stacks of triangles are like stacks of cannonballs, and they make a tetrahedron. So we can say then that *the sum of the relationships of all of our experiences is always tetrahedral*. It is pretty exciting then to discover this extraordinary, omnisymmetrical tetrahedral sum of all our experience interrelationships. We can say correctly to human beings trying to understand number relationships of arrays (that seem to be chaotic as with the stars in the sky) that all the interrelationships of all stars you are able to count in the sky, are always symmetrically triangular. This has to be. Therefore, what seemingly is disorderly on first appearance turns out to have this extraordinary order. And the sums of interrelationships of all the experiences of each of our lives is always tetrahedral, and all the relationships of all the component events of universe are always tetrahedral.

We've heard the popular myth of talking about man and the universe (the *Life* magazine type of story) which starts universe off as an astronomical aggregate of primordial chaos in some kind of vast nothingness. Somehow or other out of this enormous amount of chaos, in which the scientist finds that random elements are always increasing, ergo becoming ever more chaotic, until the random elements suddenly gell in an inexplicably orderly way and we have all the extraordinary things like daisies, diamonds, and moons. Then it is also said that the scientist wrests order out of chaos. This implies that there were extraordinary scientists standing off somewhere from the primordial ooze to suddenly make the daisies, dia-

monds, and moons. The legendary scientist is a magician and, therefore, he is a great benefactor of society.

Many a great scientist who has made a great discovery, has noted, somewhere in his letters, manuscripts, or diaries and in his recorded talks with his friends, just what he had first thought might be going on, in certain events of nature which had excited him into making an experiment. According to the great scientists' own records, their formulations, their hypotheses about what might be going on always turned out to be very crude as compared to what they actually found to be the patterns operative in nature, which always disclosed an extraordinarily sublime, *a priori* orderliness. In finding that the sum of all of our relationships always add to one, neat, complete, closest packed tetrahedron we understand why the scientist had to find orderliness.

During the early days of World War II scientists began to find their narrow fields of specialization beginning to overlap one with the other by virtue of the powerful instruments and the increasing numbers of abutting specialists. The biologist found himself suddenly overlapping the area of the chemist, and the chemist found himself overlapping the area of the physicist. This brought about all the interhyphenating of the sciences such as in bio-chemistry, and so forth. Now the micro-world scientists all find themselves so overlapped as to realize that they are in one world, with everywhere the same sublime orderliness. And the orderliness of various aspects of nature are all interrelated, so they realize that they are dealing in just one great, sublimely coordinated, comprehensive accounting system employed by nature. Nature is not only orderly but the orderliness is rationally accountable in pure principle. And pure principles have no beginnings or endings. Therefore, we are not dealing in universe that has to be pictured or explained by a beginning and an ending. The experiences may be a chaotic array. But the interconnections are orderly. What we mean by *understanding* is: apprehending and comprehending all the interrelationships of experiences. Understanding is symmetrically tetrahedral.

This is as far as I will go in the pictures. I hope that I have introduced some generalized principles which have some relationship to music; for instance, the wave phenomena, the precessional phenomena and so forth; the omnidirectionality with which we are really dealing. I am quite confident, because I have been exploring it for a long time, that nature has just one coordinate system.

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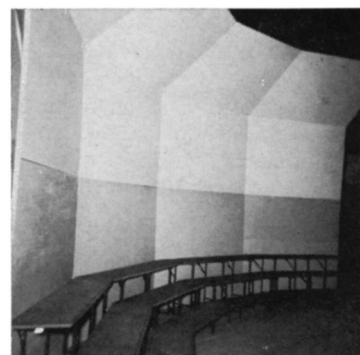
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In 1917, I found myself asserting that I didn't think that nature had a department of chemistry, a department of mathematics, a department of physics, and a department of biology and had to have meetings of department heads in order to decide what to do when you drop your stone in the water. Universe, i.e., nature, obviously knows just what to do, and everything seemed beautifully coordinate. The lily pads did just what they should do, the fish did just what they should do. Everything went sublimely, smoothly. So I thought that nature probably had one coordinate system and probably one most economical, arithmetical, and geometrical system with which to interaccount all transactions and transformations. And I thought also that it was preposterous when I was told that real models were not employed in advance science, because science was able to deal with nature by use of completely unmodelable mathematical abstractions. I could not credit that universe suddenly went abstract at some micro-level of investigation, wherefor in order to be able to deal with the physical universe in the most advanced stages of frontiers you had to deal entirely with abstract—formula, unmodelable mathematics. As we acquired larger microscopes and larger telescopes, I found that models always showed up. And men, satisfied with their abstract preoccupations, didn't bother or didn't seem to know how to explain the emerging pictures of the obviously systematic but strange, often asymmetrical but sometimes symmetrical models. I thought then that if we could find nature's own coordinate system we would understand the models and we would be able to develop much higher exploratory and application capability. In chemistry atoms were associating and disassociating in beautiful whole simple numbers arrangements: such as H_2O , or whatever the combination, chemistry seemed to avoid irrational fractions. Everything was accountable in simple and whole numbers. I felt that if we ever found nature's coordinate system, it would be very simple and always rational.

I am confident now that I have found that coordinate system because I have submitted it to bodies of competent scientists. This last October, I met with competent scientists of all the related fields of physics. I made comprehensive disclosure of the ramifications of the coordinate system which I have discovered and explored for a third of a century. They accepted the coordinated system which I disclosed as probably being nature's most efficient means of accounting

those of nature's generalized relationships which I tended to identify by the coordination system.

The omnirational coordinate system which I have named *synergetics* is not an invention. It is purely discovery. I am quite confident that with the complete and simple modelability of synergetics that it is going to be possible for children at home with c.c.T.V. documentaries coming to them and making their own models, to do valid nuclear physics formulations at kindergarten age. With that fundamental structuring experience, and sensing through models, children will be making experiments that discover why water does what it does. They will really come to understand what a triangle is and what it can do and does. The obsoleting educational system taught people to think in "squares," and to measure in terms of "inches," "squares," and "cubes." We've come to assume that a cubical or rectilinear house has structural integrity. If you make a cube with little sticks and rubber joints, you'll find that cubes always collapse. They have no structural integrity whatsoever. We find ourselves starting out on all the wrong axiomatic bases. When we use tetrahedra to account nature we are three times more efficient (with energy) than when we account in cubes. And nature is always most efficient.

In this total interprecessional set of events that I have talked to you about, I have stressed that where men think of themselves as most scientifically advanced, especially in pure mathematics, that I find them dealing in axioms that no longer hold true. What they are doing does hold true in relation to that axiom. But inasmuch as they didn't start with axioms disclosed experimentally by nature they are dealing in non-universe, and are playing perfectly good games and I love them for doing it, but they are playing games that are completely irrelevant to what we and nature are doing and need to do.

I am confident that in the world of music and in the world of art, human beings have attained much spontaneous and realistic coordination. Artists are really much nearer to the truth than have been many of the scientists.

I wasn't surprised when under the authority and funding of the National Defense Education Act, the Science Advisor to the President recently persuaded the White House to spend some of the science-aimed educational funds on an exploration with art educators in New York. They had their meeting in New York University about six weeks ago and brought together some of the best (in my esti-

mation) art educators in the country as well as some good artists. It was realized in our nation's seeking for scientists that they were only getting people who were good methodologists, who could expand or refine what was already proven, but they had no ability to conceive of as yet entirely hidden and previously unthought of conditions and relations of nature nor to explore and use their minds imaginatively. That is where the word "creative" came in. It was hoped by the scientists and the President that by going to the art educators, they might be able to discover in the knowledge and experience of art educators just how children suddenly conceive in sublimely pure and simple yet original patterns. The scientists and the President wanted to know what really constitutes and motivates and detonates the imagination of bright creative children, as well as of the inspiringly resourceful teachers who have the imagination, power, strength, and conviction to go along with the children's original conception. It is interesting to discover that our National Defense, having found the academic world of science per se, to be only a methodological system of researching and rehashing already proven phenomena, now discovers that academic science is running into a dead end. Because our scientists are unable to maintain or exceed the world pace of evolutionary development, our whole nation is losing its leadership pace. We have suddenly to turn to the artist. Art educators themselves had found that there was an extraordinary relationship between the conceptually brilliant child and the human being teacher whom the child found was not frustrating it but was accepting and fostering the child's curiosity and need to deal with its interference-born original questions.

In your musical education world and in your professional meetings, I think it important that you realize that within the next ten years the world of science and the world of seemingly very pragmatic affairs may be turning to the world of music for leadership in fostering the spontaneous development of the most powerfully coordinate capabilities of evolving life. Rather than being a pleasant side show for the more serious central affairs of economic life, you who deal with the music of the universe and the innate coordinate capability of man to tune in the music of the new life, may be recognized as dealing with the sensitive mainspring of life itself, because of which you may find yourselves called by society to perform its most responsible task allowing life to succeed. ■