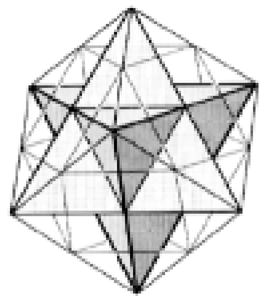

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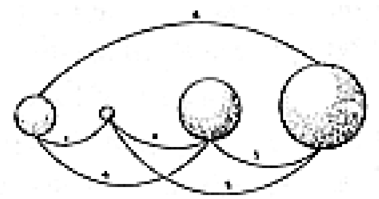

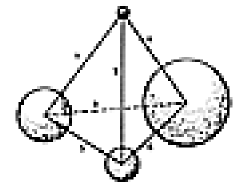

600.00 **Structure**

600.01 **Definition: Structure**

600.02 A structure is a self-stabilizing energy-event complex.

600.03 A structure is a system of dynamically stabilized self-interfering and thus self- localizing and recentering, inherently regenerative constellar association of a minimum set of four energy events.

600.04 *Stability* means angular invariability. *Inherent* means behavior principles that man discovers to be reliably operative under given conditions always and anywhere in Universe. *Regenerative* means local energy-pattern conservation. *Constellar* means an aggregation of enduring, cosmically isolated, locally co-occurring events dynamically maintaining their interpositioning: e.g., macroconstellations such as the Big Dipper, Orion, and the Southern Cross and microconstellations such as matter in general, granite, cheese, flesh, water, and atomic nuclei.

601.00 **Pattern Conservation**

601.01 It is a tendency for patterns either to repeat themselves locally or for their parts to separate out to join singly or severally with other patterns to form new constellations. All the forces operative in Universe result in a complex progression of most comfortable—i.e., least effort, rearrangings in which the macro-medio-micro star events stand dynamically together here and there as locally regenerative patterns. Spontaneously regenerative local constellations are cosmic, since they appear to be interoriented with angular constancy.

601.02 Structures are constellar pattern conservations. These definitions hold true all the way from whole Universe to lesser and local pattern differentiations all the way into the atom and its nuclear subassemblies. Each of the families of chemical elements, as well as their most complex agglomerations as super-star Galaxies, are alike cosmic structures. It is clear from the results of modern scientific experiments that *structures are not things.* Structures are *event constellations.*

602.01 Structural systems are cosmically localized, closed, and finite. They embrace all geometric forms-symmetric and asymmetric, simple and complex.

602.02 Structural systems can have only one insideness and only one out-sideness.

602.03 Two or more structures may be concentric and/or triangularly—triple-bondedly—interconnected to operate as one structure. Single-bonded (universally jointed) or double-bonded (hinged) means that we have two flexibly interconnected structural systems.

603.01 All structuring can be topologically identified in terms of tetrahedra. (See Sec. 362.)

604.00 **Structural System**

604.01 In a *structural* system:

1. the number of vertexes (crossings) is always evenly divisible by two;
2. the number of faces (openings) is always evenly divisible by four; and
3. the number of edges (trajectories) is always evenly divisible by six.

605.01 Inasmuch as there are always and everywhere 12 fundamental degrees of freedom (six positive and six negative), and since every energy event is characterized by a threefold vectoring—an action, a reaction, and a resultant—all structures, symmetrical or asymmetrical, regular or irregular, simple or compound, will consist of the twelvefoldedness or its various multiples.

606.01 "Mathematics is the science of structure and pattern in general."[1] Structure is defined as a locally regenerative pattern integrity of Universe. We cannot have a total structure of Universe. Structure is inherently only local and inherently regenerative.

(Footnote 1: From the Massachusetts Institute of Technology's 1951 offical catalog of the self-definition by M.I.T. Mathematics Department.)

606.02 Structures most frequently consist of the physical interrelationships of nonsimultaneous events.

606.03 One of the deeply impressive things about structures is that they cohere at all-particularly when we begin to know something about the atoms and realize that the components of atoms are really very remote from one another, so that we simply have galaxies of events. Man is deceiving himself when he sees anything "solid" in structures.

608.00 **Stability: Necklace**

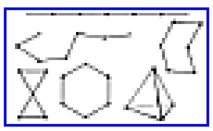
Fig. 608.01

608.01 A necklace is unstable. The beads of a necklace may be superficially dissimilar, but they all have similar tubes running through them with the closed tension string leading through all the tubes. The simplest necklace would be one made only of externally undecorated tubes and of tubes all of the same length. As the overall shape of the necklace changes to any and all polygonal shapes and wavy drapings, we discover that the lengths of the beads in a necklace do not change. Only the angles between the tubes change. Therefore, *stable* refers only to angular invariability.

608.02 A six-edged polygon is unstable; it forms a drapable necklace. If we make a five-sided polygon, i.e., a pentagonal necklace, it is unstable. It, too, is a drapable necklace and is structurally unstable. Why? A necklace of three rigid tubes also has three flexible angle-accommodating tension joints. Here are six separate parts, each with its unique behavior characteristics which self-interfere to produce a stable pattern. How and why? We are familiar with the principle of lever advantage gained per length of lever arm from the fulcrum. We are familiar with the principle of the shears in which two levers share a common fulcrum, and the stronger and longer the shear arms, the more powerfully do they cut. Steel-bolt cutters have long lever arms.

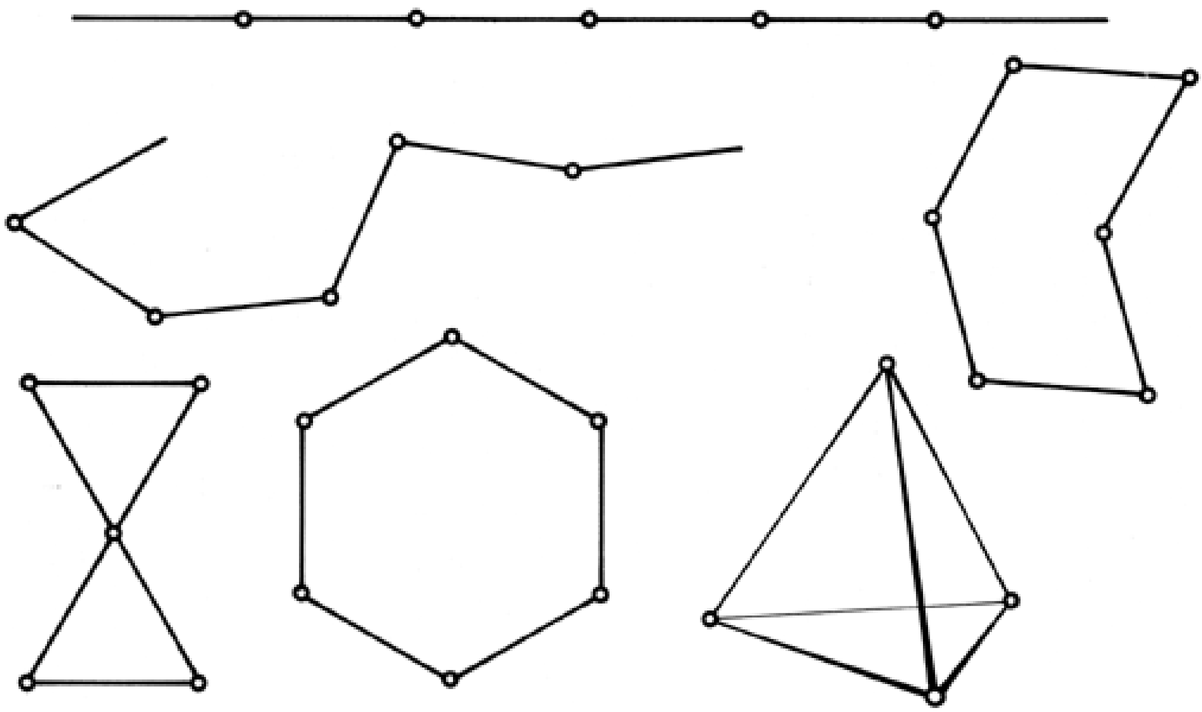

Fig. 608.01 Instability of Six Vectors Except as Tetrahedron: The alternate consequences of six vectored configurations. Only the tetrahedron is fully stable. It is synergetic.

608.03 In every triangle each comer angle tension connector serves as the common interfulcrum of the two push-pull, rigid lever arms comprising two of the three sides of the triangle adjacent to their respectively common angular corners; each pair of the triangle's tubular necklace sides, in respect to a given corner of the triangle, represent levers whose maximum-advantage ends are seized by the two ends of the third, rigid, push-pull, tubular side of the triangle, whose rigidity is imposed by its command of the two lever arm ends upon the otherwise flexible opposite angle. Thus we find that each of the necklace's triangular rigid tube sides stabilizes its opposite angle with minimum effort by controlling the ends of the two levers fulcrumed by that opposite tension fastening of the triangle. Thus we find the triangle to be not only the unique pattern-self-stabilizing, multienergied complex, but also accomplishing pattern stabilization at minimum effort, which behavior coincides with science's discovery of the omni-minimum-effort behavior of all physical Universe .

608.04 The six independent energy units of the triangle that interact to produce pattern stability are the only plural polygon-surrounding, energy-event complexes to produce stabilized patterns. (The necklace corners can be fastened together with three separate tension-connectors, instead of by the string running all the way through the tubes, wherefore the three rigid tubes and the three flexible tension connectors are six unique, independent, energy events.)

608.05 We may say that structure is a self-stabilizing, pattern-integrity complex. Only the triangle produces structure and structure means only triangle; and vice versa.

608.06 Since tension and compression always and only coexist (See Sec. 640) with first one at high tide and the other at low tide, and then vice versa, the necklace tubes are rigid with compression at visible high tide and tension at invisible low tide; and each of the tension-connectors has compression at invisible low tide and tension at visible high tide; ergo, each triangle has both a positive and a negative triangle congruently coexistent and each visible triangle is two triangles: one visible and one invisible.

608.07 Chain-linkage necklace structures take advantage of the triangulation of geodesic lines and permit us to encompass relatively large volumes with relatively low logistic investment. Slackened necklace geodesic spheres can be made as compactable as hairnets and self-motor-opened after being shot into orbit.

608.08 It is a synergetic characteristic of minimum structural systems (tetrahedra) that the system is not stable until the last strut is introduced. Redundancy cannot be determined by energetic observation of behaviors of single struts (beams or columns) or any chain-linkage of same, that are less than six in number, or less than tetrahedron.

608.10 **Necklace Polygons and Necklace Polyhedra:** Tetrahedral, octahedral, and icosahedral necklace structures are all stable. Necklace cubes, rhombic dodecahedra, pentadodecahedra, vector equilibria, and tetrakaidecahedra are all unstable. Only necklace- omnitriangulated, multifrequency geodesic spheres are stable structures, because they are based entirely on omnitriangulated tetra-, octa-, and icosahedral systems.

608.11 The number of vertexes of the omnitriangulated spherical tetra-, octa-, or icosahedral structures of multifrequency geodesic spheres corresponds exactly with the number of external layer spheres of closest-packed unit radius spherical agglomeration of tetrahedra, octahedra, or icosahedra:

Tetrahedra	$2F^2 + 2$
Octahedra	$4F^2 + 2$
Icosahedra	$10F^2 + 2$

Only tetrahedral, octahedral, and icosahedral structural systems are stable, i.e., complete, nonredundant, self-stabilizing.

608.20 **Even- and Odd-Number Reduction of Necklace Polygons**

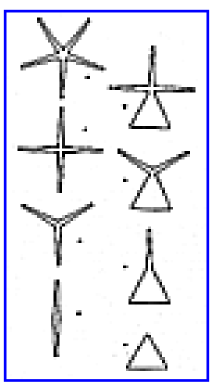

Fig. 608.21

608.21 We undertake experimental and progressive reduction of the tubularly beaded necklace's multipolygonal flexibility. The reduction is accomplished by progressive one-by-one elimination of tubes from the assembly. The progressive elimination alters the remaining necklace assemblage from a condition of extreme accommodation of contouring intimacies and drapability over complexedly irregular, multidimensional forms until the assembly gradually approaches a number of remaining tubes whose magnitude can be swiftly assessed without much conscious counting. As the multipolygonal assembly approaches a low-number magnitude of components of the polygons, it becomes recognizable that an *even* number of remaining tubes can be arranged in a symmetrical totality of inward-outward, inward-outward points, producing a corona or radiant starlike patterning, or the patterning of the extreme crests and troughs of a circular wave. When the number of tubular beads is *odd*, however, then the extra tube can only be accommodated by either a crest-to-crest or a trough-to-trough chord of the

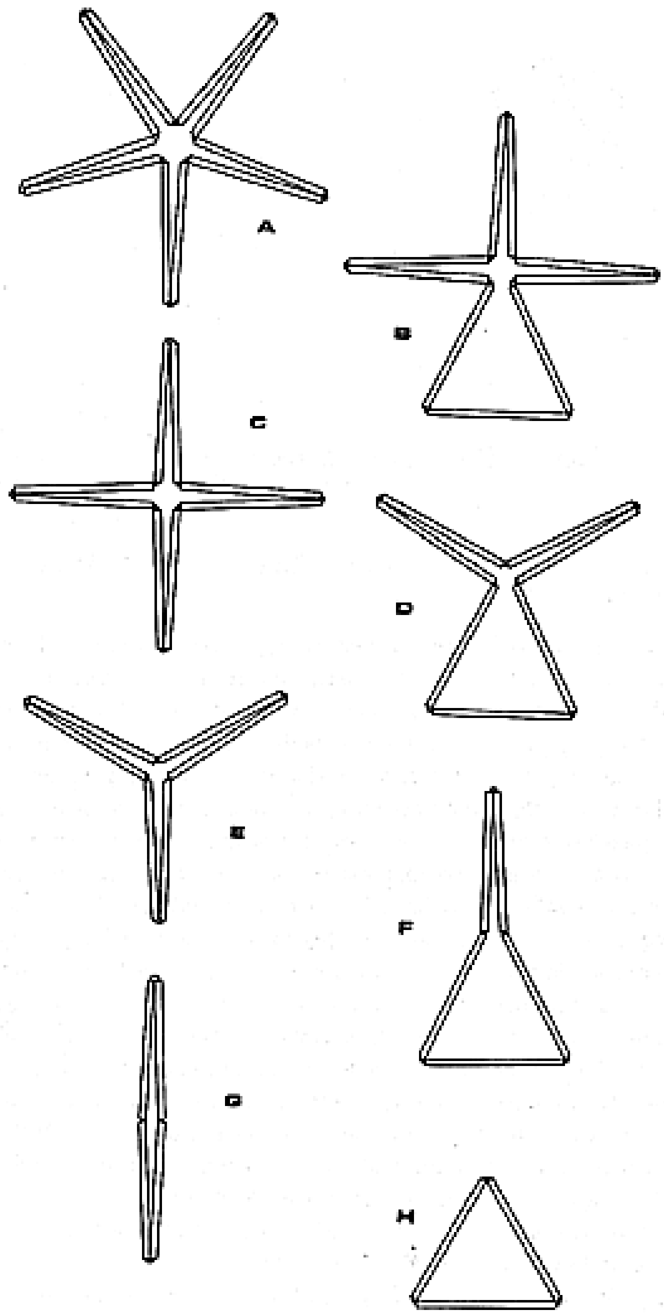

Fig. 608.21

circle. This is the pattern of a gear with one odd double-space tooth in each circle. If the extra length is used to join two adjacent crests chordally, this tooth could mesh cyclically as a gear only with an equal number of similarly toothed gears of slightly larger diameter, where the extra length is used to interconnect the two adjacent troughs chordally. (See Fig. 608.21)

608.22 Even-numbered, equilength, tubular-bead necklaces can be folded into parallel bundles by slightly stretching the interconnection tension cable on which they are strung. Odd numbers cannot be so bundled.

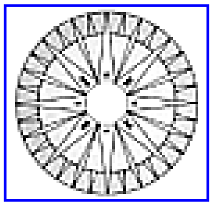
Fig. 608.23

608.23 **Congruence with Mariner's Compass Rose:** As the number of remaining tubes per circle become less than 40, certain patterns seem mildly familiar—as, for instance, that of the conventional draftsman's 360-degree, transparent-azimuth circle with its 36 main increments, each subdivided into 10 degrees. At the 32-tube level we have congruence with the mariner's compass rose, with its four cardinal points, each further subdivided by eight points (see Fig. 608.23).

608.24 Next in familiarity of the reduced numbers of circular division increments comes the 12 hours of the clock. Then the decimal system's azimuthal circle of 10 with 10 secondary divisions. Circles of nine are unfamiliar. But the octagon's division is highly familiar and quickly recognized. Septagons are not. Powerfully familiar and instantly recognized are the remaining hexagon, pentagon, square, and triangle. There is no twogon. Triangle is the minimum polygon. Triangle is the minimum-limit case.

608.25 All the necklace polygons prior to the triangle are flexibly drapable and omnidirectionally flexible with the sometimes-square-sometimes-diamond, four-tube necklace as the minimum-limit case of parallel bundling of the tubes. The triangle, being odd in number, cannot be bundled and thus remains not only the minimum polygon but the only inflexible, nonfoldable polygon.

608.30 Triangle as Minimum-altitude Tetrahedron

608.31 In Euclidean geometry triangles and other polygons were misinformedly thought of as occurring in two-dimensional planes. The substanceless, no-altitude, planar polygons were thought to hold their shape—as did any polygonal shape traced on the Earth's surface—ignoring the fact that the shape of any polygon of more than three edges is maintained only by the four-dimensional understructuring. Only the triangle has an inherent and integral structural integrity.

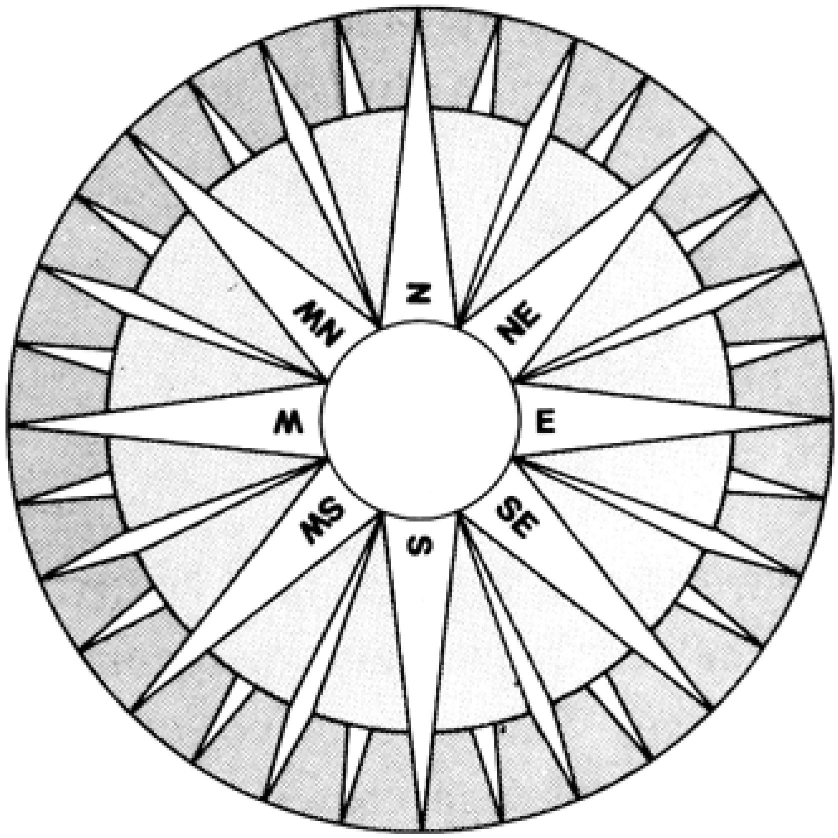

Fig. 608.23 Mariner's Compass Rose: This pattern accommodates 32 necklace tubes per circle.

608.32 The triangular necklace is not two-dimensional, however; like all experienceable structural entities it is four-dimensional, as must be all experienceably realized polygonal models even though the beads are of chalk held together by the tensile coherence of the blackboard. Triangles at their simplest consist experientially of one minimum-altitude tetrahedron.

Next Section: 609.00

609.00 **Instability of Polyhedra from Polygons of More Than Three Sides**

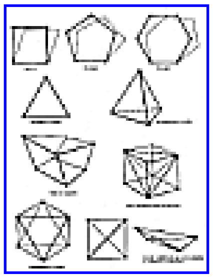

Fig. 609.01

609.01 Any polygon with more than three sides is unstable. Only the triangle is inherently stable. Any polyhedron bounded by polygonal faces with more than three sides is unstable. Only polyhedra bounded by triangular faces are inherently stable.

610.00 **Triangulation**

610.01 By structure, we mean a self-stabilizing pattern. The triangle is the only self- stabilizing polygon.

610.02 By structure, we mean omnitriangulated. The triangle is the only structure. Unless it is self-regeneratively stabilized, it is not a structure.

610.03 Everything that you have ever recognized in Universe as a pattern is re-cognited as the same pattern you have seen before. Because only the triangle persists as a constant pattern, any recognized patterns are inherently recognizable only by virtue of their triangularly structured pattern integrities. Recognition is as dependent on triangulation as is original cognition. Only triangularly structured patterns are regenerative patterns. Triangular structuring is a pattern integrity itself. This is what we mean by *structure.*

610.10 **Structural Functions**

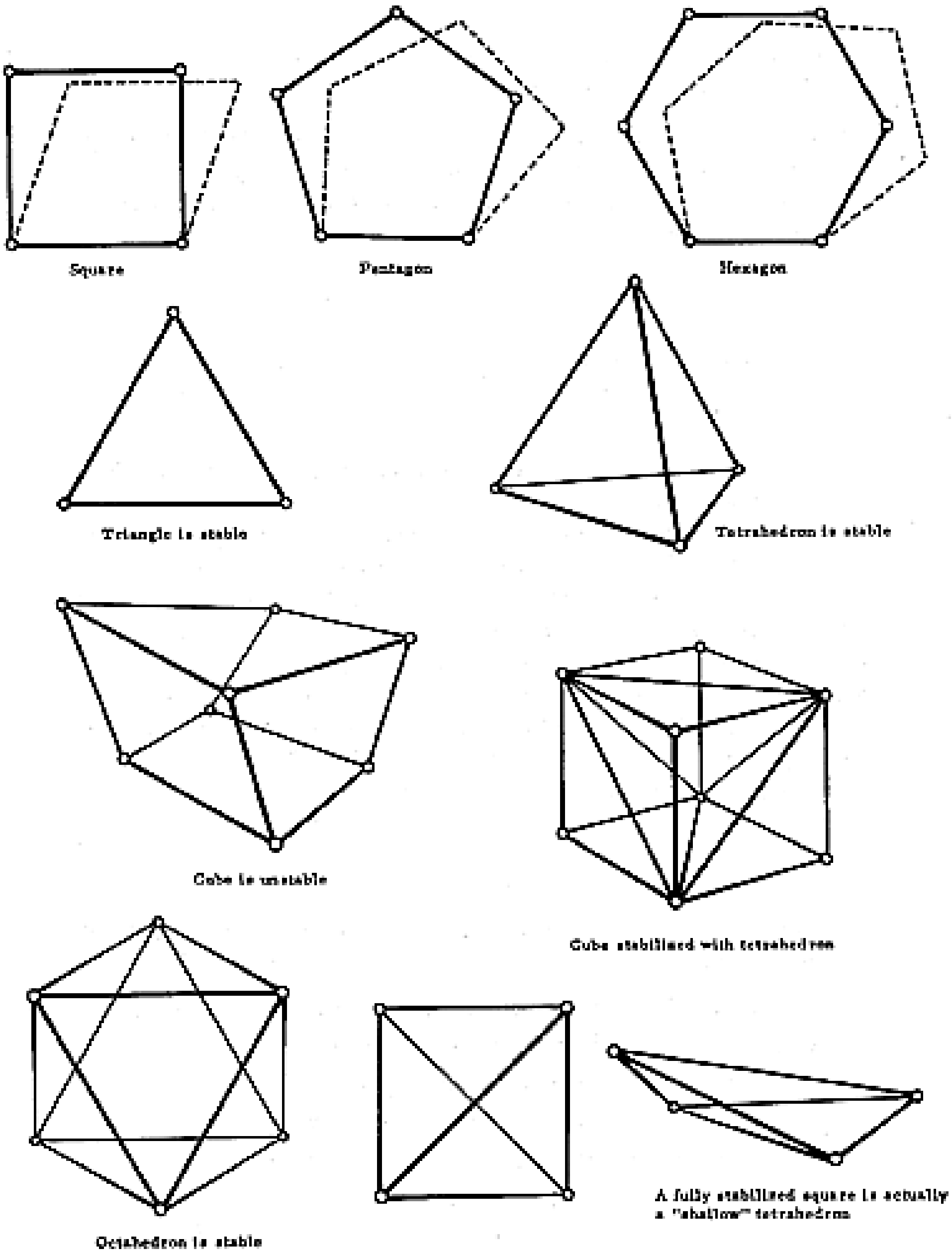

Fig. 609.01 Instability of Polyhedra from Polygons of More than Three Sides.

610.11 Triangulation is fundamental to structure, but it takes a plurality of positive and negative behaviors to make a structure. For example:

- always and only coexisting push and pull (compression and tension);
- always and only coexisting concave and convex;
- always and only coexisting angles and edges;
- always and only coexisting torque and countertorque;
- always and only coexisting insideness and outsideness;
- always and only coexisting axial rotation poles;
- always and only coexisting conceptuality and nonconceptuality;
- always and only coexisting temporal experience and eternal conceptuality.

610.12 If we want to have a structure, we have to have triangles. To have a structural *system* requires a minimum of four triangles. The tetrahedron is the simplest structure.

610.13 Every triangle has two faces: obverse and reverse. Every structural system has omni-intertriangulated division of Universe into insideness and outsideness.

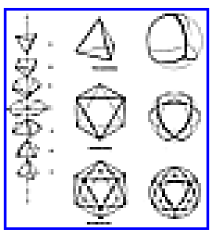

Fig. 610.20

610.20 **Omnitriangular Symmetry: Three Prime Structural Systems**

610.21 There are three types of omnitriangular, symmetrical structural systems. We can have three triangles around each vertex; a tetrahedron. Or we can have four triangles around each vertex; the octahedron. Finally we can have five triangles around each vertex; the icosahedron. (See Secs. 532.40, 610.20, 724, 1010.20, 1011.30 and 1031.13.)

610.22 The tetrahedron, octahedron, and icosahedron are made up, respectively, of one, two, and five pairs of positively and negatively functioning open triangles.

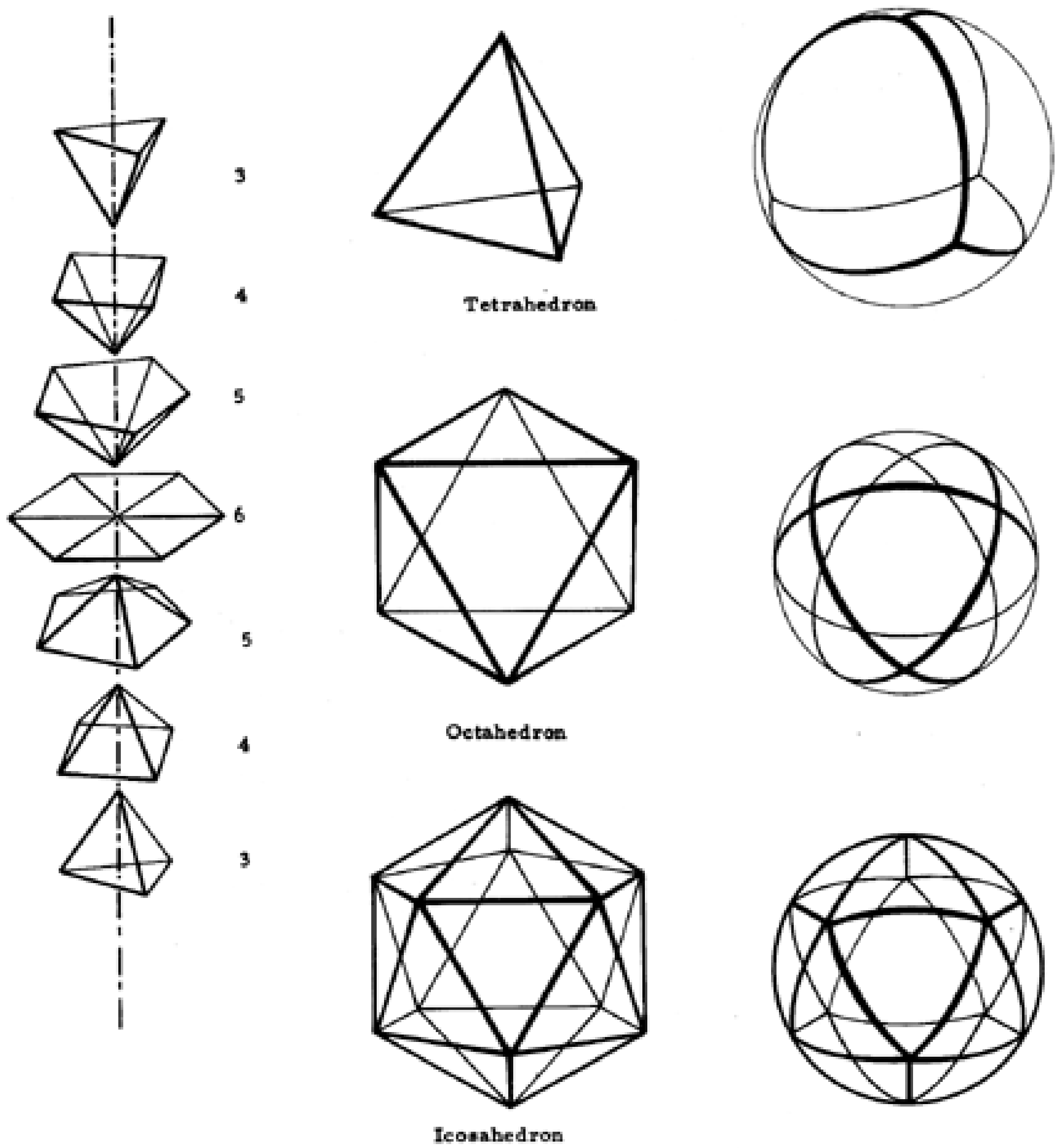

Fig. 610.20 The Three Basic Structural Systems in Nature with Three, Four or Five Triangles at Each Vertex: There are only three possible cases of fundamental omnisymmetrical, omnitriangulated, least-effort structural systems in nature: the tetrahedron with three triangles at each vertex, the octahedron with four triangles at each vertex, and the icosahedron with five triangles at each vertex. If there are six equilateral triangles around a vertex we cannot define a three-dimensional structural system, only a "plane." The left column shows the minimum three triangles at a vertex forming the tetrahedron through to the six triangles at a vertex forming an "infinite plane." The center column shows the planar polyhedra. The right column shows the same polyhedra in spherical form.

610.23 We cannot have six symmetrical or equiangular triangles around each vertex because the angles add up to 360 degrees-thus forming an infinite edgeless plane. The system with six equiangular triangles "flat out" around each vertex never comes back upon itself. It can have no withinness or withoutness. It cannot be constructed with pairs of positively and negatively functioning open triangles. In order to have a system, it must return upon itself in all directions.

610.24 **Limit Cases: Macro, Medio, and Micro:** Considered geometrically, triangles are the only self-stabilizing polygonal patterns—ergo, only triangles are structurally stable. Since we cannot construct a polyhedral system of only two triangles around each corner (because a polyhedral system must by definition have an insideness and an outsideness in order definitively and closingly to separate the Universe into macrocosm and microcosm), and since we cannot have six equilateral triangles around each vertex of a polyhedral system (for each of the six would themselves separate out from the others to form flat planes and could not close back to join one another to separate Universe definitively into macrocosm and microcosm)—ergo, the tetrahedron, octahedron, and icosahedron constitute the minimum, middle, and maximum cases of omnitriangulated—ergo, stabilized—structural subdividings of Universe into macro, medio, and micro Universe divisions.

610.30 Structural Harmonics

610.31 The conceptual sequence in the left column of Fig. 610.20 illustrates the basic octave behavior of structural transformations. The first three figures—tetra, octa, icosa—represent the positive outside-out set of primitive structural systems. Three equiangular triangles around each corner add to tetra; four around each corner add to octa; five around each corner add to icosa; but six 60-degree angles around each corner add to 360 degrees; ergo, produce an infinitely extendible plane; ergo, fail to return upon themselves embracingly to produce a system's insideness and outsideness; ergo, thus act as the zerophase of maximum evolution changing to the involution phase of maximum nothingness. As the transformation sequence changes from divergent evolution to convergent involution, from five, then four, then three equiangular triangles around each corner, it thereby produces successively the inside-out icosa, octa, and tetra, until the convergent involutional contraction attains the phase of maximum nothingness. At the minimum zero bottom of the sequence the inside-out tetra revolves outside-out to minimum somethingness of tetravolume I as the transformation diverges expansively to the maximum vector-equilibrium somethingness of tetravolume 20, thereafter attaining maximum nothingness and evolution-to-involution conversion. (See Sec. 1033.)

610.32 At six-vector hexagonality we have the vector equilibrium at maximum zero evolution-to-involution conversion.

610.33 The minimum zero tetrahedron with which the series commences repeats itself beneath the bottom figure to permit the accomplishment of octave harmony at minimum zero conversion whose terminal nothingnesses accommodate the overlapping interlinkages of the octave terminals: thus do-remi-fa-solla-ti do.

611.00 **Structural Quanta**

611.01 If the system's openings are all triangulated, it is structured with minimum effort. There are only three possible omnisymmetrical, omnitriangulated, least-effort structural systems in nature. They are the tetrahedron, octahedron, and icosahedron. When their edges are all equal in length, the volumes of these three structures are, respectively, *one*, requiring one structural quantum; *four*, requiring two structural quanta; and 18.51, requiring five structural quanta. Six edge vectors equal one minimum-structural system: 6 edge vectors = 1 structural quantum.

611.02 Six edge vectors = one tetrahedron. One tetrahedron=one structural quantum.
1 Tetrahedron (volume 1) = 6 edge vectors = 1 structural quantum;
1 Octahedron (volume 4) = 12 edge vectors = 2 structural quanta;
1 Icosahedron (volume 18.51) =30 edge vectors =5 structural quanta.
Therefore:
with tetrahedron, 1 structural quantum provides 1 unit of volume;
with octahedron, 1 structural quantum provides 2 units of volume;
with icosahedron, 1 structural quantum provides 3.7 units of volume.

612.00 **ubtriangulation: Icosahedron**

612.01 Of the three fundamental structures, the tetrahedron contains the most surface and the most structural quanta per volume; it is therefore the strongest structure per unit of volume. On the other hand, the icosahedron provides the most volume with the least surface and least structural quanta per units of volume and, though least strong, it is structurally stable and gives therefore the most efficient volume per units of invested structural quanta.

612.10 **Units of Environment Control:** The tetrahedron gives one unit of environment control per structural quantum. The octahedron gives two units of environment control per structural quantum. The icosahedron gives 3.7 units of environment control per structural quantum.

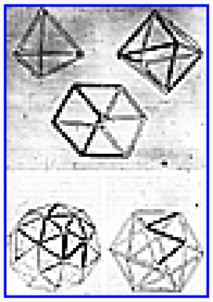
Fig. 612.11

612.11 That is the reason for the employment of the triangulated icosahedron as the most efficient fundamental volume-controlling device of nature. This is the way I developed the multifrequency-modulated icosahedron and geodesic structuring. This is probably the same reason that nature used the multifrequency-modulated icosahedron for the protein shells of the viruses to house most efficiently and safely all the DNA-RNA genetic code design control of all biological species development. I decided also to obtain high local strength on the icosahedron by *subtriangulating* its 20 basic Icosa LCD spherical triangles with locally superimposed tetrahedra, i.e., an octahedron-tetrahedron truss, which would take highly concentrated local loads or impacts with minimum effort while the surrounding rings of triangles would swiftly distribute and diminishingly inhibit the outward waves of stress from the point of concentrated loading. I had also discovered the foregoing structural mathematics of structural quanta topology and reduced it to demonstrated geodesic dome practice before the virologists discovered that the viruses were using geodesic spheres for their protein shell structuring. (See Sec. 901.)

Next Section: 613.00

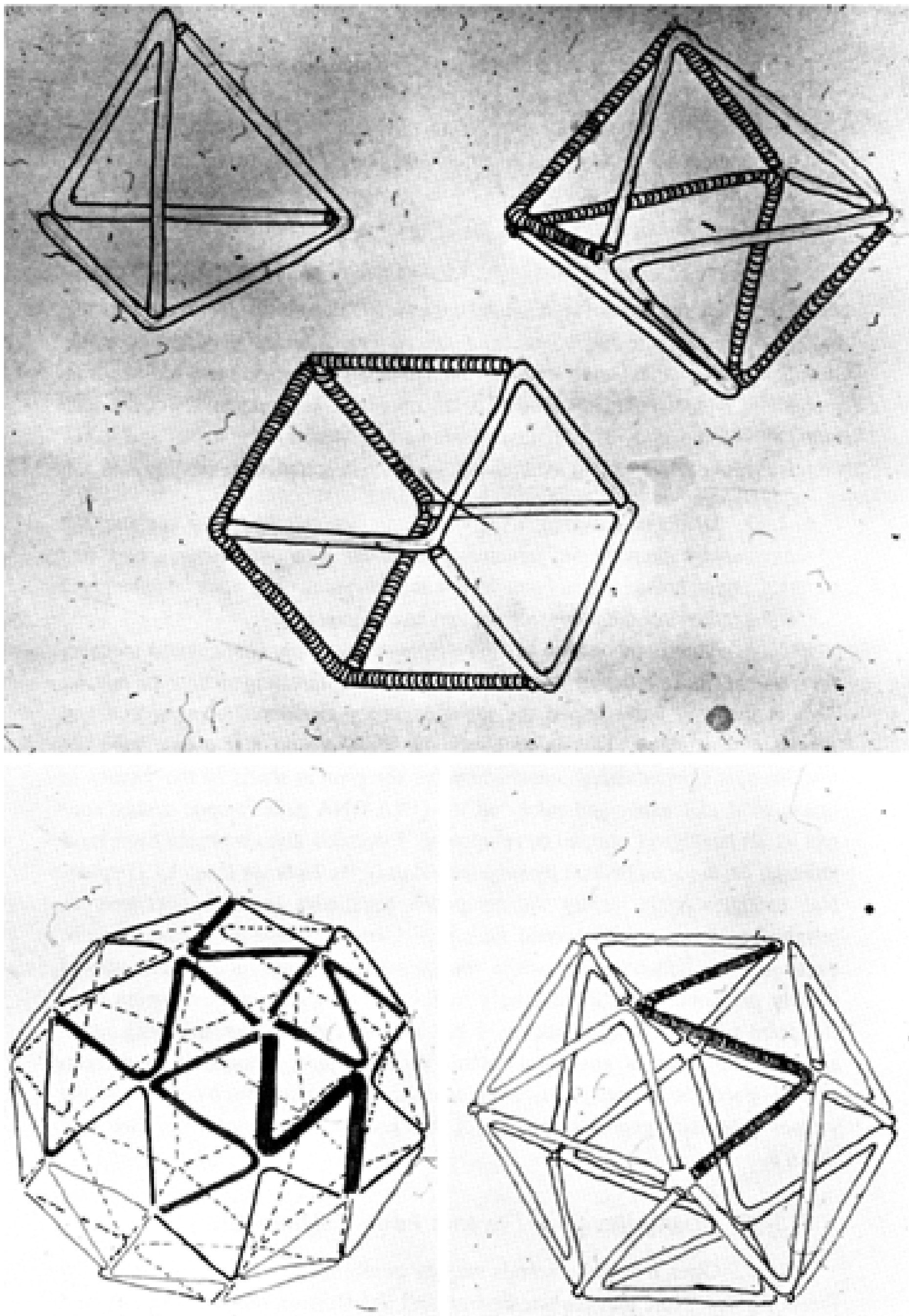

Fig. 612.11

613.00 **Triangular Spiral Events Form Polyhedra**

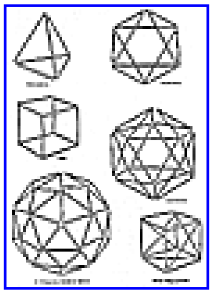

Fig. 613.01

613.01 Open triangular spirals may be combined to make a variety of different figures. Note that the tetrahedron and icosahedron require both left- and right-handed (positive and negative) spirals in equal numbers, whereas the other polyhedra require spirals of only one-handedness. (See Sec. 452, Great Circle Railroad Tracks of Energy.) If the tetrahedron is considered to be one quantum, then the triangular spiral equals one-half quantum. It follows from this that the octahedron and cube are each two quanta, the icosahedron five quanta, and the two-frequency spherical geodesic is 15 quanta.

614.00 **Triangle**

614.01 A triangle's three-vector parts constitute a basic event. Each triangle consists of three interlinked vectors. In the picture, we are going to add one triangle to the other. (See illustration 511.10.) In conventional arithmetic, one triangle plus one triangle equals two triangles. The two triangles represent two basic events operating in Universe. But experientially triangles do not occur in planes. They are always omnidimensional positive or negative helixes. You may say that we do not have any right to break the triangles' threesided rims open in order to add them together, but the answer is that the triangles were never closed, because no line can ever come completely back "into" or "through" itself. Two lines cannot be passed through a given point at the same time. One will be superimposed on the other. Therefore, the superimposition of one end of a triangular closure upon another end produces a spiral—a very flat spiral, indeed, but openly superimposed at each of its three corners, the opening magnitude being within the critical limit of mass attraction's 180-degree "falling-in" effect. The triangle's open-ended ends are within critical proximity and mass-attractively intercohered, as are each and all of the separate atoms in each of all the six separate structural members of the necklace-structure triangle. All coherent substances are "Milky Way" clouds of critically proximate atomic "stars."

614.02 Triangles are inherently open. As one positive event and one negative event, the two triangles arrange themselves together as an interference of the two events. The actions and the resultants of each run into the actions and the resultants of the other. They always impinge at the ends of the action as two interfering events. As a tetrahedron, they are fundamental: a structural system. It is a tetrahedron. It is structural because it is omnitriangulated. It is a system because it divides Universe into an outsideness and an insideness—into a macrocosm and a microcosm.

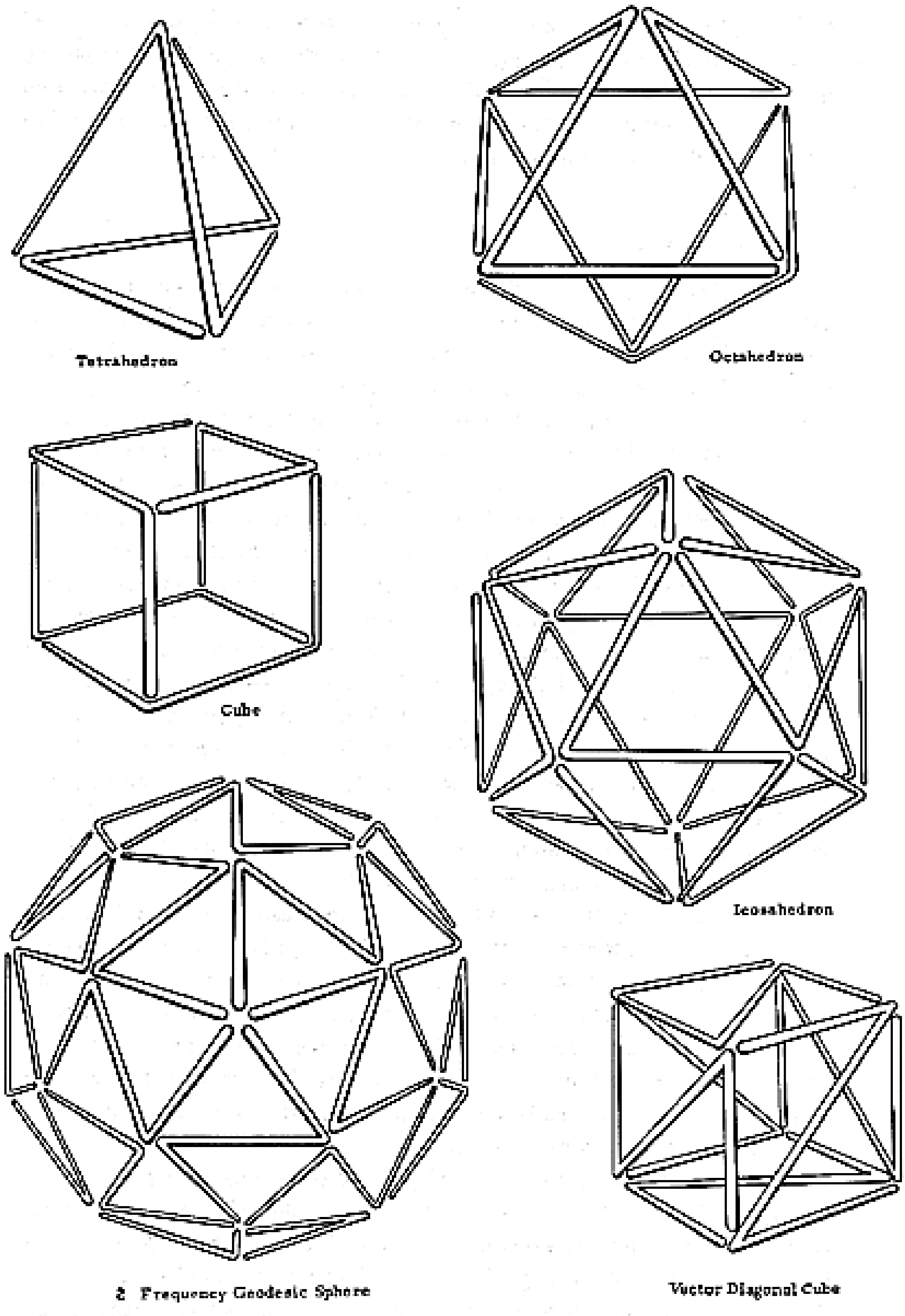

Fig. 613.01 Triangular Spiral Events From Polyhedra.

614.03 A triangle is a triangle independent of its edge-sizing.

614.04 Each of the angles of a triangle is interstabilized. Each of the angles was originally amorphous—i.e., unstable—but they become stable because each edge of a triangle is a lever. With minimum effort, the ends of the levers control the opposite angles with a push-pull, opposite-edge vector. A triangle is the means by which each side stabilizes the opposite angle with minimum effort.

614.05 The stable structural behavior of a whole triangle, which consists of three edges and three individually and independently unstable angles (or a total of six components), is not predicted by any one or two of its angles or edges taken by themselves. A triangle (a structure) is synergetic: it is a behavior of a whole unpredicted by the behavior of any of its six parts considered only separately.

614.06 When a bright light shines on a complex of surface scratches on metal, we find the reflection of that bright light upon the scratched metal producing a complex of concentric scratch-chorded circles. In a multiplicity of omnidirectional actions in the close proximity of the viewable depth of the surfaces, structurally stable triangles are everywhere resultant to the similarly random events. That triangles are everywhere is implicit in the fact that wherever we move or view the concentric circles, they occur, and that there is always one triangle at the center of the circle. We could add the word *approximately* everywhere to make the everywhereness coincide with the modular- frequency characteristics of any set of random multiplicity. Because the triangles are structurally stable, each one imposes its structural rigidity upon its neighboring and otherwise unstable random events. With energy operative in the system, the dominant strength of the triangles will inherently average to equilateralness.

614.07 When we work with triangles in terms of total leverage, we find that their average, most comfortable condition is equilateral. They tend to become equilateral. Randomness of lines automatically works back to a set of interactions and a set of proximities that begin to triangulate themselves. This effect also goes on in depth and into the tetrahedra or octahedra.

615.00 **Positive and Negative Triangulation of Cube and Vector Equilibrium**

615.01 To be referred to as a rememberable entity, an object must be membered with structural integrity, whether maple leaf or crystal complex. To have structural integrity, it must consist entirely of triangles, which are the only complex of energy events that are self-interference-regenerating systems resulting in polygonal pattern stabilization.

615.02 A vectorial-edged cube collapses. The cube's corner flexibility can be frustrated only by triangulation. Each of the four corners of the cube's six faces could be structurally stabilized with small triangular gussets, of which there would be 24, with the long edge structurals acting as powerful levers against the small triangles. The complete standard stabilization of the cube can be accomplished with a minimum of six additional members in the form of six structural struts placed diagonally, corner to comer, in each of the six square faces, with four of the cube's eight corner vertexes so interconnected. These six, end-interconnected diagonals are the six edges of a tetrahedron. The most efficiently stabilized cubical form is accomplished with the prime structural system of Universe: the tetrahedron.

615.03 Because of the structural integrity of the blackboard or paper on which they may be schematically pictured, the cubically profiled form can exist, but only as an experienceable, forms-suggesting picture, induced by lines deposited in chalk, or ink, or lead, accomplished by the sketching individual with only 12 of the compression- representing strut edge members interjoined by eight flexible vertex fastenings.

615.04 The accomplishment of experienceable, structurally stabilized cubes with a minimum of nonredundant structural components will always and only consist of one equiangled and equiedged "regular" tetrahedron on each of whose four faces are congruently superimposed asymmetrical tetrahedra, one of whose four triangular faces is equiangled and therefore congruently superimposable on each of the four faces of the regular tetrahedron; while the four asymmetrical superimposed tetrahedra's other three triangular—and outwardly exposed—faces are all similar isosceles triangles, each with two 45-degree-angle corners and one corner of 90 degrees. Wherefore, around each of the outermost exposed corners of the asymmetrical tetrahedra, we also find three 90-degree angles which account for four of the cube's eight corners; while the other four 90-degree surrounded corners of the cube consist of pairs of 45-degree corners of the four asymmetric tetrahedra that were superimposed upon the central regular tetrahedron to form the stabilized cube. More complex cubes that will stand structurally may be compounded by redundant strutting or tensioning triangles, but redundancies introduce microinvisible, high- and low-frequency, self-disintegrative accelerations, which will always affect structural enterprises that overlook or disregard these principles.

615.05 In short, structurally stabilized (and otherwise unstable) cubes are always and only the most simply compact aggregation of one symmetrical and four asymmetrical tetrahedra. Likewise considered, a dodecahedron may not be a cognizable entity-integrity, or be rememberable or recognizable as a regenerative entity, unless it is omnistabilized by omnitriangulation of its systematic subdivision of all Universe into either and both insideness and outsideness, with a small remainder of Universe to be discretely invested into the system-entity's structural integrity. No energy action in Universe would bring about a blackboard-suggested pentagonal necklace, let alone 12 pentagons collected edge to edge to superficially outline a dodecahedron. The dodecahedron is a demonstrable entity only when its 12 pentagonal faces are subdivided into five triangles, each of which is formed by introducing into each pentagon five struts radiating unitedly from the pentagons' centers to their five comer vertexes, of which vertexes the dodecahedron has 20 in all, to whose number when structurally stabilized must be added the 12 new pentagonal center vertexes. This gives the minimally, nonredundantly structural dodecahedron 32 vertexes, 60 faces, and 90 strut lines. In the same way, a structural cube has 12 triangular vertexes, 8 faces, and 18 linear struts.

615.06 The vector equilibrium may not be referred to as a stabilized structure except when six struts are inserted as diagonal triangulators in its six square faces, wherefore the topological description of the vector equilibrium always must be 12 vertexes, 20 (triangular) faces, and 30 linear struts, which is also the topological description of the icosahedron, which is exactly what the six triangulating diagonals that have hypotenusal diagonal vectors longer than the square edge vectors bring about when their greater force shrinks them to equilength with the other 24 edge struts. This interlinkage transforms the vector equilibrium's complex symmetry of six squares and eight equiangled triangles into the simplex symmetry of the icosahedron.

615.07 Both the cube and the vector equilibrium's flexible, necklacelike, six-square- face instabilities can be nonredundantly stabilized as structural integrity systems only by one or the other of two possible diagonals of each of their six square faces, which diagonals are not the same length as the unit vector length. The alternate diagonaling brings about positive or negative symmetry of structure. (See illustration 464.01 and 464.02 in color section.) Thus we have two alternate cubes or icosahedra, using either the red diagonal or the blue diagonal. These alternate structural symmetries constitute typical positive or negative, non-mirror-imaged intercomplementation and their systematic, alternating proclivity, which inherently propagate the gamut of frequencies uniquely characterizing the radiated entropy of all the self-regenerative chemical elements of Universe, including their inside-out, invisibly negative-Universe-provokable, split-second- observable imports of transuranium, non-self-regenerative chemical elements.

616.00 **Surface Strength of Structures**

616.01 The highest capability in strength of structures exists in the triangulation of the system's enclosing structure, due to the greater action-reaction leverage distance that opposite sides of the system provide. This is what led men to hollow out their buildings.

616.02 The structural strength of the exterior triangles is not provided by the "solid" quality of the exterior shell, but by triangularly interstabilized lines of force operating within that shell. They perforate the shell with force lines. The minimum holes are triangular.

616.03 The piercing of the shells with triangular holes reduces the solid or continuous surface of second-power increase of the shells. This brings the rate of growth of structures into something nearer an overall first-power or linear rate of gain—for the force lines are only linear. (See also Sec. 412, Closest Packing of Rods: Surface Tension Capability, and Sec. 750, Unlimited Frequency of Geodesic Tensegrities.)

617.00 **Cube**

617.01 If the cubic form is stable, it has 18 structural lines. If a dodecahedron is stable, it has 32 vertexes, 60 faces, and 90 structural lines. (The primes 5 and, 3 show up here to produce our icosahedral friend 15.)

617.02 Whenever we refer to a stable entity, it has to be structurally valid; therefore, it has to be triangulated. This does not throw topology out.

617.03 A nonstructurally triangulated cube exists only by self-deceptive topological accounting: someone shows you a paper or sheet-metal cube and says, "Here is a structurally stable cube without any face diagonaling." And you say, "What do you call that sheet metal or paper that is occupying the square faces without which the cube would not exist? The sheet metal or paper does diagonal the square but overdoes it redundantly."

617.04 A blackboard drawing of a 12-line cube is only an imaginary, impossible structure that could not exist in this part of Universe. It could temporarily hold its shape in gravity-low regions of space or in another imaginary Universe. Because we are realistically interested only in this Universe, we find the cube to be theoretical only. If it is real, the linear strut cube has 12 isosceles, right-angle-apexed, triangular faces.

618.00 **Dimpling Effect**

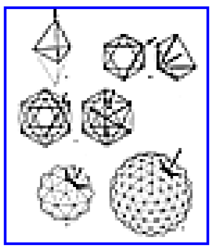

Fig. 618.01

618.01 **Definition:** When a concentrated load is applied (toward the center) of any vertex of any triangulated system, it tends to cause a dimpling effect. As the frequency or complexity of successive structures increases, the dimpling becomes progressively more localized, and proportionately less force is required to bring it about.

618.02 To illustrate dimpling in various structures, we can visualize the tetrahedron, octahedron, and icosahedron made out of flexible steel rods with rubber joints. Being thin and flexible, they will bend and yield under pressure.

618.10 **Tetrahedron:** Beginning with the tetrahedron as the minimum system, it clearly will require proportionately greater force to create a "dent." In order to dimple, the tetrahedron will have to turn itself completely inside out with no localized effect in evidence. Thus the dimpling forces a complete change in the entire structure. The tetrahedron has the greatest resistance of any structure to externally applied concentrated load. It is the only system that can turn itself inside out. Other systems can have very large dimples, but they are still local. Even a hemispherical dimple is still a dimple and still local.

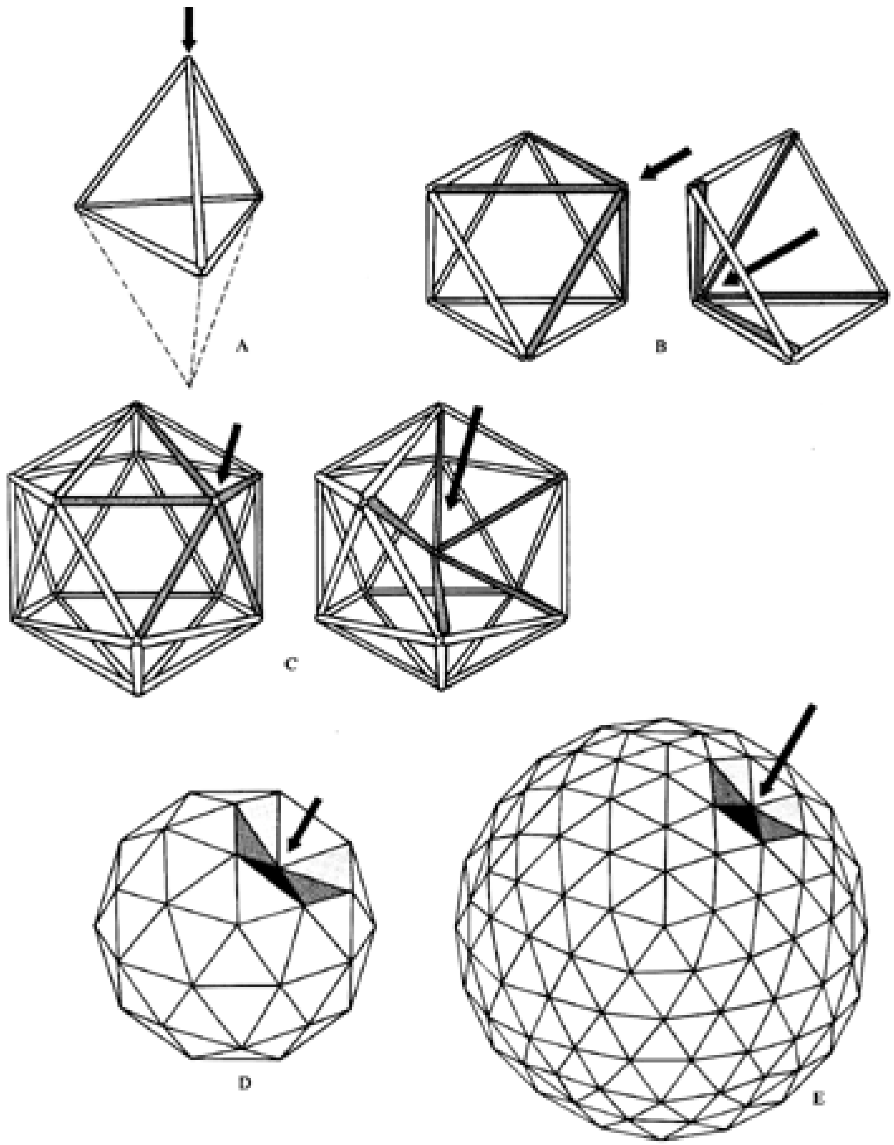

Fig. 618.01: The tetrahedron would have to turn itself completely inside out (A), and as this constitutes a complete change in the entire structure (with no localized effect in evidence) the tetrahedron clearly has the greatest resistance of any structure to externally applied concentrated load. The octahedron dimples in on itself (B), and the icosahedron (C), although dimpling locally, does reduce its volume considerably when doing so, implying that it still has good resistance to concentrated load. The geodesic spheres (D and E) exhibit "very local" dimpling as the frequency increases, suggesting much less resistance to concentrated loads but very high resistance to distributed loads.

618.20 **Octahedron:** If we apply pressure to any one of the six vertexes of the octahedron, we will find that one half will fit into the other half of the octahedron, each being the shape of a square-based Egyptian pyramid. It will nest inside itself like a football being deflated, with one half nested in the other. Although the octahedron dimples locally, it reduces its volume considerably in doing so, implying that it still has a good resistance to concentrated load.

618.30 **Icosahedron:** When we press on a vertex of the icosahedron, five legs out of the thirty yield in dimpling locally. There remains a major part of the space in the icosahedron that is not pushed in. If we go into higher and higher triangulation-into geodesics-the dimpling becomes more local; there will be a pentagon or hexagon of five or six vectors that will refuse to yield in tension and will pop inwardly in compression, and not necessarily at the point where the pressure is applied. (See Sec. 905.17.)

Next Section: 620.00

620.00 **Tetrahedron**

620.01 In the conceptual process of developing the disciplines for carrying on the process of consideration, the process of temporarily putting aside the irrelevancies and working more closely for the relationships between the components that are considered relevant, we find that a geometry of configuration emerges from our awareness of the minimum considered components. A minimum constellation emerges from our preoccupation with getting rid of the irrelevancies. The geometry appears out of pure conceptuality. We dismiss the irrelevancies in the search for understanding, and we finally come down to the minimum set that may form a system to divide Universe into macrocosm and microcosm, which is a set of four items of consideration. The minimum consideration is a four-star affair that is tetrahedral. Between the four stars that form the vertexes of the tetrahedron, which is the simplest system in Universe, there are six edges that constitute all the possible relationships between those four stars.

620.02 The tetrahedron occurs conceptually independent of events and independent of relative size.

620.03 By tetrahedron, we mean the minimum thinkable set that would subdivide Universe and have interconnectedness where it comes back upon itself. The four points have six interrelatednesses. There are two kinds of number systems involved: four being prime number two and six being prime number three. So there are two very important kinds of oscillating quantities numberwise, and they begin to generate all kinds of fundamentally useful mathematics. The basic structural unit of physical Universe quantation, tetrahedron has the fundamental prime number oneness.

620.04 Around any one vertex of the tetrahedron, there are three planes. Looking down on a tetrahedron from above, we see three faces and three edges. There are these three edges and three faces around any one vertex. That seems very symmetrical and nice. You say that is logical; how could it be anything else? But if we think about it some more, it may seem rather strange because we observe three faces and three edges from an inventory of four faces and six edges. They are not the same inventories. It is interesting that we come out with symmetry around each of the points out of a dissimilar inventory.

620.05 The tetrahedron is the first and simplest subdivision of Universe because it could not have an insideness and an outsideness unless it had four vertexes and six edges. There are four areal subdivisions and four interweaving vertexes or prime convergences in its six-trajectory isolation system. The vertexial set of four local-event foci coincides with the requirement of quantum mathematics for four unique quanta numbers for each uniquely considerable quantum.

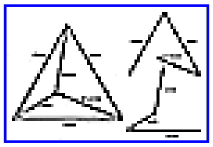

Fig. 620.06

620.06 With three positive edges and three negative edges, the tetrahedron provides a vectorial quantum model in conceptual array in which the right helix corresponds to the proton set (with electron and antineutrino) and the left helix corresponds to the neutron set (with positron and neutrino). The neutron group has a fundamental leftness and the proton group has a fundamental rightness. They are not mirror images. In the tetrahedron, the two groups interact integrally. The tetrahedron is a form of energy package.

620.07 The tetrahedron is transformable, but its topological and quantum identity persists in whole units throughout all experiments with physical Universe. All of the definable structuring of Universe is tetrahedrally coordinate in rational number increments of the tetrahedron.

620.08 Organic chemistry and inorganic chemistry are both tetrahedrally coordinate. This relates to the thinking process where the fundamental configuration came out a tetrahedron. Nature's formulations here are a very, very high frequency. Nature makes viruses in split seconds. Whatever she does has very high frequency. We come to tetrahedron as the first spontaneous aggregate of the experiences. We discover that nature is using tetrahedron in her fundamental formulation of the organic and inorganic chemistry. All structures are tetrahedrally based, and we find our thoughts resolving themselves spontaneously into the tetrahedron as it comes to the generalization of the special cases that are the physics or the chemistry.

620.09 We are at all times seeking how it can be that nature can develop viruses or billions of beautiful bubbles in the wake of a ship. How does she formulate these lovely geometries so rapidly? She must have some fundamentally pure and simple way of developing these extraordinary life cells at the rate she develops them. When we get to something as simple as finding that the tetrahedron is the minimum thinkable set that subdivides Universe and has relatedness, and that the chemist found all the structuring of nature to be tetrahedral, in some cases vertex to vertex, in others interlinked edge to edge, we find, as our thoughts go this way, that it is a very satisfying experience.

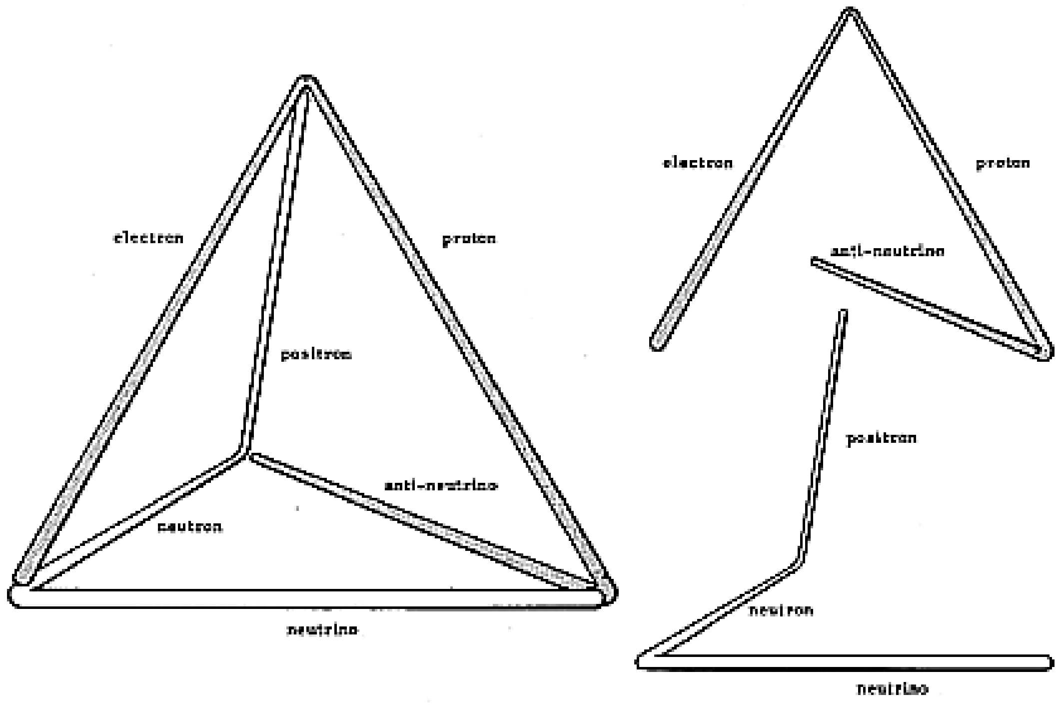

Fig. 620.06 Tetrahedron as Vectorial Model of Quantum: The tetrahedron as a basic vectorial model is the fundamental structural system of the Universe. The open-ended triangular spiral as action, reaction, and resultant (proton, electron, and anti-neutrino; or neutron, positron, and neutrino) becomes half quantum. An association of positive and negative half-quantum units identifies the tetrahedron as one quantum.

620.10 All polyhedra may be subdivided into component tetrahedra, but no tetrahedron may be subdivided into component polyhedra of less than the tetrahedron's four faces.

620.11 The triangle is the minimum polygon and the tetrahedron is the minimum structural system, for we cannot find an enclosure of less than four sides, that is to say, of less than 720 degrees of interior- (or exterior-) angle interaction. The tetrahedron is a tetrahedron independent of its edge lengths or its relative volume. In tetrahedra of any size, the angles are always sumtotally 720 degrees.

620.12 Substituting the word *tetrahedron* for the number two completes my long attempt to convert all the previously unidentifiable integers of topology into geometrical conceptuality. Thus we see both the rational energy quantum of physics and the topological tetrahedron of the isotropic vector matrix rationally accounting all physical and metaphysical systems. (See Secs. 221.01 and 424.02.)

621.00 **Constant Properties of the Tetrahedron**

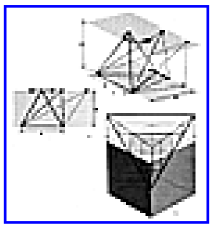

Fig. 621.01

621.01 Evaluated in conventional terms of cubical unity, the volume of a tetrahedron is one-third the base area times the altitude; in synergetics, however, the volume of the tetrahedron is unity and the cube is threefold unity. Any asymmetric tetrahedron will have a volume equal to any other tetrahedron so long as they have common base areas and common altitudes. (See Sec. 923.20.)

621.02 Among geometrical systems, a tetrahedron encloses the minimum volume with the most surface, and a sphere encloses the most volume with the least surface.

621.03 A cone is simply a tetrahedron being rotated. Omnidirectional growth—which means all life—can be accommodated only by tetrahedron.

621.04 There is a minimum of four unique planes nonparallel to one another. The four planes of the tetrahedron can never be parallel to one another. So there are four unique perpendiculars to the tetrahedron's four unique faces, and they make up a four- dimensional system.

621.05 Sixth-powering is all the perpendiculars to the 12 faces of the rhombic dodecahedron.

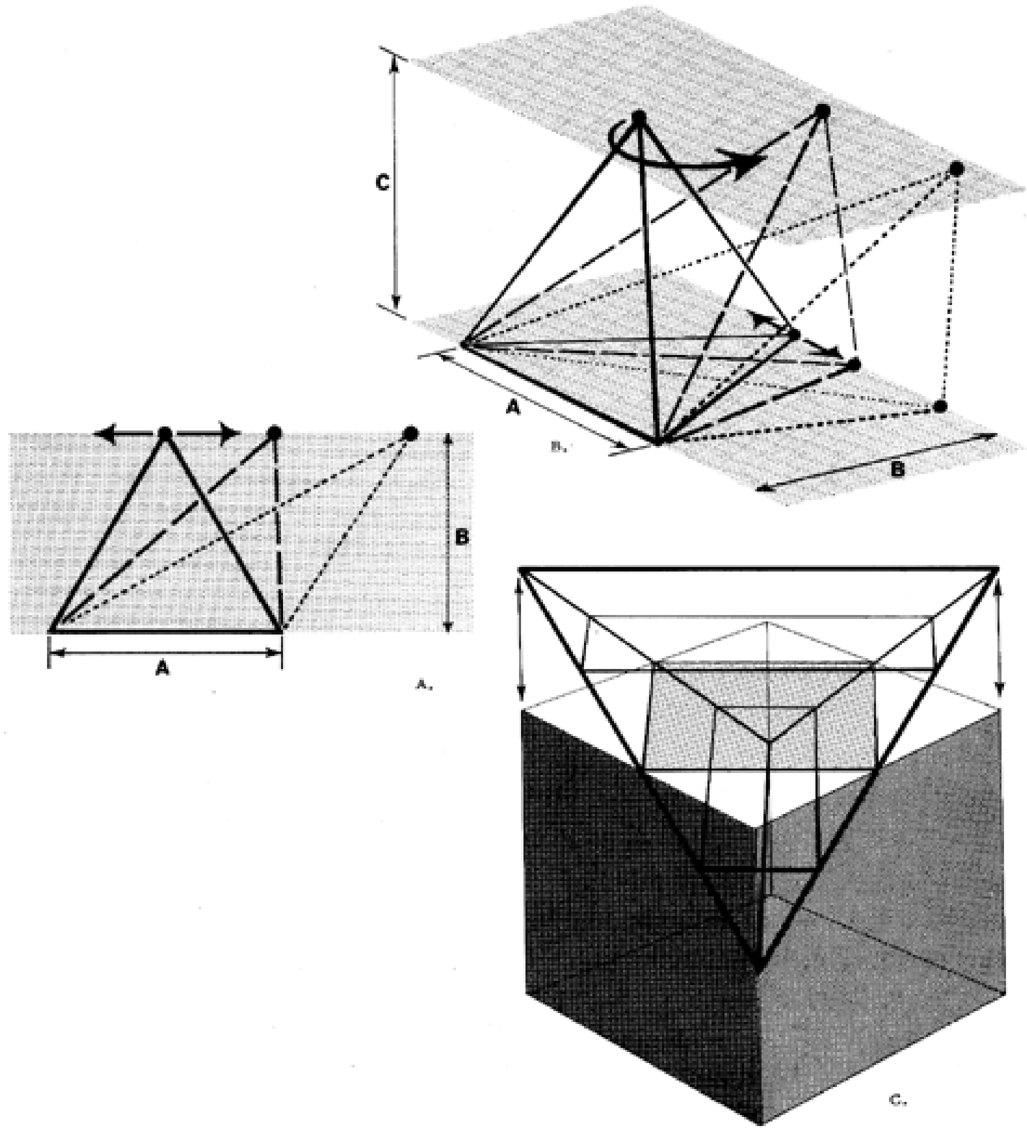

Fig. 621.01 Constant Properties of the Tetrahedron:

A. The area of a triangle is one-half the base times the altitude. Any arbitrary triangle will have the same area as any other triangle so long as they have a common base and altitude. Here is shown a system with two constants, A and B, and two variables_the edges of the triangle excepting A.
B. The volume of a tetrahedron is one-third the base area times the altitude. Any arbitrary tetrahedron will have a volume equal to any other tetrahedron so long as they have common base areas and common altitudes. Here is shown a system in which there are three constants, A, B, C, and five variables_all the tetrahedron edges excluding A.
C. As the tetrahedron is pulled out from the cube, the circumference around the tetrahedron remains equal when taken at the points where cube and tetrahedron edges cross; i.e. any rectangular plane taken through the regular tetrahedron will have a circumference equal to any other rectangular plane taken through the same tetrahedron, and this circumference will be twice the length of the tetrahedron edge.

621.06 When we try to fill all space with *regular* tetrahedra, we are frustrated because the tetrahedra will not fill in the voids above the triangular-based grid pattern. But the regular tetrahedron is a complementary space filler with the octahedron. Sec. 951 describes irregular tetrahedral allspace fillers.

621.07 The tetrahedron and octahedron can be produced by multilayered closest packing of spheres. The surface shell of the icosahedron can be made of any one layer-but only one layer-of closest-packed spheres; the icosahedron refuses radial closest packing.

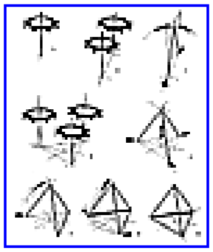
Fig. 621.10

621.10 **Six Vectors Provide Minimum Stability:** If we have one stick standing alone on a table, it may be balanced to stand alone, but it is free to fall in any direction. The same is true of two or three such sticks. Even if the two or three sticks are connected at the top in an interference, they are only immobilized for the moment, as their feet can slide out from under them. Four or five sticks propped up as triangles are free to collapse as a hinge action. Six members are required to complete multidimensional stability—our friend tetrahedron and the six positive, six negative degrees of freedom showing up again.

621.20 **Tepee-Tripod:** The tepee-tripod affords the best picture of what happens locally to an assemblage of six vectors or less. The three sides of a tepee-tripod are composed first of three vertical triangles rising from a fourth ground triangle and subsequently rocking toward one another until their respective apexes and edges are congruent. The three triangles plus the one on the ground constitute a minimum system, for they have minimum "withinness." Any one edge of our tepee acting alone, as a pole with a universal joint base, would fall over into a horizontal position. Two edges of the tepee acting alone form a triangle with the ground and act as a hinge, with no way to oppose rotation toward horizontal position except when prevented from falling by interference with a third edge pole, falling toward and into congruence with the other two poles' common vertex. The three base feet of the three poles of the tepee-tripod would slide away outwardly from one another were it not for the ground, whose structural integrity coheres the three feet and produces three invisible chords preventing the three feet from spreading. This makes the six edges of the tetrahedron. (See Secs. 521.32 and 1012.37.)

621.30 **Camera Tripod**

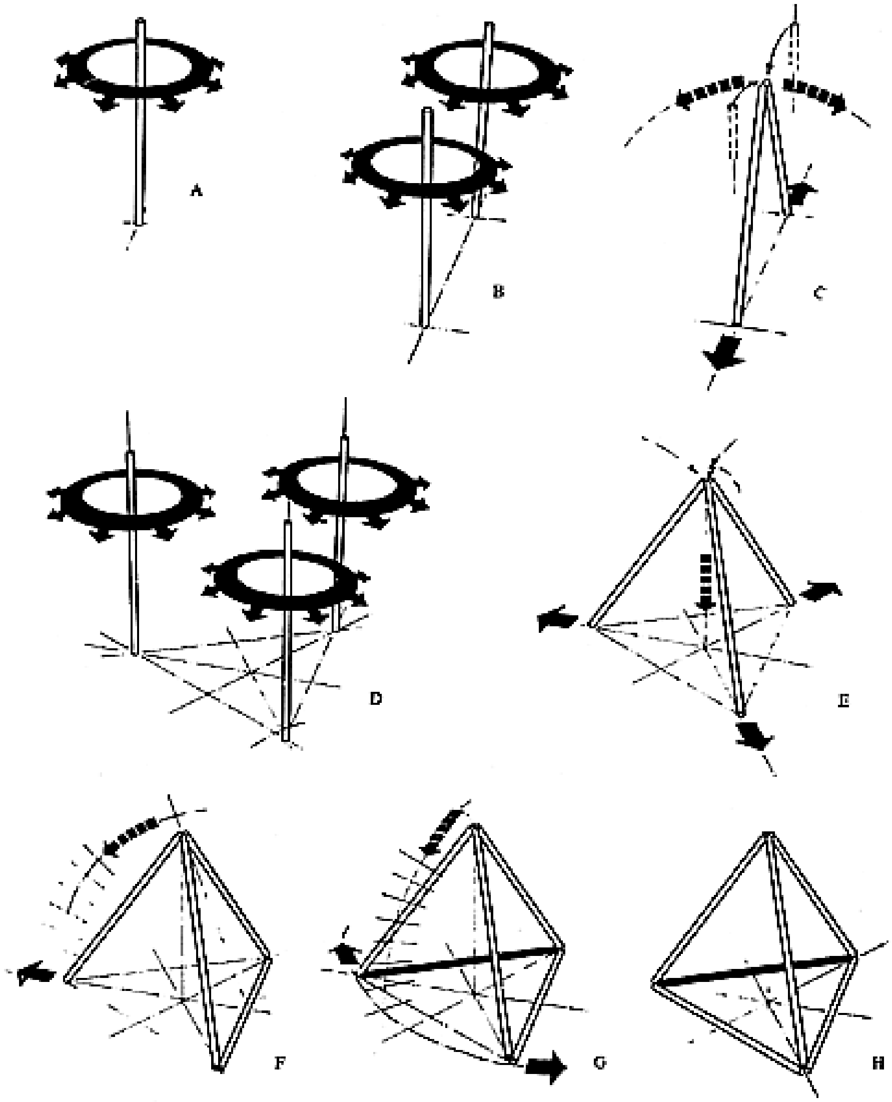

Fig. 621.10 Falling Sticks: Six Vectors Provide Minimum Stability:

A. Stick standing alone is free to fall in any direction.
B. Two sticks: free to fall in any direction.
C. Two sticks joined: free to fall in two directions and to slide apart at bases.
D. Three sticks: free to fall in any direction.
E. Three sticks joined: only free to slide apart at bases.
F. Four sticks: a propped-up triangle_the prop is free to slide out.
G. Five members: two triangles may collapse as with a hinge action.
H. Six members: complete multidimensional stability_the tetrahedron.

621.31 A simple model of the effective conservation of regenerative Universe is to be had in a camera tripod which, when its legs are folded and parallel, finds the centers of gravity and mass of its three individual legs in close proximity to one another. As the legs are progressively hinged outward from one another, the respective centers of mass and gravity recede from one another. From Newton's second law we know that as bodies increase their distance apart at an arithmetical rate, their interattractiveness decreases at a rate of the second power of the distance change—i.e., at double the distance the interattraction decreases to one-quarter intensity. Since the legs are fastened to one another at only one end (the top end), if the floor is slippery, the three bottom ends tend to slide apart at an accelerated rate.

621.32 We may think of the individual legs of the tripod as being energy vectors. The "length" of a vector equals the mass times the velocity of the force operative in given directions. We now open the equilengthed tripod legs until their bottom terminals are equidistant from one another, that distance being the same length as the uniform length of any one of the legs. Next we take three steel rods, each equal in length, mass, and structural strength to any one of the tripod legs, which renders them of equal force vector value to that of the tripod set. Next we weld the three rods together at three corner angles to form a triangle, against whose corners we will set the three bottom ends of the three downwardly and outwardly thrusting legs of the tripod. As gravity pulls the tripod Earthward, the tendency of these legs to disassociate further is powerfully arrested by the tensile integrity of the rod triangle on the ground, in which both ends of all three are joined together.

621.33 Assuming the three disassociative vectorial forces of the tripod legs to be equal to the associative vectorial force of the three-welded-together rods, we find the three-jointed closed system to be more effective than the one-jointed system. In this model the associative group in the closed triangle represents the gravity of Universe and the disassociative group—the tripod legs—represents the radiation of Universe. The whole model is the tetrahedron: the simplest structural system.

621.34 Think of the head of the camera tripod as an energy nucleus. We find that when nuclear energy becomes disassociated as radiation, it does so in a focused and limited direction unless it is intercepted and reflectively focused in a concave mirror. Radiation is inherently omnidirectional in its distribution from the nucleus outward, but it can be directionally focused. Gravity is totally embracing and convergently contractive toward all its system centers of Scenario Universe, and it cannot be focused. Like the circular waves made by an object dropped in the water, both gravitational and radiational growth-in-time patterns are concentrically arrayed; gravity convergently and contractively concentric, radiation divergently and expansively concentric. Frequency of concentricity occurrence is relative to the cyclic system considered.

Next Section: 622.00

622.00 **Polarization of Tetrahedron**

622.01 The notion that tetrahedra lack polarity is erroneous. There is a polarization of tetrahedra, but it derives only from considering a *pair* of tetrahedral edge vectors that do not intersect one another. The opposing vector mid-edges have a polar interrelationship.

622.10 **Precessionally Polarized Symmetry:** There is a polarization of tetrahedra, but only by taking a *pair* of opposite edges which are arrayed at 90 degrees (i.e., precessed) to one another in parallelly opposite planes; and only their midpoint edges are axially opposite and do provide a polar axis of spin symmetry of the tetrahedron. There is a fourfold symmetry aspect of the tetrahedron to be viewed as precessionally polarized symmetry. (See Sec. 416.01.)

622.20 **Dynamic Equilibrium of Poles of Tetrahedron:** There is a dynamic symmetry in the relationship between the mid-action, i.e., mid-edge, points of the opposing pair of polar edges of the tetrahedron. The one dot represents the positive pole of the tetrahedron at mid-action point, i.e., action center. The other dot represents the negative pole of the tetrahedron at mid-action point, i.e., at the center of negative energy of the dynamical equilibrium of the tetrahedron.

622.30 **Spin Axis of Tetrahedron:** The tetrahedron can be spun around its negative event axis or around its positive event axis.

623.00 **Coordinate Symmetry**

623.10 **Cheese Tetrahedron:** If we take a symmetrical polyhedron of cheese, such as a cube, and slice parallel to one of its faces, what is left over is no longer symmetrical; it is no longer a cube. Slice one face of a cheese octahedron, and what is left over is no longer symmetrical; it is no longer an octahedron. If you try slicing parallel to one of the faces of all the symmetrical geometries, i.e., all the Platonic and Archimedean "solids," each made of cheese, what is left after the parallel slice is removed is no longer the same symmetrical polyhedron—but with one exception, the tetrahedron.

623.11 Let us take a foam rubber tetrahedron and compress on one of its four faces inward toward its opposite vertex instead of slicing it away. It remains symmetrical, but smaller. If we pull out on a second face at the same rate that we push in on the first face, the tetrahedron will remain the same size. It is still symmetrical, but the pushing of the first face made it get a little smaller, while the pulling of the second face made it get a little larger. By pushing and pulling at the same rate, it remains the same size, but its center of gravity has to move because the whole tetrahedron seems to move. As it moves, it receives one positive alteration and one negative alteration. But in moving it we have acted on only two of the tetrahedron's four faces. We could push in on the third face at a rate different from the first couple, which is already operating; and we could pull out the fourth face at the same rate we are pushing in on the third face. We are introducing two completely different rates of change: one being very fast and the other slow; one being very hard and the other soft. We are introducing two completely different rates of change in physical energy or change in abstract metaphysical conceptuality. These completely different rates are coupled so that the tetrahedron as a medium of exchange remains both symmetrical and the same size, but it has to change its position to accommodate two alterations of the center of gravity positioning but not in the same plane or the same line. So it will be moving in a semihelix. This is another manifestation of precessional resultants.

623.12 The tetrahedron's four faces may be identified as A, B, C, and D. Any two of these four faces can be coupled and can be paired with the other two to provide the dissimilar energy rate-of-exchange accommodation. $(N^2 - N)/2$ = the number of relationships. In this case, N = 4, therefore, (16 - 4) / 2 = 6. There are six possible couples: AB, AC, AD, BC, BD, CD, and these six couples may be interpaired in $(N^2 - N)/2$ ways; therefore, (36 - 6)/2=15; which 15 ways are:

(1) AB-AC	(6) AC-AD	(11) AD-BD
(2) AB-AD	(7) AC-BC	(12) AD-CD
(3) AB-BC	(8) AC-BD	(13) BC-BD
(4) AB-BD	(9) AC-CD	(14) BD-CD
(5) AB-CD	(10) AD-BC	(15) BD-CD

Thus any one tetrahedron can accommodate 15 different *amplitude* (A) and, or *frequency* (F) of interexchanging without altering the tetrahedron's size while, however, always changing the tetrahedron's apparent occurrence locale; therefore the number of possible alternative exchanges are three; i.e., AA, AF, FF;

therefore, 3 × 15 = 45 different combinations of *interface couplings* and message contents can be accommodated by the same apparent unit-size tetrahedron, the only resultants of which are the 15 relocations of the tetrahedrons and the 45 different message accommodations.

623.13 Tetrahedron has the extraordinary capability of remaining symmetrically coordinate and entertaining 15 pairs of completely disparate rates of change of three different classes of energy behaviors in respect to the rest of Universe and not changing its size. As such, it becomes a universal joint to couple disparate actions in Universe. So we should not be surprised at all to find nature using such a facility and moving around Universe to accommodate all kinds of local transactions, such as coordination in the organic chemistry or in the metals. The symmetry, the fifteenness, the sixness, the foumess, and the threeness are all constants. This induced "motion," or position displacement, may explain all apparent motion of Universe. The fifteenness is unique to the icosahedron and probably valves the 15 great circles of the icosahedron.

623.14 A tetrahedron has the strange property of *coordinate symmetry,* which permits local alteration without affecting the symmetrical coordination of the whole. This means it is possible to receive changes in respect to one part or direction of Universe and not in the direction of the others and still have the symmetry of the whole. In contradistinction to any other Platonic or Archimedean symmetrical "solid," only the tetrahedron can accommodate local asymmetrical addition or subtraction without losing its cosmic symmetry. Thus the tetrahedron becomes the only exchange agent of Universe that is not itself altered by the exchange accommodation.

623.20 **Size Comes to Zero:** There are three different aspects of size—linear, areal, and volumetric—and each aspect has a different velocity. As you move one of the tetrahedron's faces toward its opposite vertex, it gets smaller and smaller, with the three different velocities operative. But it always remains a tetrahedron with six edges, four vertexes, and four faces. So the symmetry is not lost and the fundamental topological aspect—its 60-degreeness—never changes. As the faces move in, they finally become congruent to the opposite vertex as all three velocities come to zero at the same time. The degreeness, the six edges, the four faces, and the symmetry were never altered because they were not variables. The only variable was size. Size alone can come to zero. The conceptuality of the other aspects never changes.

624.00 **Inside-Outing of Tetrahedron**

624.01 The tetrahedron is the only polyhedron, the only structural system that can be turned inside out and vice versa by one energy event.

624.02 You can make a model of a tetrahedron by taking a heavy-steel-rod triangle and running three rubber bands from the three vertexes into the center of gravity of the triangle, where they can be tied together. Hold the three rubber bands where they come together at the center of gravity. The inertia of the steel triangle will make the rubber bands stretch, and the triangle becomes a tetrahedron. Then as the rubber bands contract, the triangle will lift again. With such a triangle dangling in the air by the three stretched rubber bands, you can suddenly and swiftly plunge your hand forth and back through the relatively inert triangle . . . making first a positive and then a negative triangle. (In the example given in Sec. 623.20, the opposite face was pumped through the inert vertex. It can be done either way.) This kind of oscillating pump is typical of some of the atom behaviors. An atomic clock is just such an oscillation between a positive and a negative tetrahedron.

624.03 Both the positive and negative tetrahedra can locally accommodate the 45 different energy exchange couplings and message contents, making 90 such accommodations all told. These accommodations would produce 30 different "apparent" tetrahedron position shifts, whose successive movements would always involve an angular change of direction producing a helical trajectory.

624.04 The extensions of tetrahedral edges through any vertex form positive-negative tetrahedra and demonstrate the essential twoness of a system.

624.05 The tetrahedron is the minimum, convex-concave, omnitriangulated, compound curvature system, ergo, the minimum sphere. We discover that the additive twoness of the two polar (and a priori awareness) spheres at most economical minimum are two tetrahedra and that the insideness and outsideness complementary tetrahedra altogether represent the two invisible complementary twoness that balances the visible twoness of the polar pair.

624.06 When we move one of the tetrahedron's faces beyond congruence with the opposite vertex, the tetrahedron turns inside out. An inside-out tetrahedron is conceptual and of no known size.

624.10 **Inside Out by Moving One Vertex:** The tetrahedron is the only polyhedron that can be turned inside out by moving one vertex within the prescribed linear restraints of the vector interconnecting that vertex with the other vertexes, i.e., without moving any of the other vertexes.

624.11 Moving one vertex of an octahedron within the vectorial-restraint limits connecting that vertex with its immediately adjacent vertexes (i.e., without moving any of the other vertexes), produces a congruence of one-half of the octahedron with the other half of the octahedron.

624.12 Moving one vertex of an icosahedron within the vectorial-constraint limits connecting that vertex with the five immediately adjacent vertexes (i.e., without moving any of the other vertexes), produces a local inward dimpling of the icosahedron. The higher the frequency of submodulating of the system, the more local the dimpling. (See Sec. 618.)

625.00 **Invisible Tetrahedron**

625.01 The Principle of Angular Topology (see Sec. 224) states that the sum of the angles around all the vertexes of a structural system, plus 720 degrees, equals the number of vertexes of the system multiplied by 360 degrees. The tetrahedron may be identified as the 720-degree differential between any definite local geometrical system and finite Universe. Descartes discovered the 720 degrees, but he did not call it the tetrahedron.

625.02 In the systematic accounting of synergetics angular topology, the sum of the angles around each geodesically interrelated vertex of every definite concave-convex local system is always two vertexial unities less than universal, nondefined, finite totality.

625.03 We can say that the difference between any conceptual system and total but nonsimultaneously conceptual—and therefore nonsimultaneously sensorial—scenario Universe, is always one exterior tetrahedron and one interior tetrahedron of whatever sizes may be necessary to account for the balance of all the finite quanta thus far accounted for in scenario Universe outside and inside the conceptual system considered. (See Secs. 345 and 620.12.)

625.04 Inasmuch as the difference between any conceptual system and total Universe is always two weightless, invisible tetrahedra, if our physical conceptual system is a regular equiedged tetrahedron, then its complementation may be a weightless, metaphysical tetrahedron of various edge lengths—ergo, non-mirror-imaged—yet with both the visible and the invisible tetrahedra's corner angles each adding up to 720 degrees, respectively, though one be equiedged and the other variedged.

625.05 The two invisible and *n*-sized tetrahedra that complement all systems to aggregate sum totally as finite but nonsimultaneously conceptual scenario Universe are mathematically analogous to the "annihilated" left-hand phase of the rubber glove during the right hand's occupation of the glove. The difference between the sensorial, special- case, conceptually measurable, finite, separately experienced system and the balance of nonconceptual scenario Universe is two finitely conceptual but nonsensorial tetrahedra. We can say that scenario Universe is finite because (though nonsimultaneously conceptual and considerable) it is the sum of the conceptually finite, after-image-furnished thoughts of our experience systems plus two finite but invisible, *n*-sized tetrahedra.

625.06 The tetrahedron can be turned inside out; it can become invisible. It can be considered as antitetrahedron. The exterior invisible complementary tetrahedron is only concave having only to embrace the convexity of the visible system and the interior invisible complementary tetrahedron is only convex to marry the concave inner surface of the system.

625.10 **Macro-Micro Invisible Tetrahedra**

625.11 In finite but nonunitarily conceptual Scenario Universe a minimum-system tetrahedron can be physically realized in local time-and-space Universe—i.e., as tune-in- able only within human-sense-frequency-range capabilities and only as an inherently two- in-one tetrahedron (one convex, one concave, in congruence) and only by concurrently producing two separate invisible tetrahedra, one externalized macro and one internalized micro—ergo, four tetrahedra.

625.12 The micro-tetra are congruent only in our Universe; in metaphysical Universe they are separate.

626.00 **Operational Aspects of Tetrahedra**

626.01 The world military forces use reinforced concrete tetrahedra for military tank impediments. This is because tetrahedra lock into available space by friction and not by fitting. They are used as the least disturbable barrier components in damming rivers temporarily shunted while constructing monolithic hydroelectric dams.

626.02 The tetrahedron's inherent refusal to fit allows it to get ever a little closer; in not fitting additional space, it is always available to accommodate further forced intrusions. The tetrahedron's edges and vertexes scratch and dig in and thus produce the powerfully locking-in-place frictions . . . while stacks of neatly fitting cubes just come apart.

626.03 This is why stone is crushed to make it less spherical and more tetrahedral. This is why beach sand is not used for cement; it is too round. Spheres disassociate; tetrahedra associate spontaneously. The limit conditions involved are the inherent geometrical limit conditions of the sphere enclosing the most volume with the least surface and the fewest angular protrusions, while the tetrahedron encloses the least volume with the most surface and does so with most extreme angular vertex protrusion of any regular geometric forms. The sphere has the least interfriction surface with other spheres and the greatest mass to restrain interfrictionally; while the tetrahedra have the most interfriction, interference surface with the least mass to restrain.

630.00 **Antitetrahedron**

631.00 **Minimum of Four Points**

631.01 We cannot produce constructively and operationally a real experience-augmenting, omnidirectional system with less than four points. A fourth point cannot be in the plane approximately located, i.e., described, by the first three points, for the points have no dimension and are unoccupiable as is also the plane they "describe." It takes three points to define a plane. The fourth point, which is not in the plane of the first three, inherently produces a tetrahedron having insideness and outsideness, corresponding with the reality of operational experience.

631.02 The tetrahedron has four unique planes described by the four possible relationships of its four vertexes and the six edges interconnecting them. In a regular tetrahedron, all the faces and all the edges are assumed to be approximately identical.

632.00 **Dynamic Symmetry of the Tetrahedron**

632.01 There is a symmetry of the tetrahedron, but it is inherently four-dimensional and related to the four planes and the four axes projected perpendicularly to those planes from their respective subtending vertexes. But the tetrahedron lacks three-dimensional symmetry due to the fact that the subtending vertex is only on one side of the triangular plane, and due to the fact that the center of gravity of the tetrahedron is always only one- quarter of its altitude irrespective of the seeming asymmetry of the tetrahedron.

632.02 The dynamic symmetry of the tetrahedron involves the inward projection of four geodesic connectors with the center of area of the triangular face opposite each vertex of the tetrahedron (regular or maxi-asymmetrical); which four vertex-to-opposite- triangle geodesic connectors will all pass through the center of gravity of the tetrahedron—regular, mini- or maxi-asymmetric; and the extension of those geodesics thereafter through the four centers of gravity of those four triangular planes, outwardly from the tetrahedron to four new vertexes equidistant outwardly from the three corners of their respective four basal triangular facet planes of the original tetrahedron. The four exterior vertexes are equidistant outwardly from the original tetrahedron, a distance equal to the interior distances between the centers of gravity of the original tetrahedron's four faces and their inwardly subtending vertexes. This produces four regular tetrahedra outwardly from the four faces of the basic tetrahedron and triple-bonded to the original tetrahedron.

632.03 We have turned the tetrahedron inside out in four different directions and each one of the four are dimensionally similar. This means that each of the four planes of the tetrahedron produces four new points external to the original tetrahedron, and four similar tetrahedra are produced outwardly from the four faces of the original tetrahedron; these four external points, if interconnected, produce one large tetrahedron, whose six edges lie outside the four externalized tetrahedra's 12 external edges.

633.00 **Negative Tetrahedron**

633.01 As we have already discovered in the vector equilibrium (see Sec. 480), each tetrahedron has its negative tetrahedron produced through its interior apex rather than through its outer triangular base. In the vector equilibrium, each tetrahedron has its negative tetrahedron corresponding in dynamic symmetry to its four-triangled, four- vertexed, fourfold symmetry requirement. And all eight (four positive and four negative) tetrahedra are clearly present in the vector equilibrium. Their vertexes are congruent at the center of the vector equilibrium. Each of the tetrahedra has one internal edge circumferentially congruent with the other tetrahedra's edge, and each of the tetrahedra's three internal edges is thus double-bonded circumferentially with three other tetrahedra, making a fourfold cluster in each hemisphere. This exactly balances a similarly bonded fourfold cluster in its opposite hemisphere, which is double-bonded to their hemisphere's fourfold cluster by six circumferentially double-bonded, internal edges. Because there are four equatorial planes of symmetry of the vector equilibrium, there are four different sets of the fourfold tetrahedra clusters that can be differentiated one from the others.

633.02 Each of the eight tetrahedra symmetrically surrounding the nucleus of the vector equilibrium can serve as a nuclear domain energy valve, and each can accommodate 15 alternate intercouplings and three types of message contents; wherefore, the vector equilibrium cosmic nucleus system can accommodate 4 × 45 = 180 positive, and 4 × 45 = 180 negative, uniquely different energy—or information—transactions at four frequency levels each. We may now identify (a) the four positive-to-negative-to positive, triangular intershuttling transformings within each cube of the eight corner cubes of the two- frequency cube (see Sec. 462 *et seq*.); with (b) the 360 nuclear tetrahedral information valvings as being cooperatively concurrent functions within the same prime nuclear domain of the vector equilibrium; they indicate the means by which the electromagnetic, omniradiant wave propagations are initially articulated.

634.00 **Irreversibility of Negative Tetrahedral Growth**

634.01 When the dynamic symmetry is inside-outingly developed through the tetrahedron's base to produce the negatively balancing tetrahedron, only the four negative tetrahedra are externally visible, for they hide entirely the four positive triangular faces of the positive tetrahedron's four-base, four-vertex, fourfold symmetry. The positive tetrahedron is internally congruent with the four internally hidden, triangular faces of the four surrounding negative tetrahedra. This is fundamental irreversibility: the outwardly articulated dynamic symmetry is not regeneratively procreative in similar tetrahedral growth. The successive edges of the overall tetrahedron will never be rationally congruent with the edges of the original tetrahedron. This growth of dissimilar edges may bring about all the different frequencies of the different chemical elements.

635.00 **Base-Extended Tetrahedron**

635.01 The tetrahedron extended through its face is pumpingly or diaphragmatically inside-outable, in contradistinction to the vertexially extended tetrahedron. The latter is single-bonded (univalent); the former is triple-bonded and produces crystal structures. The univalent, single-bonded universal joint produces gases.

636.00 **Complementary to Vector Equilibrium**

636.01 In the vector equilibrium, we have all the sets of tetrahedra bivalently or edge-joined, i.e., liquidly, as well as centrally univalent. Synergetics calls the basally developed larger tetrahedron the *non-mirror-imaged complementary* of the vector equilibrium.[2] In vectorial-energy content and dynamic-symmetry content lies the complementarity.

(Footnote 2: The non-mirror-imaged complementary is not a negative vector equilibrium. The vector equilibrium has its own integral negative.)

637.00 **Star Tetrahedron**

637.01 The name of this dynamic vector-equilibrium complementary tetrahedron is the *star tetrahedron.* The star tetrahedron is one in which the vectors are no longer equilibrious and no longer omnidirectionally and regeneratively extensible. This star tetrahedron name was given to it by Leonardo da Vinci.

637.02 The star tetrahedron consists of five equal tetrahedra, four external and one internal. Because its external edges are not 180-degree angles, it has 18—instead of six—equi-vector external edges: 12 outwardly extended and six inwardly valleyed; ergo, a total of 18. It is a compound structure. Four of its five tetrahedra, which are nonoutwardly regenerative in unit-length vectors, ergo, non-allspace-filling, are in direct correspondence with the five four-ball tetrahedra which do close-pack to form a large, regular, three- frequency tetrahedron of four-ball edges, having one tetrahedral four-ball group at the center rather than an octahedral group as is the case with planar and linear topological phenomena. This is not really contradictory because the space inside the four-ball tetrahedron is always a small concave octahedron, wherefore, an octahedron is really at the center, though not an octahedron of six balls as at the center of a four, four-ball tetrahedral "pyramid."

638.00 **Pulsation of Antitetrahedra**

638.01 The star tetrahedron is a structure—but it is a compound structure. The fifth tetrahedron, which is the original one, and only nuclear one accommodates the pulsations of the outer four. Its outward pulsings are broadcast, and its inward pulsings are repulsive—that is why it is a star. The four three-way—12 in total—external pulsations are unrestrained, and the internal pulsations are compressionally repulsed. Leonardo called it the star tetrahedron, not because it has points, but because he sensed intuitively that it gives off radiation like a star. The star tetrahedron is an impulsive-expulsive transceiver whose four, 12-faceted, exterior triangles can either (a) feed in cosmic energy receipts which spontaneously articulate one or another of the 15 interpairings of the six A, B, C, D, interior tetrahedron's couplings, or (b) transmit through one of the external tetrahedra whose respective three faces each must be refractively pulsated once more to beam or broadcast the 45 possible AA, AF, FF messages.

638.02 There is a syntropic pulsation receptivity and an outward pulsation in dynamic symmetry of the star tetrahedron. As an energy radiator, it is entropic. It does not regenerate itself internally, i.e., gravitationally, as does the isotropic vector matrix's vector equilibrium. The star tetrahedron's entropy may be the basis of irreversible radiation, whereas the syntropic vector equilibrium's reversibility—inwardly-outwardly—is the basis for the gravitationally maintained integrity of Universe. The vector equilibrium produces conservation of omnidynamic Universe despite many entropic local energy dissipations of star tetrahedra. The star tetrahedron is in balance with the vector equilibrium—pumpable, irreversible, like the electron in behavior. It has the capability of self-positionability by converting its energy receipts to unique refraction sequences, which could change output actions to other dynamic, distances-keeping orbits, in respect to the—also only remotely existent and operating—icosahedron, and its 15 unique, great-circle self-dichotomizing; which icosahedra can only associate with other icosahedra in either linear-beam export or octahedral orbital hover-arounds in respect to any vector equilibrium nuclear group. (See Sec. 1052.)

638.03 The univalent antitetrahedra twist but do not pump. The singlebonded tetrahedra are also inside-outable, but by torque, by twist, and not by triangular diaphragm pumping. The lines of the univalent antitetrahedron are non-self-interfering. Like the lamp standards at Kennedy International Airport, New York, the three lines twist into plus (+) and minus (-) tetrahedra. MN and OP are in the same plane, with A and A ` on the opposite sides of the plane. So you have a *vertexial* inside-out twisting and a basal inside- out pumping.

638.10 **Three Kinds of Inside-Outing:** Of all the Platonic polyhedra, only the tetrahedron can turn inside out. There are three ways it can do so: by single-, double-, and triple-bonded routes. In double-bonded, edge-to-edge inside-outing, there are pairs of diametric unfoldment of the congruent edges, and the diameter becomes the hinge of reverse positive and negative folding.

639.00 **Propagation**

639.01 The star tetrahedron is nonreversible. It can only propagate outwardly. (The vector equilibrium can keep on reproducing itself inwardly or outwardly, gravitationally.) The star tetrahedron's four external tetrahedra cannot regenerate themselves; but they are external-energy-receptive, whether that energy be tensive or pressive. The star tetrahedron consists only of A Modules; it has no B Modules. The star tetrahedron may explain a whole new phase of energetic Universe such as, for instance, Negative Universe.

639.02 The vector equilibrium's closest-packed sphere shell builds outwardly to produce successively the neutron and proton counts of the 92 regenerative chemical elements. The star tetrahedron may build negatives for the post-uraniums. The star tetrahedron's six potential geodesic interconnectors of the star tetrahedron's outermost points are out of vector-length frequency-phase and generate different frequencies each time they regenerate; they expand in size due to the self-bulging effects of the 15 energy message pairings of the central tetrahedron. Because their successive new edges are noncongruent with the edges of the original tetrahedron, the new edge will never be equal to or rational with the original edge. Though they produce a smooth-curve, ascending progression, they will always be shorter—but only a very little bit shorter—than twice the length of the original edge vectors. Perhaps this shortness may equate with the shortening of radial vectors in the transition from the vector equilibrium's diameter to the icosahedron's diameter. (See Sec. 460, Symmetrical Contraction of Vector Equilibrium.) This is at least a contraction of similar magnitude, and mathematical analyses may show that it is indeed the size of the icosahedron's diameter. The new edge of the star tetrahedron may be the same as the reduced radius of the icosahedron. If it is, the star tetrahedron could be the positron, as the icosahedron seems to be the electron. These relationships should be experimentally and trigonometrically explored, as should all the energy-experience inferences of synergetics. The identifications become ever more tantalizingly close.

Next Section: 640.00

640.00 **Tension and Compression**

640.01 One cannot patent geometry per se nor any separately differentiated out, pure principle of nature's operative processes. One can patent, however, the surprise complex behaviors of associated principles where the behavior of the whole is unpredicted by the behavior of the parts, i.e., synergetic phenomena. This is known as invention, a complex arrangement not found in, but permitted by, nature, though it is sometimes superficially akin to a priori natural systems, formulations, and processes. Though superficially similar in patternings to radiolaria and flies' eyes, geodesic structuring is true invention. Radiolaria collapse when taken out of water. Flies' eyes do not provide human- dwelling precedent or man-occupiable, environment-valving structures.

640.02 Until the introduction of geodesic structures, structural analysis and engineering-design strategies regarding clear-span structural enclosures in general, and domical structures in particular, were predicated upon the stress analysis of individual beams, columns, and cantilevers as separate components and thereafter as a solid compressional shell with no one local part receiving much, if any, aid from other parts. Their primarily compressional totality was aided here and there by tensional sinews, but tension was a discontinuous local aid and subordinate. As academically constituted in the middle of this 20th-century, engineering could in no way predict, let alone rely upon, the synergetic behaviors of geodesics in which any one, several, or many of the components could be interchangeably removed without in any way jeopardizing the structural-integrity cohering of the remaining structure. Engineering was, therefore, and as yet is, utterly unable to analyze effectively and correctly tensegrity geodesic structural spheres in which none of the compression members ever touch one another and only the tension is continuous.

640.03 It appeared and as yet appears to follow, in conventional, state-licensed structural engineering, that if tension is secondary and local in all men's structural projections, that tension must also be secondary in man's philosophic reasoning. As a consequence, the popular conception of airplane flight was, at first and for a long time, erroneously explained as a compressional push-up force operating under the plane's wing. It "apparently" progressively compressed the air below it, as a ski compresses the snow into a grooved track of icy slidability. The scientific fact remains, as wind-tunnel experiments proved, that three-quarters of the airplane's weight support is furnished by the negative lift of the partial vacuum created atop the airfoil. This is simply because, as Bernoulli showed, it is longer for the air to go around the top of the foil than under the foil, and so the same amount of air in the same amount of time had to be stretched thinner, ergo vacuously, over the top. This stretching thinner of the air, and its concomitant greater effectiveness of interpositioning of bodies (that is, the airplane in respect to Earth), is our same friend, the astro- and nucleic-tensional integrity of dynamic interpatterning causality.

640.10 **Slenderness Ratio:** Compression members have a limit ratio of length to section: we call it the slenderness ratio. The compression member may very readily break if it is too long. But there is no limit of cross section to length in a tension member; there is no inherent ratio.

640.11 The Greeks, who built entirely in compression, discovered that a stone column's slenderness ratio was approximately 18 to 1, length to diameter. Modern structural-steel columns, with an integral tensional fibering unpossessed by these stone columns, have a limit slenderness ratio of approximately 33 to 1. If we have better metallurgical alloys, we can make longer and longer tension members with less and less section—apparently ad infinitum. But we cannot make longer compression columns ad infinitum.

640.12 If we try to load a slender column axially—for instance, a 36-inch-long by l/8-inch-diameter steel rod—it tends to bend in any direction away from its neutral axis. If, however, we take a six-inch-diameter bundle of 36-inch-long by 1/8-inch-diameter rods compacted parallel to one another into a closest-packed, hexagonally cross-sectioned bundle, bind them tensionally with circumferential straps in planes at 90 degrees to the axis of the rods, around the bundle's six-inch girth, and then cap both ends of the tightly compacted, hexagonally cross-sectioned bundle with tightly fitting, forged-steel, hexagonal caps, we will have a bundle that will act together as a column. If we now load this 36-inch-high column axially under an hydraulic press, we discover that because each rod could by itself be easily bent, but they cannot bend toward one another because closest packed, they therefore bend away from one another as well as twisting circumferentially into an ever-fattening, twisting cigar that ultimately bursts its girth-tensed bonds. So we discover that our purposeful compressing axially of the bundle column is resulting in tension being created at 90 degrees to our purposeful compressing.

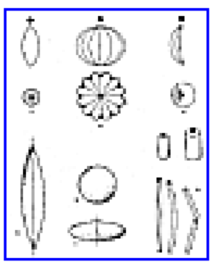

Fig. 640.20

640.20 Sphere: An Island of Compression: Aiming of the compressional loading of a short column into the neutral or central-most axis of the column provides the greatest columnar resistance to the compressing because, being the neutral axis, it brings in the most mass coherence to oppose the force. To make a local and symmetrical island of compression from a short column that axial loading has progressively twisted and expanded at girth into a cigar shape, you have to load it additionally along its neutral axis until the ever-fattening cigar shape squashes into a sphere. In the spherical condition, for the first and only time, any axis of the structure is neutral—or in its most effective resistant-to-compression attitude. It is everywhere at highest compression and tension- resisting capability to withstand any forces acting upon it.

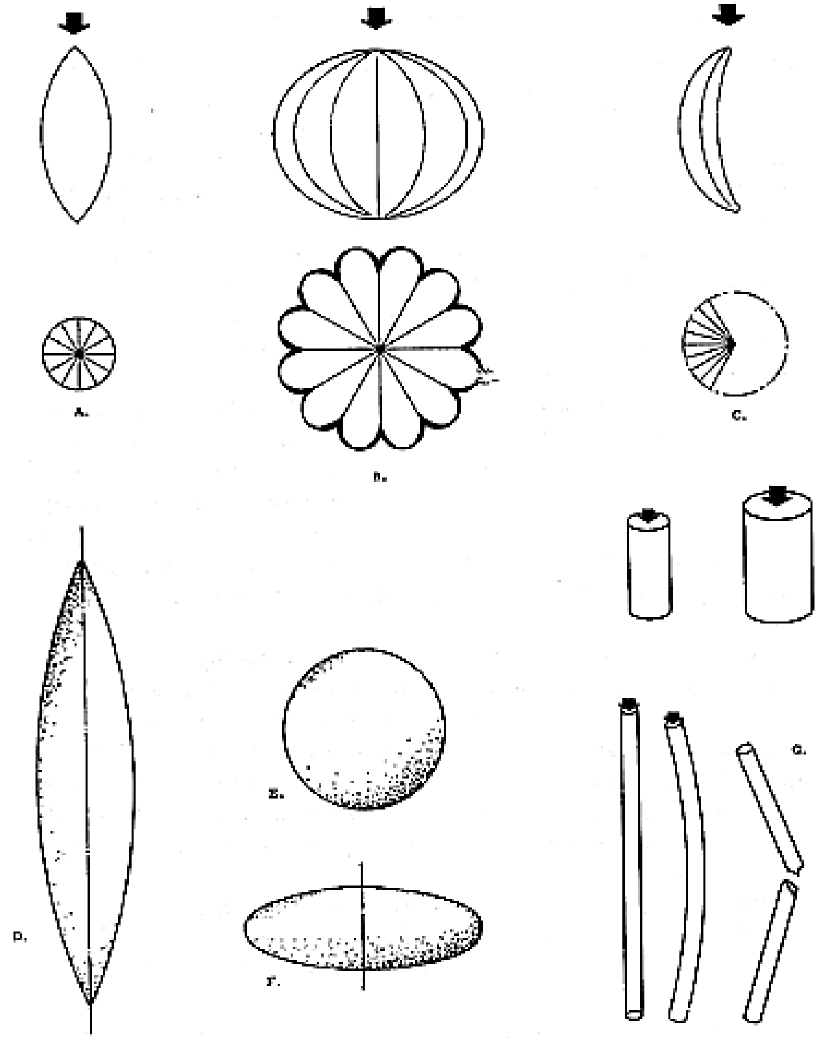

Fig. 640.20 Compression Members Under Stress: A cigar shape (A) (with radials short and compact) under pressure in its long axes goes to squash shape (B) (radials long and separating) or to banana shape (C) (radials longer and collecting). Note that on the squash the stretching edge gets thinner and breaks. The cigar (D) has only one neutral axis: axial or polar exaggerated asymmetry. The sphere (E) has an infinity of equi-neutral axes: symmetry. The disc (F) has only one neutral axis: equatorially exaggerated asymmetry. Compression columns (G) tend toward axes of ever lesser radius. As columns become longer in respect to their cross section (slenderness ratio) they tend to flex and break into two shorter columns in an attempt to restore a desirable slenderness ratio.

640.21 It is not surprising, in view of these properties, that ball bearings prove to be the most efficient compression members known to and ever designedly produced by man. Nor are we surprised to find all the planets and stars to be approximately spherical mass aggregations, as also are the atoms, all of which spherical islands of the macrocosmic and microcosmic aspects of scenario Universe provide the comprehensive, invisible, tensional, gravitational, electromagnetic, and amorphous integrity of Universe with complementarily balancing internality of compressionally most effective, locally and temporarily visible, islanded compressional entities. It is also not surprising, therefore, that Universe islands its spherical compression aggregates and coheres the whole exclusively with tension; discontinuous compression and continuous tension: I call this tensional integrity of Universe *tensegrity*.

640.30 **Precession and Critical Proximity:** Compressions are always local and, when axially increased beyond the column-into-cigar-into-sphere stage of optimum compression-resisting effectiveness, they tend toward edge-sinused, lozenge shapes, then into edge-fractionated discs, and thereafter into a plurality of separately and visibly identifiable entities separating inwardly in a plane at 90 degrees to the compressional forces as the previously neighboring atoms became precessionally separated from one another beyond the critical threshold between the falling-inward, massive integrity coherence proclivities of islanded "matter"—beyond that proclivity threshold of critical proximity, now to yield precessionally at 90 degrees to participate in the remotely orbiting patterns characterizing 99.99 percent of all the celestially accountable time-distance void of known Universe.

640.40 **Wire Wheel:** In the high- and low-tide cooperative precessional functionings of tension versus compression, I saw that there are times when each are at half tide, or equally prominent in their system relationships. I saw that the exterior of the equatorial compressional island rim-atoll of the wire wheel must be cross-sectionally in tension as also must be its hub-island's girth. I also saw that all these tension-vs- compression patterning relationships are completely reversible, and are entirely reversed, as when we consider the compressively spoked artillery wheel vs. the tensionally spoked wire wheel. I followed through with the consideration of these differentiable, yet complementarily reversible, functions of structural systems as possibly disclosing the minimum or fundamental set of differentiability of nonredundant, precessionally regenerative structural systems. (See Sec. 537.04.)

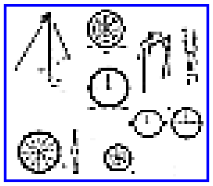

Fig. 640.41a

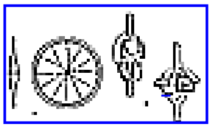

Fig. 640.41b

640.41 As I considered the 12 unique vectors of freedom constantly and nonredundantly operative between the two poles of the wire wheel—its islanded hub and its islanded equatorial rim-atoll, in effect a Milky Way-like ring of a myriad of star islands encircling the hub in a plane perpendicular to the hub axis—I discerned that this most economic arrangement of forces might also be that minimum possible system of nature capable of displaying a stable constellar compressional discontinuity and tensional continuity. A one-island system of compression would be an inherently continuous compression system, with tension playing only a redundant and secondary part. Therefore, a one-island system may be considered only as an optically illusory "unitary" system, for, of course, at the invisible level of atomic structuring, the coherence of the myriad atomic archipelagos of the "single" pebble's compression-island's mass is sum-totally and only provided by comprehensively continuous tension. This fact was invisible to, and unthought of by, historical man up to yesterday. Before the discovery of this fact in mid-20th- century, there was naught to disturb, challenge, or dissolve his "solid-rock" and other "solid-things" thinking. "Solid thinking" is as yet comprehensively popular and is even dominant over the practical considerations of scientists in general, and even over the everyday logic of many otherwise elegantly self-disciplined nuclear physicists.

640.42 As I wondered whether it was now possible for man to inaugurate an era of thinking and conscious designing in terms of comprehensive tension and discontinuous compression, I saw that his structural conceptioning of the wire wheel documented his intellectual designing breakthrough into such thinking and structuring. The compressional hub of the wire wheel is clearly islanded or isolated from the compressional "atoll" comprising the rim of the wheel. The compressional islands are interpositioned in structural stability only by the tensional spokes. This is clearly a tensional integrity, where tension is primary and comprehensive and compression is secondary and local. This reverses the historical structural strategy of man. His first wire wheel had many and varied numbers of spokes. From mathematical probing of generalized principles and experimentally proven knowledge governing the tensional integrity of the wire wheel, we discover that 12 is the minimum number of spokes necessary for wire wheel stability. (See Sec. 537, Twelve Universal Degrees of Freedom.)

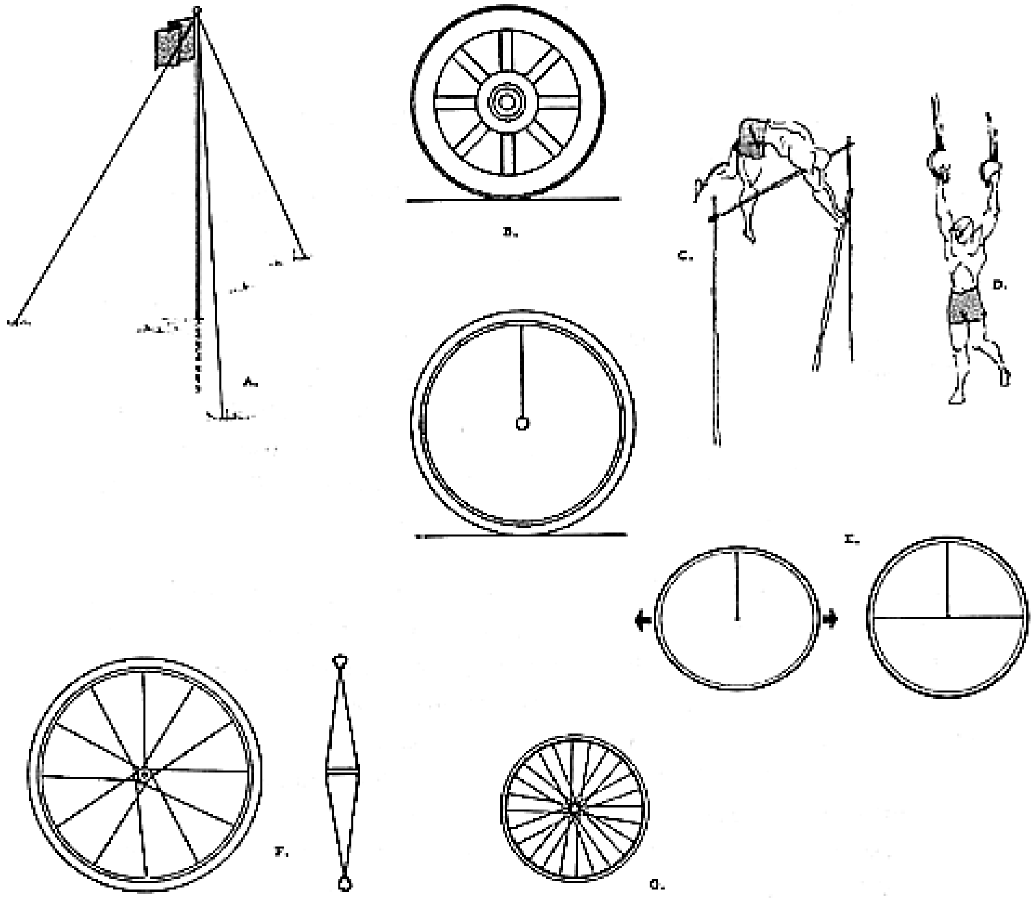

Fig. 640.41A Stabilization of tension: Minimum of 12 Spokes:

A. A solid mast without stays stands erect by itself in "solid" earth. Tension stays may be added at end of the lever arm helping against hurricane "uprooting." Men have until now employed a compression continuity as the primary load-carrying structural system with tension employed secondarily to stabilize angular relationships.
B. The old artillery wheel provides a series of vaulting poles.
C. Pole vaulting along, a "pushing-up" load.
D. Hanging in tension like the wire wheel.
E. The wire wheel provides a series of tension clings. The axle load of the wire wheel is hung from the top of the wheel, which tries to belly out, so spokes as additional tension members are added horizontally to keep it from bellying.
F. It takes a minimum of 12 spokes to fix the hub position in relation to the rim: six positive diaphragm and six negative diaphragm, of which respectively three each are positively and negatively opposed turbining torque members.
G. 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.

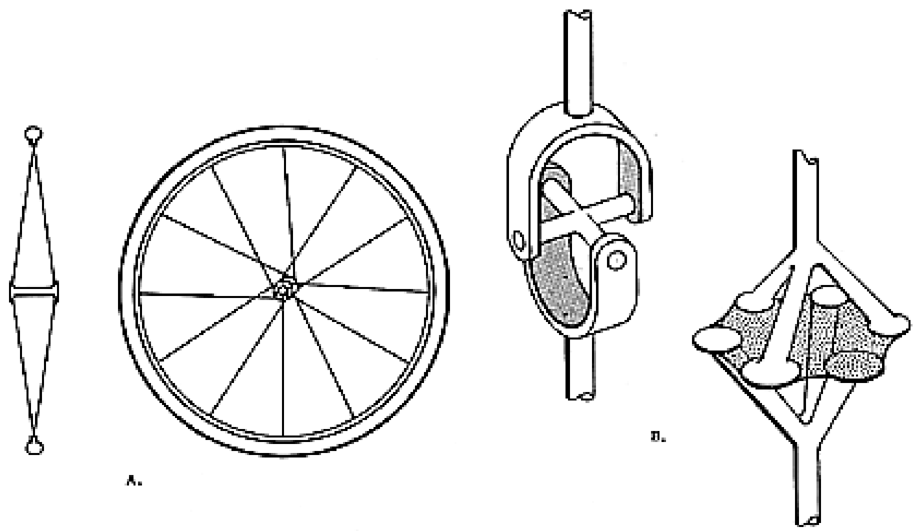

Fig. 640.41B Minimum of Twelve Spokes Oppose Torque: Universal Joint:

A. It takes a minimum of 12 spokes to overcome the turbining evident with the minimum four vectors of restraint. This is demonstrated with the 12-spoke wire wheel with its six positive diaphragm and six negative diaphragm of which respectively three each are positively and negatively opposed turbining or torque members.
B. Two-axis and three-axis "universal joints," analogous to the wire wheel as a basic system relying on the differentiation of tension and compression for its effectiveness. These all may be considered basic tensegrity systems.

640.50 **Mast in the Earth:** In his primary regard for compressional structuring, man inserts a solid mast into a hole in the "solid" Earth and rams it in as a solid continuity of the unitary solid Earth. In order to keep the wind from getting hold of the top of the mast and breaking it when the hurricane rages, he puts tension members in the directions of the various winds acting at the ends of the levers to keep it from being pulled over. The set of tension stays is triangulated from the top of the masthead to the ground, thus taking hold of the extreme ends of the potential mast-lever at the point of highest advantage against motion. (See illustration 640.41A.) In this way, tension becomes the helper. But these tensions are secondary structuring actions. They are also secondary adjuncts in man's solidly built, compressional-continuity ships. He puts in a solid mast and then adds tension helpers as shrouds. To man, building, Earth, and ship seemed alike, compressionally continuous. Tension has been secondary in all man's building and compression has been primary, for he has always thought of compression as solid. Compression is that "realistic hard core" that men love to refer to, and its reality was universal, ergo comprehensive. Man must now break out of that habit and learn to play at nature's game where tension is primary and where tension explains the coherence of the whole. Compression is convenient, very convenient, but always secondary and discontinuous.

640.60 **Tensed Rope:** There is a unique difference in the behaviors of tension and compression. When we take a coil of rope of twisted hemp and pull its ends away from one another, it both uncoils along its whole length and untwists locally in its body. This is to say that a tensed rope or tensed object tends to open its arcs of local curvation into arcs of ever greater radius. But we find that the rope never attains complete straightness either of its whole length or of its separate local fibers or threads. Ropes are complexes of spirals. Tensed mediums tend to a decreasing plurality of arcs, each of the remainder continually tending to greater radius but never attaining absolute straightness, being always affected in their overall length by other forces operating upon them. We see that tension members keep doing bigger and bigger arc tasks. The big patterns of Universe are large-radius patterns, and the small patterns are small-radius patterns. Compressed columns tend to spiral-arc complexes of ever-increasing radius. So we find the compression complexes tend to do the small local structural tasks in Universe, and the tension complexes tend to do the large structural tasks in Universe. As tension accounts for the large patternings and pattern integrities, compression trends into locally small pattern integrities.

Next Section: 641.00

641.00 **High Tide and Low Tide**

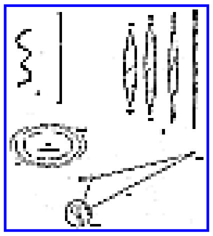
Fig. 641.01

641.01 No tension member is innocent of compression, and no compression member is innocent of tension. That is, when we are tensing a rope visibly and axially, its girth contracts as it goes untwistingly into compression, precessionally, compressing in planes at 90 degrees to the axis of our purposeful tensing. We learn experimentally that tension and compression always and only coexist and operate precessionally at right angles to one another, covarying in such a way that one is ebbing toward low tide while the other is flowing toward high tide, or vice versa, in respect to relative human apprehendability, as they fluctuate between visibly obvious and human subvisibility.

641.02 Tension and compression are inseparable and coordinate functions of structural systems, but one may be at its "high tide" aspect, i.e., most prominent phase, while the other is at low tide, or least prominent aspect. The *visibly* tensioned rope is compressively contracted in almost *invisible* increments of its girth dimensions everywhere along its length. This low-tide aspect of compression occurs in planes perpendicular to its tensed axis. Columns *visibly* loaded by weights applied only to their top ends are easily seen to have their vertical axes in compression, but *invisibly* the horizontal girths of these columns are also in tension as the result of a cigar-shaped, swelling pattern of forces acting in the column at right angles to its loaded axis, which tends, *invisibly*, to transform toward the shape of a squash or a banana. As a result of the visible, or high-tide, vertical compressioning aspect of such axial loading of the column's system, this swelling force imperceptibly stretches, or tenses, the column's girth as a low-tide reciprocal function of the overall structural-integrity reciprocity.

642.00 **Functions**

642.01 Functions are never independent of one another. There is a plurality of coexistent behaviors in nature; these are the complementary behaviors. Functions occur only as inherently cooperative and accommodatively varying subaspects of synergetically transforming wholes. Functions are covariants. Wave magnitude and frequency are experimentally interlocked as covarying cofunctions, and both are experimentally gear- locked with energy quanta. The meaning of a function is that it is part of a complementary pattern. No function exists by itself: X only in respect to Y. Tension and compression are always and only interfunctioning covariables whose seeming relative importance is a consequence of local pattern inspection. Multiplication is accomplished only by division. Universe expands through progressively differentiating out or multiplying discrete considerations.

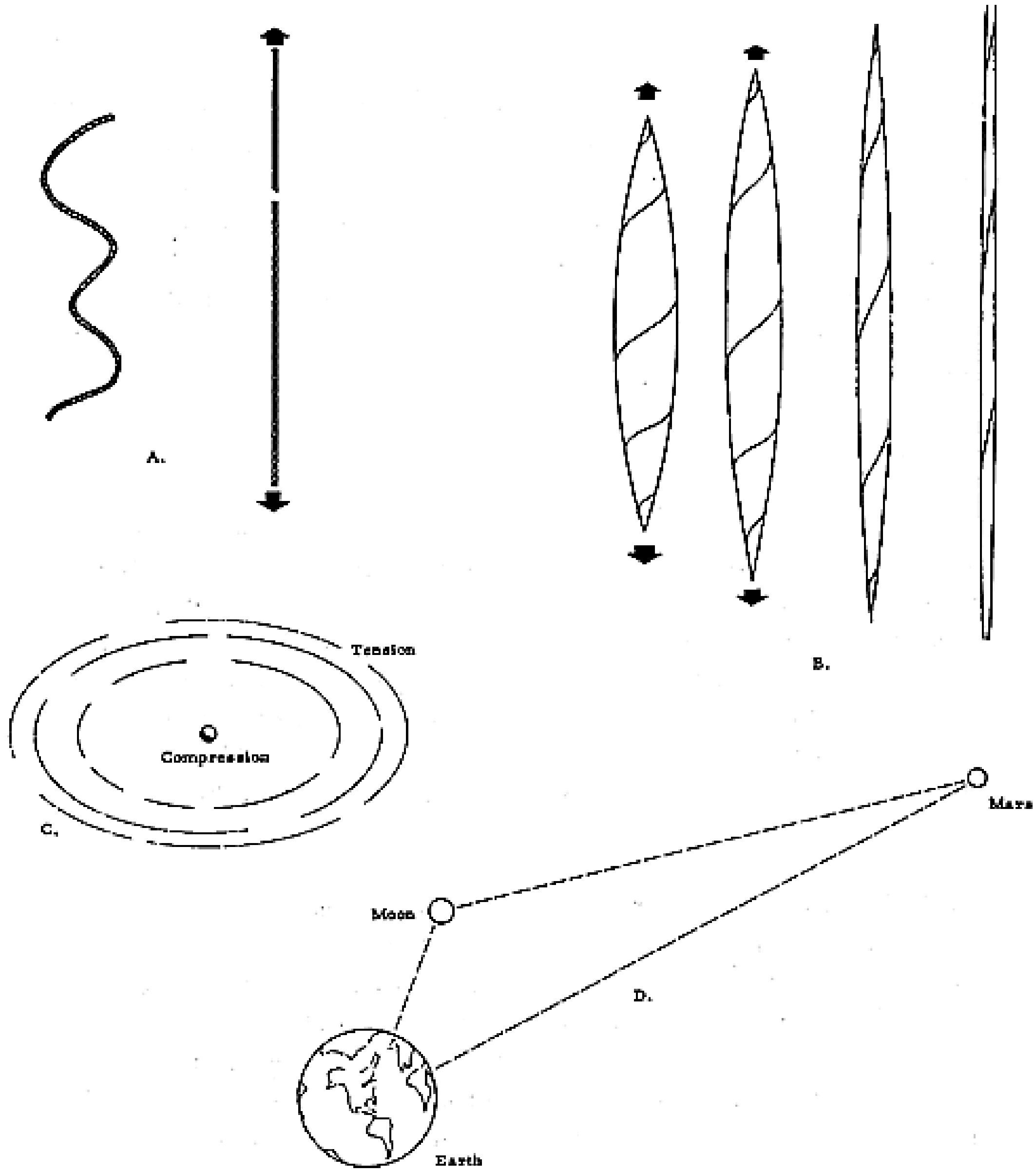

Fig. 641.01 Tension Members Tend Toward Arcs of Ever Greater Radius:

A. Slack rope and tensed rope: tensed rope tends toward "straight," i.e. toward arcs of ever greater radius, but never attains complete "straightness."
B. As tension increases: neutral axis lengthens and girth contracts (becomes more compact). Therefore, the long-dimension profile arcs increase in radius and spiral arcs' "radii" increase in dimensions but never attain "straightness" of relation between two "fixed" points, as there are no experiences of fixed points and straight points.
C. Tension goes toward arcing of larger and fewer different radii all ultimately spirally closing back on self. Tension: inherently comprehensive and finite. Compression goes toward relatively smaller radius and toward more of smaller and multiplying microcosmic differentiation. Compression: inherently local and infinite.
D. Tension as gravity: a tension structure is nature's fundamental pattern-cohering principle.

642.10 **Tetrahedral Models of Functions**

642.11 Covarying functions are tetrahedrally modelable. A series of covarying tetrahedral models is presented in Secs. 961.10-48.

643.00 **Tension and Compression: Summary**

Compression is IN.	*Tension* is OUT.
Compression is dispersive both laterally and circumferentially, inherently electrostatic because differentiative, divisive, temporary, and local.	*Tension* is omniradially conversive and is both electromagnetically and gravitationally tensive because eternally and integrally comprehensive.
Compression tends to local dichotomy and multiplication by separation.	*Tension* is unit: universally cohering and comprehensively finite.
Compression is locally expressive in discrete tones and frequencies internal to the octave.	*Tension* is both internal and external to the octave and is harmonic with either the unit octave or octave pluralities.
Compression accumulates potential. As demonstrated in the arch, compression is limited to absolute, local, and within-law relationships of one fixed system.	*Tension* is comprehensive, attractive, and gravitational. Tension is inherently integral and eternally, invisibly, infinitely comprehensive. Tension is comprehensively without law.
Compression tends toward arcs of decreasing radius.	*Tension* tends toward arcs of increasing radius.
Compressions are plural.	*Tension* is singular.
Compression is time.	*Tension* is eternity.
Compression is specifically directional.	*Tension* is both omni- and supra-directional.
Compression is inherently partial.	*Tension* is inherently total.

644.00 **Limitless Ratios of Tension**

644.01 I adopted as a working hypothesis that there is a limit to slenderness ratio of the girth diameter of a compression member in respect to its longitudinal axis and that there is no limit to the slenderness ratio of structures dominated by tensional components. Astronomical magnitudes of structural-system coherence are accomplished by tensionally dominated structural functions of zero slenderness ratio, i.e., by gravitational functioning. Compressionally dominated structural components tend toward contour transformation in which the radius of curvature steadily decreases under axial loading, that is, the cigar- shaped column forces tend toward squash- or bananalike bending of their contours. This tending of compressionally loaded systems toward arcs of lessening radius is in direct contrast to the contour transformation tending of tensionally dominated structural components, which always tend toward arcs of ever-increasing radius of axial profile. For instance, the coil of rope tends toward straightening out when terminally tensed, but it never attains absolute straightness; instead, it progresses toward ever-greater radius of locally spiraling but overall orbital arcing, which must eventually cycle back upon itself. Tensionally dominated patterning is inevitably self-closing and finite.

644.02 Compressionally dominated functions of structural systems are inherently self-diminutive in overall aspect. Tensionally dominated functions of structural systems are inherently self-enlarging in overall involvement. The sum of all the interactive-force relationships of Universe must continually accelerate their intertransforming in such a manner as to result in ever more remotely and locally multiplied, islanded, compressional functions—comprehensively cohered by ever-enlarging finite patternings of the tensional functions. Universe must be a comprehensively finite integrity, permitting only a locally islanded infinitude of observer-considered and regenerated-differentialing discovery. We have herein discovered a workable man-awareness of a complete reversal of presently accepted cosmology and of general a priori conceptioning regarding the general patterning scheme of Universe, which has heretofore always conceived only of locally finite experiences as omnidirectionally surrounded by seemingly unthinkable infinity.

645.00 **Gravity**

645.01 The ratio of length to section in tension appears to be limitless. I once wondered whether it was a nonsensical question that we might be trending toward bridges that have infinite length with no section dimension at all. As a sailor, I looked spontaneously into the sky for indicated clues. I observed that the solar system, which is the most reliable structure that we know of, is so constituted that Earth does not roll around Mars as would ball bearings, which is to say that the compressional components of celestial structures are astro-islands, spatially remote from one another, each shaped in the most ideal conformation for highest compressional-structure effectiveness, which is the approximately spherical shape. All other spheroidal shapes (cigar, turnip, egg, potato, spider) have only one most neutral axis. This is why spherical ball bearings are the ideal compressional-system structures of man's devising, as they continually shift their loads while distributing the energetic effects to the most parts in equal, ergo relatively minuscule, shares in the shortest time. I saw that the astro-islands of compression of the solar system are continuously controlled in their progressive repositioning in respect to one another by comprehensive tension of the system. This is what Newton called *gravity*. The effective coherence between island-components varies in respect to their relative proximities and masses, in ratio gains and losses of the second power in respect to the dimensional distance as stated in terms of the radius of one of the component bodies involved.

645.02 Throughout the Universe, we find that tension and compression are energetically and complementarily interactive. A steel wire of ever stronger metallic alloys can span ever greater distances. In this kind of patterning, we find that the nonsimultaneous structural integrities of Universe are arranged by the tensional coherences. As thinner and thinner wire can span ever greater and greater distances, visible cross section of the tension members trends toward ever lesser and lesser diameters.

645.03 Finally, because there is no limit ratio in tension, may we not get to where we have very great lengths and no section at all? We find this is just the way Universe is playing the game. This is demonstrated astronomically because it is just the way the Earth and the Moon are invisibly cohered . . . remotely cohered and coordinated, noncontiguous, nontangent, physical entities with their respective coherence decreasing at a second-power rate of their relative remoteness multiplied by their combined masses. It is the way the solar system coheres.

645.04 The gravitational, mass-attractive cohering is noncontiguous, and so there is no cross-sectional diameter or identifiable local entity. This is why tension and coherence are able to approach larger and larger magnitudes while working toward no cross section at all: for there never was any cross section in the adjacent atoms. You have enormous tension with no section at all. This is also true in the atoms: true in the macrocosm and true in the microcosm. The same relative distance intervenes as between the Earth and the Moon in respect to their relative masses. The only surprise here is that man has been so superficially misled into ever having thought that there could be solids or continuous compressional or tensional structural members. Only man's mentality has been wrong in trying to organize the idea of structure.

645.05 The trends are to increasing amplification of tension to infinite length with no section. Every use of gravity is a use of such sectionless tensioning. The electric tension first employed by man to pull energy through the nonferrous conductors and later to close the wireless circuit was none other than such universally available sectionless tension. In the phenomenon tension, man is in principle given access to unlimited performance. It seems fantastic, but there it is!

645.10 Tension is shown experientially to be nondimensional, omnipresent, finitely accountable, continuous, comprehensive, ergo timeless, ergo eternal. Comprehensive Universe is amorphous and only locally finite as it transformingly differentiates into serially conceptual pattern integrities, some much larger than humanly apprehendable, some much smaller than humanly apprehendable, ever occurring in nonsimultaneous sets of human observings, most of whose time-canceling, harmonically integrative synchronizations are supra- or subhuman sensibility and longevity experienceability and whose periodicities are therefore so preponderantly unexpected as to induce human reaction of overwhelming disorder, so that . . . suddenly, around comes the comet again, for the first known time in humanly recorded experience, periodically closing the gap and periodically pulsing through eternally normal zero.

645.11 In our old ways of thinking, infinity was expressible numerically as N + 1. We tried to get a static picture of a sphere, but we could not understand one more layer beyond it and what was beyond that—in order for it to be something.

645.12 In the nonsimultaneous experiencing of Universe, there is no simultaneous "one frame." We are not faced with that at all. We get to the finite physical world of the physicist and then to the local compressionals and we find that the local is continually subdivisible. We started with a whole that was finite and then began to subdivide it. So there is, in a sense, an infinity of subdivisions locally. This is very much the way the intellectual pattern goes, so that the only thing you might call infinity here is the further subdivision of finity. So it is really never infinite because you are not looking at one part. It is never just Plus One. It is always plus the rest of Universe when you separate that One out. You can separate unity up further and further. You can multiply the subdivisions of unity.

Next Section: 646.00

646.00 **Chemical Bonds**

646.01 While tension and compression always and only coexist, their respective structural behaviors differ greatly. Structural columns function most predominantly in compression of inherent limit of length to cross section, whereas tension cables or rods have no cross section diameter-to-length ratio.

646.02 Mass attraction is always involved in bonding. There may not be atomic bonding without either electromagnetic or mass attraction: either will suffice.

646.03 As man's knowledge of chemical-element interalloying improves, it becomes apparent that critically effective, mass-attractive atomic proximities are intensified by symmetrical congruence. The mass attractions increase as of the second power with each halving of the distance of atomic interstices—the length of structural tensile members, such as those of suspension bridge cables, relative to a given cross section of cable diameter or of any given stress. The overall lengths trend to amplify in every-multiplying degree, thus approaching infinite lengths with no cross section at all. Incredible? No! Look at the Moon and Earth flying coheringly around the Sun. Every use of gravity is a use of such *sectionless* tensioning. The electrical tensioning first employed by man to pull energy through the nonferrous conductors, and later to close the wireless circuit, was none other than such universally available sectionless tension.

646.04 Electromagnetic energy is produced by accelerating the inexhaustible mass attraction into other permitted patterns, as we may stir water in a bathtub to develop cyclic rotation.

646.10 **Spherical Behavior of Gravity and Bonding**

[646.10-646.22 Spherical Gravity Scenario]

646.11 Gravitational behavior is an operational concept embracing the following discoveries:

1. Spheres contain the most volume with the least surface.
2. Nature always employs only the most economical intertransformative and omnicosmically interrelated behavioral stratagems.
3. With each event in Universe there are always 12 unique degrees of freedom (see Sec. 537.06).
4. Falling bodies manifest a mathematically uniform, second-power, exponential rate of acceleration (discovered by Galileo).
5. Hidden within the superficial disorder of individual omnidifferences—differences of size; differences in distance from the Sun; and differences in Sun-orbiting rates—there nonetheless exists an elegantly exact, one-to-one mathematical correspondence in the Sun's planets' intercoordinate behaviors manifest by the equiareas of the radii- and arc-bounded, piece-of-apple-pie-shaped, areal sweepouts, within an identical time span, of all the Sun's planets as they orbit elliptically around the Sun at vast distances from one another, all accomplished without any visible mechanical interlinkage such as gears, yet whose orbiting around the Sun (rather than flying off tangentially from those orbits by centrifugal force, as do the round iron balls released by hammer-throwing athletes) altogether suggests that some incredibly powerful interattractiveness is operative. (All of the foregoing planetary behavior was discovered by Kepler. Compare Sec. 791.01.)
6. The above discoveries (1-5) were correlated by Newton to reveal:
   First, that the prime interattractiveness magnitude existing between two mutually remote bodies, as compared to the prime interattractiveness existing between any other two mutually remote bodies, is arrived at by multiplying each of the respective couples' separate masses by one another; and
   Second, as a cosmic generalization of the second-power, time-distance acceleration rate of Galileo's Earthward-falling bodies, Newton discovered the second-power mathematical rate of interattractiveness gain occurring with each halving of the intervening distance of any two given celestial bodies; whereby it was thereafter shown by other astronomers that there are interrelationship behaviors manifest in physical Universe that are in no wise indicated to be interoperative between those bodies by any or all of the unique and integral geometrical, chemical, or physical characteristics

of any one of the mass-interattracted bodies when either one is only separately considered.

7. Synergy means behavior of whole systems unpredicted by the integral characteristics of any of the systems' separate parts; thus it has come to pass that it has been synergetically *proven* that Copernicus was right, for the exponentially ever-increasing interattractiveness of bodies freed of other external restraints must induce their ultimate huddling together in the most economical volume-to-enclosing-surface manner, which, as the number of converging bodies increases, is that of the *spherical* conformation.

646.12 The spherical behavior of gravity is illustrated in the trending series of intertransforming events that would take place as two large, independent spherical masses, such as two asteroids, fell into one another and their multitudinous individual atoms began to sort themselves into most economical interarray. Interestingly enough, this is the opposite of what transpires with biological cell dichotomy.

646.13 Electromagnetic radiant energy is entropic; gravitational energy is syntropic (see Sec. 1052.80).

646.14 Speaking mathematically, the surface area growth is always at a second-power rate of increase in respect to the linear dimension's rate of increase. As Newton's linear distance apart was measured arithmetically, we can understand systematically why the relative interattraction of the bodies varies as the second power, which represents their relative surface rates of change, but this does not explain why there is any interattraction. Interattraction is eternally mysterious.

646.15 **Circumferential Behavior of Gravity: Hammer Men and Closest Packing:** Sheet-metal workers never seem to think of what they are doing in terms of what their work does to the atoms, of the ways the atoms accommodate to their work. The hammer men have learned that they can gather the metal together in a way that hammers it thicker. It is easy to conceive of hammering metals thinner, but few of us would think spontaneously of hammering metals thicker. But the hammer men are quite able to do this, to hammer the metal in such a way as to increase its bulk. They can start with a flat sheet of metal and hammer it thicker, as you would knead dough together after it has been rolled out thin with a rolling pin. But you push the dough together horizontally with your hands; you do not pummel it vertically from above. The skilled sheet-metal workers can do just that with the metal, though amateurs might assume it to be illogical, if not impossible. (See Secs. 1024.13 —15 and 1024.21).

646.16 We can conceive of heating metal until it becomes liquid and flows together. Thus the blacksmith's heating of his horseshoes to a bright red, to a condition just short of melting; this makes it easy for us to think of the cherry-red metal as being in a plastic or semimolten condition that permits the smith to smite it into any preferred shapes—thicker or thinner. But the sheet-metal men hammer cold, hard sheet metal into any shape without preheating.

646.17 What the hammer men do intuitively without sensing it consciously is to hit the indestructible atoms tangentially, as a billiards player might "kiss" the object ball with his cue ball. Thus does the hammer inadvertently impel atoms sidewise, often to roll atop the next-nearest "spherical" aggregate of atoms. The aggregate of atoms is spherical because of the electrons' orbiting combined with the atoms' spinning at so high a rate as usually to present a dynamically spherical surface. Hammer men do not think about their work as bounce-impelling the spherical atoms around as if they were a bunch of indestructible ball bearings stuck together magnetically, as a consequence of which the accelerated ball bearings would cleave-roll to relodge themselves progressively in certain most-economically-traveled-to, closest-packed, internested rearrangements.

646.18 Atoms dislodged from the outer layer of the omniintermagnetized ball bearings would always roll around on one another to relocate themselves in some closest- packing array, with any two mass-interattracted atoms being at least in tangency. When another dynamic-spherical-domain atom comes into closest-packing tangency with the first two, the mutual interattractiveness interrolls the three to form a triangle. Three in a triangle produce a "planar" pattern of closest packing. When a fourth ball bearing lodges in the nest formed between and atop the first three, each of the four balls then touches three others simultaneously and produces a tetrahedron having a concave-faceted void within it. In this tetrahedral position, with four-dimensional symmetry of association, they are in circumferential closest packing. Having no mutual sphere, they are only intercircumferentially mass-interattracted and cohered: i.e., gravity alone coheres them, but gravity is hereby seen experimentally to be exclusively circumferential in interbonding.

646.19 With further spherical atom additions to the initial tetrahedral aggregate, the outermost balls tend to roll coherently around into asymmetrical closest-packing collections, until they are once more symmetrically stabilized with 12 closest packing around one and as yet exercising their exclusively intercircumferential interattractiveness, bound circumferentially together by four symmetrically interacting circular bands, whereby each of the 12 surrounding spheres has four immediately adjacent circumferential shell spheres interattracting them circumferentially, while there is only one central nuclear ball inwardly—i.e., radially attracting each of them. In this configuration they form the vector equilibrium.

646.20 In the vector-equilibrium configuration of closest-packed, "spherical" atoms we have clarification of the *Copernican nostalgia,* or synergetic proclivity, of the circumferentially arrayed spheres to associate symmetrically around the nucleus sphere or the nucleus void, which, as either configuration—the vector equilibrium or the icosahedron—rotates dynamically, producing a spherical surface. But the modus operandi of *four* symmetrically intertriangulated gravitational hoops (in the case of the vector equilibrium) and the *six* hoops (in the case of the icosahedron) is lucidly manifest. If we take out the central ball, or if it shrinks in diameter, we will discover synergetics' jitterbug model (see Sec. 460), showing that the 12 circumferential spheres will closest pack circumferentially until each of the 12 circumferentially arrayed balls is tangent to five surrounding balls, and thus they altogether form the icosahedron.

646.21 Gravity has been described by Arthur Koestler as the nostalgia of things to become spheres. The nostalgia is poetic, but the phenomenon is really more of a necessity than it is a nostalgia. Spheres contain the most volume with the least surface: Gravity is circumferential: Nature is always most economical. Gravity is the most effective embracement. Gravity behaves spherically *of necessity*, because nature is always most economical.

646.22 The hammer man probably does not think about these properties of atoms. The fact is that the spheres do not actually touch each other. They are held together only mass-interattractively, and their electron paths are of course at distances from their atomic nuclei equivalent relatively to that of the distance of the Earth from the Sun, as proportioned to the respective radii of these vastly different-sized spheres. Thus the hammer man can push the atoms only as the physical laws allow them to be moved. Nature accommodates his only-superficially contrived hammering strategies, while all the time all those atoms are intercohered by gravity—which the hammer associates only with falling objects. Almost nothing of the reality of our present life meets the human eye; wherefore our most important problems are invisible.

647.00 **Absolute Velocity: Shunting**

647.01 Synergetics discloses that the apparently different velocities, or rates of acceleration, ascribed by humans to environmental events are optical aberrations. The seemingly different velocities are a plurality of angularly precessed—or shunted—energy- action systems regeneratively operated in respect to other systems. Velocity is always 186,000 miles per second. All other relative motion patterns are the result of remotely observed, angularly precessed, 186,000 m.p.s., energy-action shunting. Angularly precessed shunting may divert omnidirectional energy into focused (angularly shunted) actions and reactions of either radial or circumferential patterns, or both.

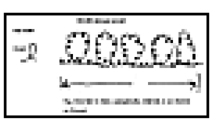

Fig. 647.02

647.02 Frequency modulation is accomplished through precession-shunted circuit synchronizations. "Valving" is angular shunting. Competent design is predicated upon frequency modulation by application of the precessional-shunting principle.

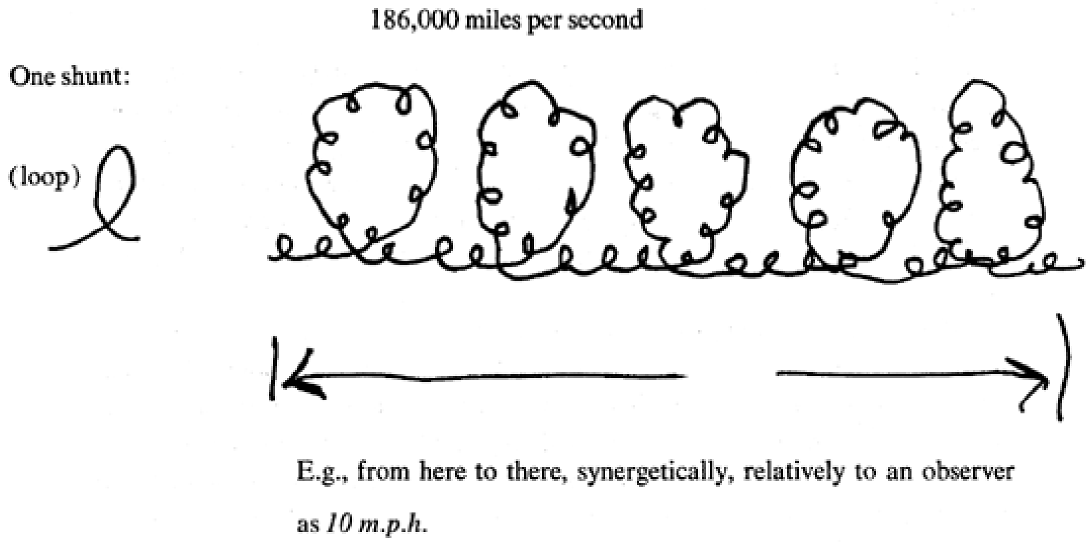
186,000 miles per second
One shunt:
(loop)
E.g., from here to there, synergetically, relatively to an observer as *10 m.p.h.*

Fig. 647.02.

647.03 Because tension is ever a spiraling arc, it must close back upon itself; it is, therefore, finite and cohesive. Universe is inherently finite and a comprehensive integrity. Compression systems tend, when compression-loaded, to yield to arcs of lesser radius and also, by precessional axial despiraling, tend to unravel and to separate into a plurality of subsystems. Tension systems tend, when axially loaded, to arcs of greater radius. Tension systems tend to greater cohesiveness of precessional inspiraling.

647.04 Discontinuous-compression, continuous-tension structures are finite islands of microcosmic, inwardly precessing, zonal wave-sequence displacements of radial-to- circumferential-to-radial energy knotting regenerations as *nuclear* phenomena—and the whole, which is enclosed in infinite, macrocosmically trending, precessional unravelings, regenerates precessionally as radial-to-circumferential-to-radial *nebular* phenomena— circumferential micro- or macro-being finite, and radial being infinite. Compression is micro and tension is macro.

647.10 In topological systems, vertexes are finite relationships; turbo-systems are in convergence tendencies; and faces are finite sections of infinite open-angle divergent tendencies.

647.20 The equilibriously regenerative octet truss is regenerated as fast and as extensively as man explores and experiences it. As I define Universe as the sum-total aggregate of men's experiences, then we may say that the octet truss-vector equilibrium is universally extensive. *Universally extensive* is a term quite other than *to infinity*, a term the semantic integrity of synergetic geometry may not employ.

647.30 The open end of an angle is infinite, but so too is its convergent end, in that the two actions cannot pass either instantaneously or simultaneously through the same point.

648.00 **Macrocosmic and Microcosmic**

648.01 If we switch our observation from the macrocosmic to the microcosmic, we witness man's probing within the atom, which discloses the same kind of discontinuous- compression, continuous-tension apparently governing the structure of the atom. That is, the islands of energy concentration of the atom and its nucleus are extraordinarily remote from one another in respect to their measurable local-energy-concentration diameters, and all are bounded together by a comprehensive but invisible tensional integrity.

648.02 In the new awareness of synergetics, the remote patternings of Universe are inherently finite, and only the local islands of compression are subdivisible to the degree of infinity projected by the existence of local life and its differential dichotomies of progressive probing. We discover that the more visible, i.e., the more sensorially tunable, the structural functions are, then the more infinitely subdivisible do their potential treatments become. The more invisible the structural functions of Universe, the more comprehensively and comprehendably finite they become.

648.03 As a consequence of these macro-micro structural observations, I also wondered whether man was congenitally limited to his solid structural conceptioning. Man obviously tended to think only of a "solid," brick-on-brick, pile-up law as governing all fundamental forms of structural modifications, i.e., formal local alterations of the "solid" compressional Earth's crust. Could he therefore never participate in the far more efficient structural strategies evidenced in his (only instrumentally harvested) infra- and ultrasensorial data of universal patterning? I saw that man had long known of tensional structures and had experienced and developed tensional capabilities, but apparently only as a secondary accessory of primary compressional structuring.

650.00 **Structural Properties of Octet Truss**

650.01 **Rationale**

650.011 Conventional engineering analysis long ago discovered that a two-way, vertically sectioned beam crossing at 90 degrees, supported from four walls, provided no more strength at the mid-crossing point than could be found in the stronger of the two beams, for they were redundantly acting as hinges, and only one axis of hinging could be articulated at one time.

650.02 In three-way beam crossings, each vertically sectioned beam has a two-way tendency to rock or torque or hinge over from its most favorable aspect of maximum dimension in opposition to gravity into its least favorable aspect, that of least dimension in opposition to gravity. As each beam could hinge from the vertical in two ways, each may be split theoretically into two vertical parts and thus hinge both ways. The three-way beam crossing is thus countered by the simultaneous and symmetrical both-ways split rocking of all three vertical split-beam hinges—as three sets of parallel planes until their edges meet in ridge poles to provide a matrix of tetrahedra, with common lean-to stability and with maximum energy-repose economy, synergetically between a fourth—or horizontal—set of planes.

650.03 While the three beams' sets of uniquely split plus-and-minus vertical planes rotate into three positive-and-negative parallel sets of planes at 35° 16' off vertical, each of the tilted beam's tops and bottoms is in two parallel and horizontal planes, respectively. This makes a total of four unique and symmetrically oriented planes within the system. Where the four unique sets of planes intercept each other, there is established a system of interconnected lines; as the interconnected lines contain all the stress patternings, struts may be substituted for them and the planar webs may then be eliminated. When struts alone are used for horizontal decking, they are designed to receive loads at their vertexial ends and to send their loads through their neutral axis, whereas beams inefficiently take loads anywhere at 90 degrees to their neutral axes.

650.04 In the octet truss, three planes of beams and their triangularly binding edge patterns rotate tepee-wise[3] positively and negatively to nonredundant ridge-pole fixity, and with such symmetry as to result in radial distribution of all loads from any one loaded vertex through the neutral axes of all the edges of the system. Loads are precessionally differentiated as either pure-compression or pure-tension stresses. They are metered at even rates because their edge vectors are identical in length. The loads precess further into positive and negative radial and circumferential waves eccentric to the loaded vertex, with the stress distributed positively and negatively throughout those adjacent vertexes surrounding any one loading center, and with the wave distribution in all directions precessing into tensile action the concentric series of rings around the originally loaded vertex. The increasing succession of concentric rings that continually redistribute the received loads act in themselves as unitary systems, with an increasing number of eccentrically distributive vectors as full-dispersion loads come to symmetric reconcentration at supporting areas in direct pattern reversal. (See Secs. 420 and

825.28.)

(Footnote 3: See Sec. 621.20.)

650.10 **Inherent Nonredundance**

650.101 The octet truss is synergetic because the four planes comprise a system, and what were previously individual beams, and therefore free systems in themselves, are now fixed components in a larger tetrahedral system, which is inherently nonredundant because it is the minimum fixed system. Ergo, all those previous individual, free-system beams are now converted into one nonredundant complex of basic systems, and all the previous beams' component biological and subchemical structures are systematically refocused in such a manner that all subcomponents are nonredundantly interactive in the second-power rates of effectiveness accruing to the circumferential finiteness of systems in respect to their radial modules.

650.11 The unitary, systematic, nonredundant, octet-truss complex provides a total floor system with higher structural performance abilities than engineers could possibly ascribe to it through conventional structural analysis predicated only upon the behavior of its several parts. It is axiomatic to conventional engineering that if parts are "horizontal," they are beams; and the total floor ability by such conventional engineering could be no stronger than the single strongest beam in the plural group. Thus their prediction falls short of the true behavior of the octet truss by many magnitudes, for in true mathematical fact, no "beams" are left in the complex; that is, there are no members in it loaded at other than polar terminals. Down to the minutest atomic components, the octet truss is therefore proved to be synergetic, and its discovery as a structure—in contradistinction to its aesthetic or superficial appearance—is synergetic in performance; that is, its behavior as a whole is unpredicted by its parts. This makes its discovery as a structure a true surprise, and therefore it is a true invention.

650.12 What is the surprise? It is because we had used three planes of the beams oriented to most favorable ability aspect in respect to gravity, and in so doing we had inadvertently gained a fourth interacting favorable-aspect plane of symmetry not consciously introduced as a previously acquired component of the whole, which thereby made the beams "vanish" into abstract limbo. The fourth plane is strictly the fourth plane of the tetrahedron inadvertently accruing, as does the hinging on of one triangle to two previously hinged equilateral triangles provide inadvertently a fourth triangle: 1 + 2 = 4. Q.E. D.

650.13 A second derivative surprise is the nonredundance of the larger associated complex of tetrahedra, occasioned by its precessionally induced self-differentiation of functions: when loaded at any one vertex in such a manner that every member acts in axially focused pure tension or pure compression, and with the subsequent loading of any next adjacent vertex, there is inherently induced comprehensive reversal of all the system's pure tension into pure compression functions, and vice versa. That is to say, it is dynamically nonredundant.

Next Chapter: 700.00
