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.

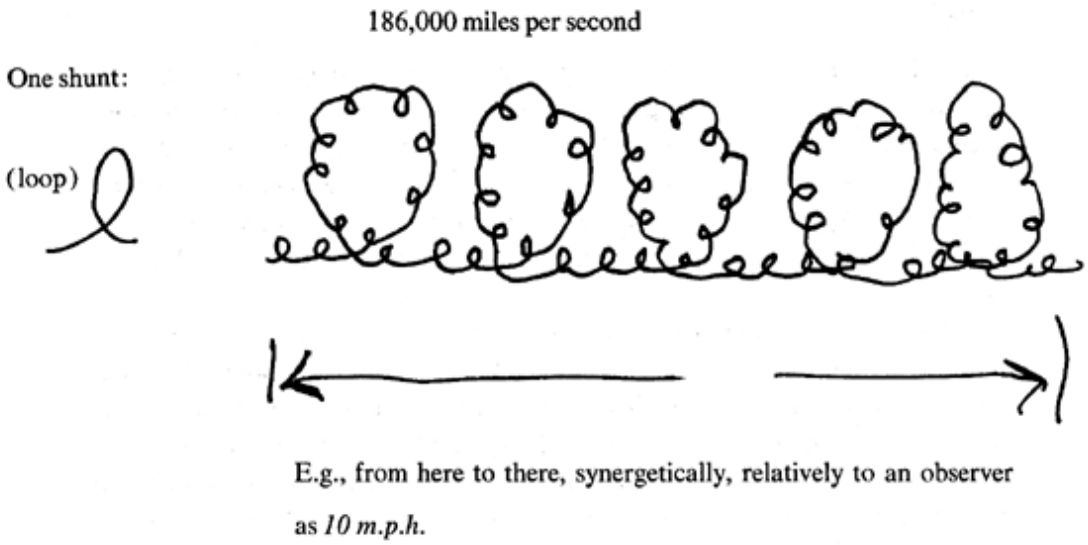

Fig. 647.02.

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
