986.200 **Narrative Exposition of Spherical Accommodation**

986.201 **Consideration 10: The Spheric Experience: Energetic-reality Accounting vs Abstract-cubic Accounting**

986.202 In *Synergetics 1,* Secs. 962 through 966, I developed the first-, second-, and third-power values of my numerical factors for converting the XYZ coordinate system's edge lengths, square areas, and cubical volumes to my 1927-discovered synergetic system's unit VE vectorial edge lengths, triangular areas, and tetrahedral volumes.[3] (See Table 963.10.)

(Footnote 3: My chart of these conversion factors, which I at first called the Dymaxion constants, was privately published in 1950 at North Carolina State University, and again in 1959 in *The Dymaxion World of Buckminster Fuller,* written with Robert W. Marks.)

986.203 The synergetics coordinate system-in contradistinction to the XYZ coordinate system-is linearly referenced to the unit-vector-length edges of the regular tetrahedron, each of whose six unit vector edges occur in the isotropic vector matrix as the diagonals of the cube's six faces. We also recall that the eight corners of the cube are defined and structured omnitriangularly by the symmetrically interarrayed and concentric pairs of positive and negative tetrahedra (Figs. 110A and 110B).

986.204 Since the cube-face diagonal is the edge of the six-vector-edged, four-planes-of-symmetry tetrahedron, and since synergetics finds the unit-vector-edged tetrahedron to be the simplest structural system in Universe, the tetrahedron's vector edge logically becomes the most economically primitive simplex module of relative length in synergetics' coordinate system of exploratory reference. Thus the tetrahedron's unit vector edge of unity 2 is manifest as nature's coordinate primitive-length module for assessing:

second-power triangular area, $2^2 = 4$

as well as for assessing that vector's

third-power tetrahedral volume, $2^3 = 8$,

These areas and volumes become the logical unit of areal and volumetric reference in accounting the relative geometrical area and volume values of the entire hierarchy of primitive, concentrically congruent, symmetrical polyhedra as these naturally occur around any vertex of the isotropic vector matrix, and that matrix's experimentally demonstrable, maximum-limit set of seven axes of polyhedral symmetries, which seven symmetries (Sec. 1040) accommodate and

characterize the energetic special case formulations of all great- circle gridding.

986.205 The synergetics hierarchy of topological characteristics as presented in Table 223.64 of *Synergetics 1* (which was contracted for with Macmillan in 1961 and published by them in 1975), discloses the rational values of the comprehensive coordinate system of nature, which my 60-year exploration discovered. In 1944 I published a paper disclosing this rational system. At that time I was counseled by some of my scientist friends, who were aware that I was continuing to make additional refinements and discoveries, that premature publication of a treatise of disclosure might result in the omission of one or more items of critical information which might be later discovered and which might make the difference between scientific acceptance or rejection of the disclosures. Reminded by those scientist-artist friends that we have only one opportunity in a lifetime out of many lifetimes to publish a prime-science-reorienting discovery, I postponed publishing a comprehensive treatise until in 1970, at the age of 75, I felt it could no longer be delayed.

986.206 The eleventh-hour publishing of *Synergetics 1* coincided with my busiest years of serving other obligations over a period calling for a vast number of tactical decisions regarding the methodology of producing what proved to be a 780-page book. Typical of the problems to be swiftly resolved are those shortly to be herewith recounted. The accounting also discloses the always surprisingly productive events that ensue upon mistake-making that are not only discovered and acknowledged, but are reexplored in search of the significance of the mistakes' having occurred.

986.207 Because the XYZ-coordinate, three-dimensional system values are arrived at by successive multiplying of the dimensions, volume in that system is an inherently three- dimensional phenomenon. But in synergetics the primitive values start holistically with timeless-sizeless tetrahedral volume unity in respect to which the cube's primitive value is 3, the octahedron's relative timeless-sizeless value is 4, the rhombic triacontrahedron's is 5, and the rhombic dodecahedron's is 6. In synergetics, when time-size special-case realizations enter into the consideration, then the (only-interrelated-to-one-another) primitive volumes of the synergetic hierarchy are multiplied by frequency of the edge modulation to the third power. Since innate primitive volume is a base-times-altitude three-dimensional phenomenon, and since all the synergetics hierarchy's time-size realization volumes are inherently six-dimensional, I was confronted with an exploratory tactical quandary.

986.208 The problem was to arrive at the numerical volume value for the sphere in the synergetics hierarchy, and the dilemma was whether I should apply my synergetics' volumetric constant to the first power or to the third power of the XYZ-coordinate system's volumetric values as arrived at by the conventional XYZ-coordinate system's method of calculating the volume of a sphere of radius vector = 1. This operation is recorded in Sec. 982.55 of *Synergetics 1*, where I misconceptualized the operation, and (without reviewing how I had calculated the constant for converting XYZ to synergetics) redundantly took the number 1.192324, which I assumed (again in mistaken carelessness) to be the third-power value of the synergetics-conversion constant, and I applied it to the volumetric value of a sphere of unit vector diameter as already arrived at by conventional XYZ-referenced mathematics, the conventional XYZ-coordinate volumetric value for the volume of a sphere of radius 1 being 4.188, which multiplied by 1.192324 gave the product 4.99—a value so close to 5 that I thought it might possibly have been occasioned by the unresolvability of tail-end trigonometric interpolations, wherefore I tentatively accepted 4.99 as probably being exactly 5, which, if correct, was an excitingly significant number as it would have neatly fitted the sphere into the hierarchy of primitive polyhedra (Sec. 982.61). My hindsight wisdom tells me that my subconscious demon latched tightly onto this 5 and fended off all subconsciously challenging intuitions.

986.209 But what I had mistakenly assumed to be the third-power synergetics constant was in fact the ninth power of that constant, as will be seen in the following list of the synergetics constant raised to varying powers:

Table 986.209

Synergetics Power Constants

$S^1 = 1.019824451$

$S^2 = 1.040041912$

$S^3 = 1.060660172$

$S^4 = 1.081687178$

$S^5 = 1.103131033$

$S^6 = 1.125$

$S^9 = 1.193242693$

$S^{12} = 1.265625$

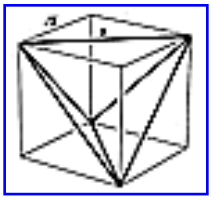

Fig. 986.210

986.210 In our always-experimental-evidenced science of geometry we need only show ratio of proportion of parts, for parts of primitive polyhedra have no independent existence. Ergo, no experimental proof is required for (square) roots and (square) roots. Though those numbers are irrational, their irrationality could not frustrate the falling apart of the polyhedral parts, because the parts are nonexistent except as parts of wholes, and exact proportionality is not required in the structuring.

986.211 Whatever the workings of my subconscious may have been, the facts remain that I had erroneously concluded that the 5 was the tetravolume of the sphere whose diameter was our unit vector whose value was 2. In due course I received a letter from a mathematician, Ramsey Campbell, whose conventional calculations seemed to show that I was wrong. But I was not convinced that his conventional results were not also erroneous, inasmuch as they had been "cubically" arrived at rather than tetrahedrally referenced.

986.212 At this point a young associate of mine, Robert Grip—who was convinced that I was misconvinced—and who knew that I would alter my position only as confronted by physically demonstrable evidence, made a gallon-sized, water-holding tetrahedron and a sphere whose diameter was identical with the prime vector length of the tetrahedron's edge. The water content-the volume of the sphere was indeed 4.43 units—0.57 less than 5.

986.213 The cubically-arrived-at spherical volume (A) of a sphere of diameter equal to the unit edge of the XYZ coordinate system's cube is 4.188. To convert that spherical volume value (A) to that of sphere (B) whose diameter is equal to the diagonal of the face of the XYZ system's cube, we multiply the volume of sphere (A) by the synergetics hierarchy's volumetric constant, which is obtained by taking synergetics' unit VE vector linear constant 1.0198 and raising it to its third-power—or volumetric—dimension, which is 1.0198 × 1.0198 × 1.0198, which equals 1.0606. Multiplying the XYZ system's cube- edge-diametered (A) sphere's volume of 4.1888 by the synergetics' volumetric constant of 1.0606 gives us 4.4429, which is the sought-for volume of the sphere (B). I thanked Mr. Campbell and acknowledged my error.

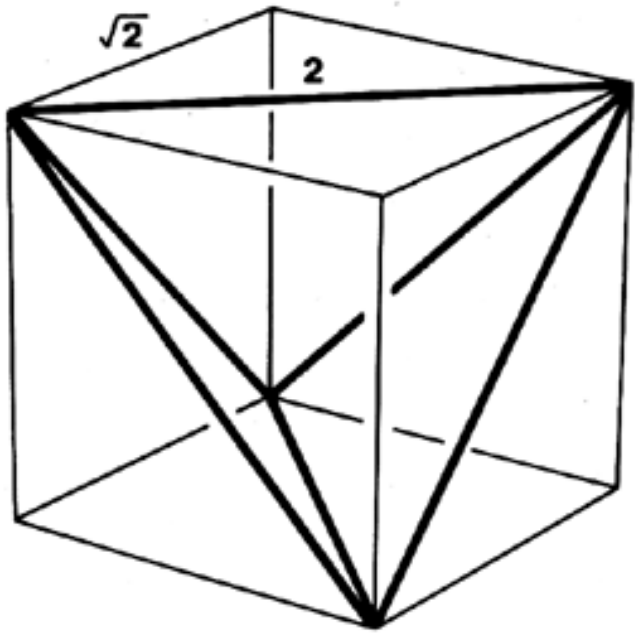

Fig. 986.210 Diagonal of Cube as Unity in Synergetic Geometry: In synergetic geometry mensural unity commences with the tetra edge as prime vector. Unity is taken not from the cube edge but from the edge of one of the two tetra that structure it. (Compare Fig. 463.01.) Proportionality exactly known to us is not required in nature's structuring. Parts have no existence independent of the polyhedra they constitute.

986.214 I then said to my mathematical associates, Robert Grip and Chris Kitrick, that there is no single item that more effectively advances research than the unblocking of our thought processes—through experiential evidence—of a previously held erroneous assumption. Wherefore my intuition told me that my error may have been stubbornly clung to because there might be something very important to be discovered in this region of investigation. There is possibly some enlightening significance in the fact that I had intuitively applied (and again forsaking the first correction, had doubly reapplied) my third-power synergetics' conversion factor to an already-three-dimensional cubic-volume quantation, which on the occasion of these retreatments had erroneously seemed to me to be as yet three powers short of the minimum primitive realizable somethingness.

986.215 Why did I think as I did? Why was I puzzled? I was not confused about arithmetical operations per se. We conventionally arrive at the area of a square by multiplying the square's edge length by itself, and we arrive at the volume of a cube by multiplying its edge length times itself twice—that is, we identify the square's area by the second power of its edge length, and we identify a cube's volume by the third power of its edge length. All that seems simple and clear . . . until we discover that the cube does not exist and cannot exist until it has at least three other observable attributes: weight, duration, and temperature. Given the quantitative inputs for those coordinate factors, the cube as yet fails to "exist," because as calculated it is now "solid," and physics has discovered and proven that no such solid phenomenon exists; wherefore the cubical domain has to be substantively populated by atoms which have a variety of interspacing and interpositioning behavioral patterns.

986.216 Also, in order to exist the cube must have both tension and compression forces so arranged and quantated as to produce a self-stabilizing, independent behavior in the presence of the cosmic complex of coexisting force events. For it to exist there also must be introduced coordinate factors that account for the fact that this special case cube is keeping locatable company with the planet Earth with which it is traveling around the Sun at approximately 60,000 miles per hour.

986.217 As the Earth and the Sun whirl circumferentially in company with the other hundred billion stars of the galactic system, and as all the while the galactic system keeps company with all the now-known billion such galaxies whose uniformly angled retreat from one another at an astronomical speed altogether constitutes what is called the Expanding Universe . . . if we wrote out the formula for integrating all those quantities and for realistically diagramming its geometry and its dimensions, we would have to admit that the dimensions of the cube did not as yet produce existence. There would as yet be required the set of coordinate factors stating when and where the cube was born, how old it was at the moment of its dimensioning, and what its exact remaining longevity would be—and with all that, we have not disclosed its smell, its resonance factor, its electromagnetic-wave propagation length and frequencies. My quandary was one of adequately identifying and calculating the magnitude of relevant dimensions for the "considered set" (Section 509).

986.218 My quandary also included, "Which exactly are the attributes that are being disclosed by the successive powerings?" With all the foregoing considerations I resolved upon the following set as that which I would employ in publishing *Synergetics.*

986.219 Since our dimensional control is the prime vector, and since a vector's relative size represents mass times velocity, and since mass has a priori both volume and weight, it inherently introduces one more dimension to velocity's a priori two-dimensional product of time and distance. Ergo, vectors are in themselves primitive, pre-time-size, potentially energizable, three-dimensional phenomena. Any special case time-size phenomena must also be multiplied by frequency of subdivision of the primitive system taken volumetrically to the third power. We seem thus to have arrived at nine dimensions—i.e., ninth powering—and we have altogether identified geometrical realization as being at least nine-dimensional.

986.220 This is how I came to adopt my ninth-power factor for conversion from XYZ coordination to synergetics coordination. Employing the XYZ coordinated volume of 4.188790205, I multiplied it by the appropriate factor (see table 986.209, where we find that $S^9 = 1.193242693$), which produced the inherently imperfect (only chord-describable rather than arc-describable) sphere of 4.998243305. This I knew was not a primitive three- dimensional or six-dimensional *volume*, and I assumed it to be the value of potential energy embraceable by a sphere of vector radius = 1. Ergo, both my conscious and subconscious searchings and accountings were operating faultlessly, but I was confusing the end product, identifying it as *volume* instead of as potential *energy*.

986.221 I was astonished by my error but deeply excited by the prospect of reviewing the exponentially powered values. Looking over the remaining valid trail blazings, I ruminated that the proximity to 5 that provoked the 4.998243305 figure might have other significance—for instance, as a real ninth-dimensional phenomenon. There was some question about that constant 1.193242693 being a sixth-dimension figure: $N^3 \cdot N^3 = N^6$, which operation I had—in my forgetfulness and carelessness—inadvertently performed. Or the figure I had arrived at could be taken as nine-dimensional if you assume primitive demonstrability of minimum something always to have a combined a priori volumetric- and-energetic existence value, which is indeed what synergetics vectorial structuring does recognize to be naturally and demonstrably true. (See Sec. 100.20.)

986.222 Synergetics demonstrates that the hierarchy of vectorially defined, primitive, triangularly self-stabilized, structural-system polyhedra is initially sixth-dimensional, being both a vectorially six-way coordinate system (mass × velocity) as well as being tetrahedrally—ergo, four-dimensionally-coordinate[4] —ergo, $N^6 \cdot N^4 = N^{10}$ somethings; and that they grow expansively in time-size—ergo, in volume at the rate of F^3 —ergo, in time-size $D^{10}\ D^3 = D^{13}$, a 13-dimensional special-case-somethingness of reality.

(Footnote 4: It was a mathematical requirement of XYZ rectilinear coordination that in order to demonstrate four-dimensionality, a fourth perpendicular to a fourth planar facet of the symmetric system must be found--which fourth symmetrical plane of the system is not parallel to one of the already-established three planes of symmetry of the system. The tetrahedron, as synergetics' minimum structural system, has four symmetrically interarrayed planes of symmetry--ergo, has four unique perpendiculars--ergo, has four dimensions.)

986.223 We have learned in synergetics by physical experiment that in agglomerating unit-radius, closest-packed spheres around a nuclear sphere of the same unit radius, successively concentric symmetrical layers of the nuclear surroundment occur in a pattern in which the number of spheres in the outer shell is always the second power of the frequency of modular-system subdivision of the vector-defined edges of the system, and that when the primitive interhierarchy's relative volumetric values are multiplied by frequency to the third power—and an additional factor of six—it always gives the symmetrical system's total cumulative volume growth, not only of all its progressively concentric, closest-packed, unit-radius spheres' combined shells, but also including the volume of the unit-radius, closest-packed sphere shells' *interstitial spaces*, as altogether embraced by the exterior planes of the primitive polyhedra of reference. (See Sec. 971 and, in the drawings section, Fig. 970.20, "Dymax Nuclear Growth" (10 June 1948), and "Light Quanta Particle Growth" (7 May 1948); also drawings published in 1944 appearing as end papers to *Synergetics 2*.)

986.230 **System Spinnability**

986.231 Synergetics assumes an a priori to time-size, conceptually primitive, relative volumetric value of all the hierarchy of primitive polyhedra; and it also assumes that when we introduce frequency, we are also introducing *time* and *size* (see Secs. 782.50 and 1054.70), and we are therefore also introducing all the degrees of freedom inherent in time-size realizations of energetic-system behavior—as for instance the phenomenon of inherent *system spinnability.*

986.232 With the introduction of the phenomenon of system spinnability around any one or several or all of the hierarchy of concentric symmetric systems' seven axes of symmetry (Sec. 1040), we observe experientially that such inherent system spinnability produces a superficially spherical appearance, whose time-size realizations might be thought of as being only the dynamic development in time-size aspects of the primitive static polyhedral states. We recall the scientific nondemonstrability of the Greek sphere as defined by them (Secs. 981.19 and 1022.11). We also recall having discovered that the higher the frequency of the unit-radius-vertexed, symmetrical polyhedra of our primitive cosmic hierarchy, the more spherical do such geodesic-structured polyhedra appear (compare Sec. 986.064). I realized that under these recalled circumstances it could be safely assumed that *a sphere does not exist in the primitive hierarchy of pre-time-size polyhedral conceptioning*, whose timeless-sizeless—ergo, eternal—perfection alone permitted consideration of the vector equilibrium's isotropic vector matrix

as the four- dimensional frame of reference of any time-size intertransforming aberrations of realizable physical experience. Such perfection can be only eternal and timeless.

986.233 Timeless but conceptually primitive polyhedra of differently-lengthed-and- radiused external vertexes can be dynamically spinnable only in time, thereby to produce circular profiles some of whose longer radii dominantly describe the superficial, illusory continuity whose spherical appearance seems to be radially greater than half the length of the prime vector. (See Fig. 986.314.)

986.234 Thus the only-superficially-defined spherical appearance is either the consequence of the multiplicity of revolving vertexes of the polyhedron occurring at a distance outwardly of the unit vector radius of the prime polyhedral hierarchy, or it could be inherent in the centrifugal deformation of the polyhedral structure. Wherefore I realized that my having unwittingly and redundantly applied the synergetics constant of the sixth power—rather than only of the third power—and my having applied that sixth-power factor to the theretofore nonexistent static sphere of the Greeks' energy-and-time deprived three-dimensionality, was instinctively sound. Thus the erroneous result I had obtained must not discourage my intuitive urge to pursue the question further. I had inadvertently produced the slightly-greater-than-vector-radiused, highfrequency "spheric" polyhedron.

986.235 It seemed ever more evident that it could be that *there is no true sphere in Universe*. This seemed to be confirmed by the discovery that the sum of the angles around all the vertexes of any system will always be 720 degrees—one tetra—less than the number of the system's external vertexes times 360 degrees (Sec. 224). It could be that the concept conjured up by the mouthed-word *sphere* itself is scientifically invalid; ergo, it could be that the word *sphere* is not only obsolete but to be shunned because it is meaningless and possibly disastrously misleading to human thought.

986.240 **The Sphere Experimentally Defined**

986.241 The best physically demonstrable definition of the "spheric" experience is: an aggregate of energy events approximately equidistant, multidirectionally outwardly from approximately the same central event of an only approximately simultaneous set of external events-the more the quantity of external points measuringly identified and the more nearly simultaneous the radius-measuring events, the more satisfactorily "spherical." With each of all the outward unit-radius events most economically and most fully triangularly interchorded with their most immediate neighbors—chords being shorter than their corresponding arcs—we find that the "spheric" experience inherently describes only high-frequency, omnitriangularly faceted polyhedra. By geometrical definition these are geodesic structures whose volumes will always be something less than a theoretically perfect omni-arc-embraced sphere of the same radius as an omni-chord-embraced geodesic sphere's uniformly radiused outer vertexes.

986.242 As is demonstrated in Sec. 224, the sum of the angles around all the vertexes of any system will always be 720 degrees less than the number of vertexes multiplied by 360 degrees. By the mathematicians' definition a perfect arc-embraced sphere would have to have 360 degrees around every point on its surface, for the mathematicians assume that for an infinitesimal moment a sphere's surface is congruent with the tangent plane. Trigonometry errs in that it assumes 360 degrees around every spherical surface point.

986.300 **Minimum-Maximum System Limits**

986.301 **Consideration 11: Maximum-limit Case**

986.302 The explorer gains assurance by discovering the relevant minimum-maximum limit cases—the min-max limits of the variables—of the system under consideration.

986.303 For instance, we have learned through experimental evidence, the cosmic hierarchy of primitive polyhedra has a limit set of seven axes of great-circle symmetries and spinnabilities. They are the 3, 4, 6 (VE), 12, 10, 15, 6 (icosa) great-circle-spinnable systems. (See Table 986.304 and Sec. 1040.) Within that inherently limited hierarchy of seven symmetries, the triacontahedron, with its 15 different great circles' self- hemispherings and 120 triangular interconfigurings, produces the maximum-limit number of identical polyhedral surface self-facetings of all great-circle systems in Universe (Sec. 400).

Table 986.304: **Limit Set of Seven Axes of Spinnability**

Generalized Set of All Symmetrical Systems:	Spinnable System Great Circles:
#l	3
#2	4
#3	6 (VE)
#4	12
#5	10
#6	15
#7	6 (icosa)

(Compare Secs. 1041.01 and 1042.05.)

Next Section: 986.310
