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The Living Spiral

A Dimensionless Biological Constant Gives a New Perspective to Physics

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Key words. Constants, spiral, generation/regeneration, force, continuity, discontinuity, intersection, quantum, correspondence, adaptation, complementation.

Abstract. *In biological development, the spiral is an intrinsic generative design that enables adaptation. This spiral generates itself at a constant ratio. This ratio, as a biological dimensionless constant, is a component of the universal, dimensional constants of physics. This reflects a universal, spirally regenerative correspondence between adaptive biological designs and those physical designs or phenomena on all scales and orders in nature, including that of the atom and quantum. Thus, the biological design of a pinecone can give insight into the atom and quantum. The generation of the quantum and diverse forces arises out of the intersections of spiral continuities of undifferentiated force within a plenum, and these intersections may represent a*

type of phyllotaxis. The biological dimensionless constant defines such a generation and points to a universal template which projects itself by dynamical imprinting, on the plenum, through all scales/orders of nature. This projection necessitates that all natural designs are adaptive through a dynamic process of spiral complementation or completion and would suggest an implicit determinism within all scales of nature.

1. INTRODUCTION: THE DIMENSIONLESS BIOLOGICAL CONSTANT DEFINES NATURE'S SPIRAL UNITY

The Spiral is the universal form in biological phenomena (Fig. 1, 2a, 2b). Many examples of this are given by Cook [1914] and D'Arcy Thompson [1917]. Such a spiral generates itself over 90 degrees at various scales by a constant, dimensionless ratio generally having a quotient value of 1.618. This ratio has been referred to as the Golden Ratio or Section, and its constant value is symbolized here as Q, though others (e.g., Cook) have represented it by ϕ. Q becomes, therefore, the mathematical parameter defining the geometrical/dynamical generation of the spiral in biological

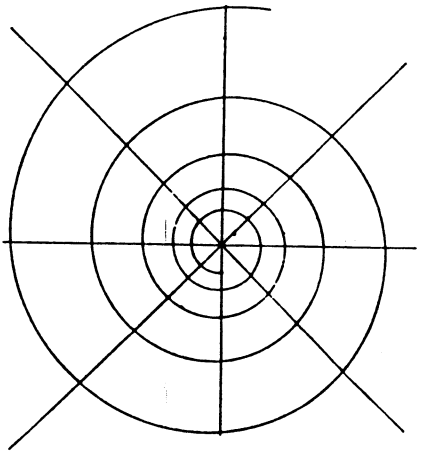

Fig. 1 - Logarithmic spiral with radii (Reprinted from Cook [1914]).

situations, where the spiral can be seen as the core of life's first principle, that of growth, or more specifically, an intrinsic generative design that enables developmentally adaptive growth. Such a spiral may reflect the inherent patterned-means through which such adaptation is developmentally achieved or allowed, and thus Q would represent an immutable window on this. It (Q) should thus be viewed as a type of biological constant that becomes explicitly manifest in the realm of biology. According to Shevelev [1994], the Golden Ratio governs the formation of biostructures and is a critical component in a mathematical expression which reflects the generation of unity within biological development. This unity or integrity, and its maintenance through continual spiral generation, would be essential for the adaptation and hence survival of the organism, especially during growth. D'Arcy Thompson [1917] illustrated that form in growth, and in particular spiral form or design, is stably expressed through, and a manifestation of, a display of forces.

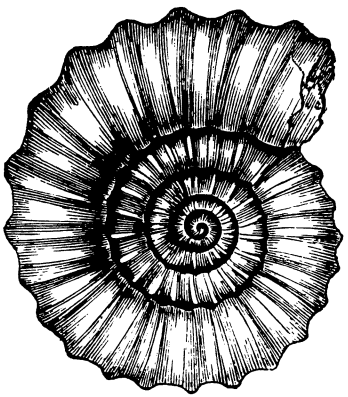

Fig. 2a - Spiral shell of an ammonite (Reprinted from Thompson [1917]).

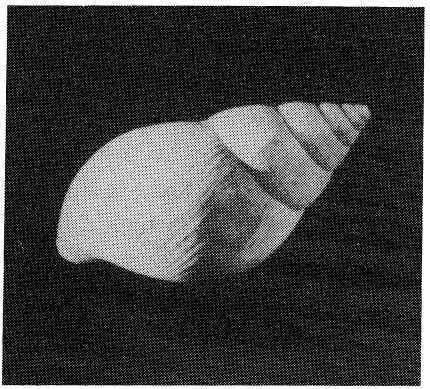

Fig. 2b - A gastropod shell with spiral morphology

If one accepts as a primary premise, supported by ample evidence, the unity between the physical and biological realms, especially its unity by means of forces, then one can infer that the Golden Ratio, as designated by Q, also plays a significant role as a

dimensionless constant in the physical realm. This is given further credence by the fact that the conical spiral or conical helix, of which Q represents the constant generative parameter in biology, becomes manifest in many physical phenomena, such as in hydrodynamics, electrodynamics, and in the periodicity of the atomic elements, the latter being based on quantum electrodynamics, thus implying that Q itself may reflect a constant, generative process underlying quantum behaviour. In general, Q may reflect a generative (or regenerative) process inherent in all physical phenomena, irrespective of scale and type. Not surprisingly, in view of this, many of the important, dimensional, universal physical constants that have become manifest in physics could thus be composed of or based upon the dimensionless constant, Q.

P. Lieber [1968] has demonstrated how the dimensional, universal physical constants can provide deep insights into natural phenomena. These universal constants are conceptually identified with ultimate, inaccessible, regenerative processes or structures in nature. In structuring space-time by impressing themselves on the space-time manifold, these processes are manifested in a generative, substantive-dynamical manner, that is, in a dynamical generation, namely a generation of forces giving a patterned non-uniformity to space-time.

In this context, the dimensionless constant Q may be a more basic, universal constant, a dimensionless, universal biological constant defining in part such dynamic generation throughout physical phenomena; and, in so doing, it may tie all, or at least a majority of, the universal physical constants together, and thus may define a more basic, underlying unity within the universe. It would so provide a deeper understanding of the quantum of action constant (the basis of quantum mechanics), among other constants, that quandary which reflects the problem of resolving continuity of energy with its discontinuity, and relatedly, how process or change resolves with conservation or constancy. Q does define or manifest such resolution, and this article, among other, related matters, will illustrate how this is the case.

2. THE DIMENSIONLESS BIOLOGICAL CONSTANT IS INHERENT IN THE UNIVERSAL PHYSICAL CONSTANTS

Through significant and hidden components in the universal, physical constants, biology provides insights into a dynamic, as in the operation of forces, and pattern in physical phenomena/processes, i.e., in the physical world. Such universal, physical constants contain in their numerals a non-apparent, component numeral designating a hybrid of two universal constants of significant meaning, and which also refers to a particular generation of force in biological process. This component-numeral is 1.618, first manifested in the biological realm, and it designates two intimately connected universal constants, i and Q. Though dimensionless, each defines, as part of a hybrid-constant, respectively temporal-involved and spatial-involved parameters of force regeneration over 90 degrees at a near-infinitesimal point, the angle 90 degrees itself remaining constant irrespective of scale of the physical or biological structure coming into existence through such regeneration. Such a dynamic regeneration, necessary for physical/biological existence, could also occur globally and simultaneously over all scales of 90 degrees. This could be represented by a type of fractal geometry. This geometry shows that specific patterns repeat at descending scales, such that their components, at any scale, are similar in morphology to that of the whole (Mandelbrot [1983]); this is pervasively manifested in nature. Relevantly, Morchio [1996] found a fractal dimension constantly equal to 1.6 in sections of two dimensional, tree-like, nervous structures. It is pointed out that this particular dimension is also manifested in other biological, tree-like structures. This dimension may reflect a constant proportion of 1.6:1, and thus it might reflect the process marked by the constant value 1.618.

Implicitly or explicitly, 1.618 can be found to be a numerical component of many dimensional physical constants, as in, for example, the electric charge constant of the electron and proton respectively. This constant, which is a very fundamental constant, equals 1.60×10^{-19} coulombs (units of charge). It bears a significant relationship to the other atomic constants such as the quantum of action, Planck's constant (Cohen *et al.* [1957]), which de-

fines energy discontinuity, suggesting through this relationship that this numeral, 1.618, is involved in those constants as well. In point of fact, it is also contained in the first numerical term of Planck's constant, 6.6, as an approximate integer-multiple of 4. When expressed in terms of electron volts, rather than in mechanical energy-units (ergs), the quantum of action equals $(2Q + Q^{-1} + Q^{-2}) \times 10^{-15}$ electron volt-sec, where Q equals 1.618. There are other illustrations of this. For example, the Compton wavelength of the electron is a constant composed of the fine structure constant and the Rydberg wave-number constant (Cohen *et al.* [1957]). The Compton constant equals 24.26×10^{-11} cm or $40(Q^{-1}) \times 10^{-11}$ cm. When this constant is divided by 2π, we find the constant to equal 3.86×10^{-11} cm (Cohen *et al.* [1957]), or expressed in terms of Q, $3(Q) - 1 \times 10^{-11}$ cm. As another example of this, the constant magnetic moment of the proton is 2.79 (or 2.80) nuclear magnetons which equals 3(Q) - 2 nuclear magnetons. And, when the constant Rydberg wave-number per cm (of spectra from hydrogen and helium nuclei) is multiplied by the speed of light constant, c, one obtains $2(Q) \times 10^{15}$ per second, an expression which significantly connects or relates Q with time. With regard to Q's relationship to mass, the constant ratio of the proton rest mass to the electron rest mass is $3(Q^{-1}) \times 10^{3}$. The integers in these dimensionless components would appear to have a significant meaning, probably referring in some manner to the seeming discontinuity manifested at the atomic level, as well to the degree or pattern of dynamic regeneration which Q reflects. In general, the other dimensional constants may contain Q in related ways.

One may counter this view, however, by asserting that the numerals considered significant, such as 1.60, are arbitrary insofar as those numbers are based upon what appears to be the arbitrary units of space and time. Such units were originally based upon the derivation of the metric system. For example, until relatively recently, the meter has historically been equal to 10^{-7} x the distance from the geographic North Pole along the earth's circumference to its equator. Simple calculation from this shows the meter to be equal to 0.25π x D (the earth's diameter) x 10^{-7}. This shows that units of metric measurement (or dimension), on which the physical constants were historically founded, have had a constant pa-

rameter themselves, namely π, a very important mathematical constant involving the circle, and one that scientists have come upon repeatedly in the description and elucidation of physical phenomena. This circumference also represents a curvature or rotation over 90 degrees. Historically, the imaginary number (or unit), i, has represented a rotation or generation of a vector over 90 degrees, and Q is approximately one-half π. Thus, one can also express the meter in terms of i, that is, also as i/Q.

Hence, such metric units contain π, a dimensionless constant, or parameters of i, a dimensionless constant which contributes to π. This indicates that indirectly or ultimately all spatial units that have been used in physics contain or have been based upon or have been a function of a dimensionless constant parameter. Furthermore, the time-unit, on which the physical constants were also built, is itself based upon a periodicity or revolution which also has as its ultimate parameter the constant π. Geometrically, there are connections between i/Q and π. The presence and importance of π has repeatedly been manifested in the historic development of the physical/astronomical sciences. It is not a coincidence that many physical principles utilize mathematical representations involving and expressing π, e.g., classical and quantum mechanics as well as astronomy. Hence, with regard to the relation between π and i/Q, it would not be a surprise that i/Q would be contained in many dimensional, physical constants. By also defining the metric unit in terms of a curvature or rotation over 90 degrees, its parameters become implicitly defined in terms of circular regeneration, and so allow the manifestation of those dimensionless component-constants which represent the universal properties of circular/helical regeneration that involve or maintain space-time.

One can begin to illustrate this by first considering time. The second, the basic unit of time, has originally and historically been defined, or has meant, 1.15×10^{-5} of a mean solar day, or the completion of one rotation of the earth about its axis, that is, of a circular motion – a circle. One such rotation equals 360 degrees or 2π radians. As one-half π is i, a rotation over 0.5 π radians, then one second becomes 1.15×10^{-5} radians x 4i and as 1.618 or Q also represents generation (of a vector) over 90 degrees, then the second also becomes 1.15×10^{-5} radians x 4(1.618). Thus, time, or

the second, is a function of i or Q. That is, time is contingent on the regenerative-marking, dimensionless constant i, as is the unit-space, the meter, contingent on i or Q, that is, on i/Q, as both components refer to aspects of the same regeneration.

Thus, space or extension and time have in common or are unified by or have a unifying component: 1.618 or i or i/Q, a dimensionless constant. This means that time and space have an unity in 1.618 or i, a unity which appears to be more profound than that implied by the Theory of Relativity. This would appear to mean that space-time is maintained and held together by that to which i (or Q) refers. i/Q refers to a spirally regenerative process. This process, among other things, resolves constancy with change, by creating constancy through change, as also represented mathematically by the exponential function, $y = e^x$, whose very derivative is equal to the function itself. Within a polar co-ordinate system, this function generates a logarithmic spiral. This spiral generates (or regenerates) itself at a constant logarithmic rate or ratio over 90 degrees, at a nearly infinitesimal region, and this 90 degrees is represented by i in the exponent (Clifford, republished [1955]). For this particular spiral, its constant rate of regeneration has the dimensionless value 1.718. Though exceedingly close to 1.618, 1.718 may nevertheless be a spirally regenerative-defining, dimensionless component of some other physical constants not including Q. Designating 1.718 as Q_2, its existence is clearly tied to i, as is Q. Perhaps, i also represents an even more fundamental parameter within spiral regeneration and is included in a family of dimensionless biological constants, each representing a different, constant ratio of spiral regeneration, e.g., i/Q, i/Q_2, i/Q_3, i/Q_4,...i/Q_n. i/Q would be seen as being the most important and prevalent, and would be seen as the mean value of the others; though, there may be other, more complex dimensionless biological constants, connected to physical phenomena, that are based upon or derived from i/Q.

Interestingly, Clifford, many years before Einstein's Relativity Theory, stated that curvatures or twists in space generate physical phenomena through the twisted space, such as electromagnetism, and hence the physical forces involved. He implied that i is an important parameter in representing such spatial twists involved in

physical processes. Might it not also denote the temporality in such twist generation?

Most significantly, in this connection, Minkowski (Einstein [1916], [1952]; D'Arbro [1950]) denoted, more inclusively, the temporal dimension of the space-time continuum in Special Relativity as the product (i)(c)(t), c being the constant speed of light propagation. Through such a dimensional product, it is implied that the temporal dimension is contingent on i. Implicit in time as in space is i or Q. As we have seen, the constant i/Q is implicit in the fabric of space-time, probably defining its generative basis. That constant is representative of that which is the generative "glue" or the unifying, spirally generative thread which holds the fabric together. This thread is spiral regeneration, creating constancy through change and discontinuity out of continuity, the quantum singularity out of dynamic continuity.

The metric units are but a quantification of such space-time, and hence, ultimately, they are built upon Q and i. This would mean, for example, that the second, the centimeter, the gram, the unit measurement of mass, historically defined as a cubic centimeter of water (at 4°C), and the unit of force, the dyne, defined in terms of grams-centimeters-seconds, are ultimately built upon the dynamic of a constant of spiral regeneration, whose temporal-involved parameter, regenerative duration, is represented by i within the hybrid constant representing such regeneration, i/Q. Thus, it would be by necessity, and not by coincidence, that the physical dimensional constants, such as those which contain a force parameter, as does the quantum of action, would be built upon or manifest the dimensionless constant i/Q, showing up numerically as 1.618. In view of this, the dimensionless constant, i/Q, would thus, as a window, reveal insights into force, its source or pattern of generation, constancy and change, continuity and discontinuity, and so begin to provide fresh insights.

3. THE BIOLOGICAL CONSTANT, GENERATIVE INTERSECTIONS, THE GENERATION OF THE QUANTUM AND DIVERSE FORCES

Within space-time, apparent physical discontinuities arise or

are generated and maintained through the dynamic intersections of spiral continuities of undifferentiated force. A spiral continuity of undifferentiated force may correspond to a complex tensor representing a continual component of an asymmetrical unified field. The geometrical construction of such a tensor was seen by certain physicists as way of uniting the electromagnetic (EM) and gravitational (inertial) forces into a unified force or field (Einstein [1925], [1952]; D'Arbro [1950]). From a biological perspective, this latter force would be an undifferentiated force, and through the repeated, regenerative intersections of undifferentiated continuities of force, the different forces of nature would arise or generate, that is, differentiate repeatedly, thereby, constantly.

Hence, constancy through change is manifested as a repeated, thus continual, dynamic generation/regeneration of intersections on all scales. On the quantum or the micro-level, such intersections are nearly infinitesimal quadrants, as represented by the integer 4, consisting of regenerations of force over 90 degrees through dynamic imprinting, to which intersectional regeneration i/Q refers. The i component of the hybrid constant marks the constant duration of that regeneration and hence marks a constant, temporal-involved unit of nearly instantaneous duration, a time-source constant. The true or deeper meaning of the quantum of action, to which Planck's constant h refers, is that it defines or represents a particular gestalt of such dynamic, regenerative intersections, the dynamic being of force.

On a much higher order or scale, the dynamically regenerative intersections of continuities are manifested in biological development in a particular manner also defined by i/Q. In the development of a pinecone, there are protrusions or bulbous structures within regions demarcated by intersecting, continuous logarithmic spirals (see Fig. 3). These are regions of developing seed primordia, and they can be likened to the complex quanta of the atomic nucleus, the protons and neutrons, these regions also respectively manifesting, vortically, quanta of action. Such intersections of spiral continuities may define and contribute to complex regions of concentrated, integrated and integrative forces, energy quanta on a higher scale, required for such seed development within the pinecone. Relevantly, "on the analogy of the hydrodynamic lines

of force in certain vortex movements, and of similar lines of force in certain magnetic phenomena, Mr. Church proceeds to argue that the energies of life follow lines comparable to those of electrical energy, and that the logarithmic spirals of the sunflower [and pine cone] are, so to speak, lines of equipotential" (D'Arcy Thompson [1917]).

Fig. 3 - Pinecone displaying seed nodules arranged in logarithmic spirals. Note that each nodule emerges within a quadrant formed by four intersecting spirals.

The concentrations of integrative forces, referred to in connection with the pinecone, may also reside in those regions where buds develop in angiosperms. Such buds also develop at sites of intersecting logarithmic spirals (see Fig. 4 and 5), and sites of bud development are separated by a constant angle based upon Q (Cook [1914]). This pattern of bud/leaf development, first noted

by the British botanist, A.F. Church, is referred to as phyllotaxis, and it allows for maximum exposure of a developed bud/leaf to light and air (Cook [1914]). Hence, phyllotaxis allows for maximum adaptation for the developing and developed plant. Biologically, it is another example of the spiral generations of discontinuous, primordia-quanta, complexes of forces, from intersecting continuities. A series or integral of such bud quanta could define an energy band or level of integrated force within the plant. A group of such series could themselves comprise intersecting energy levels or boundaries of the developing plant and pinecone.

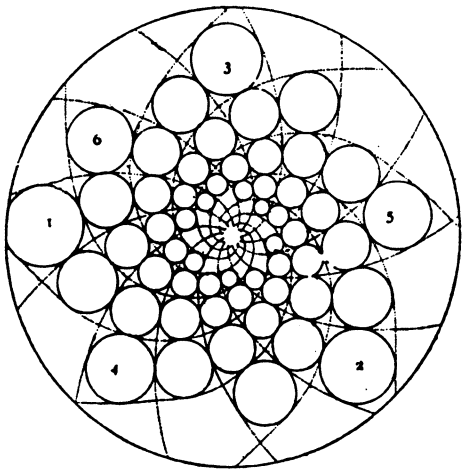

Fig. 4 - Abstract, diagrammatic representation of phyllotaxis as viewed from the top of a growing plant (Diagram reprinted from Cook [1914]). The circles within the quadrants represent developing bud primordia.

Such biological manifestation of regenerative intersections – which give rise to apparent discontinuities and diversity – would give new insight into physical structures such as the atom and its nucleus, providing a different perspective on physics. For example, in view of what has earlier been said, the atomic nucleus of a complex element may be a regenerative structure with a morphology that may be similar to that of a pinecone. Therefore, a biological

reality may provide a model for a phenomenon in physics. Biological development and the dynamic atom, especially its nucleus, have in common a significant dynamic structure marked by i/Q. As an illustration of this, the constant Bohr radius of the atom equals $2Q^2 \times 10^{-9}$ cm, or $2(i/Q^2) \times 10^{-9}$ cm, indicating a geometrical regenerative parameter to the atom's existence and its quantum levels based on dynamic intersections.

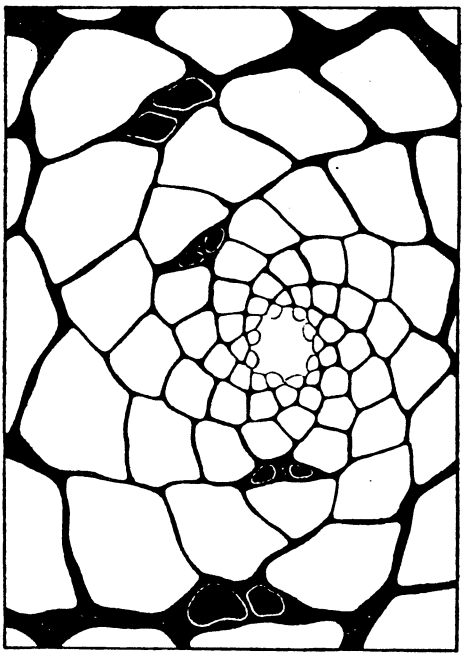

Fig. 5 - Diagram of the plant *Araucaria excelsa*: Transverse section of growing point of a branch (Reprinted from Cook [1914]). Note the bud primordia at the intersections of the logarithmic spirals.

From what has been said with regard to regenerative intersections, one can also predict the existence of quantum levels within the atomic nucleus itself, possibly represented by the Rydberg constant. Such levels would be defined by intersecting logarithmic spirals. Based upon a generative process defined by i/Q, these spi-

rals would also be embedded in a derivative process to which i/Q also refers, namely, the smallest constant unit of regenerative intersection, the ultimate quantum, in general, being defined by the intersection(s). It would be the dynamic quantum unit of nearly infinitesimal, intersectional dynamic regeneration; and, as such, it would compose, and be the nearly infinitesimal constant unit and limit of, a regenerative, more inclusive quantum-electrodynamic field, namely, that of the atom.

i/Q may also define the concurrent generation of inertial force over or by means of the dynamic intersections. This generation of inertial and electromagnetic forces by means of and over the nearly infinitesimal quadrants defined by the generative intersections would suggest a common locus or root to such forces.

Such regeneration over a nearly infinitesimal quadrant or at a nearly infinitesimal region is also the dynamic resolution of process or change and constancy. Force at such a near-regional-point is a manifestation or reification of such resolution. If one takes an integral of – or progressively integrates or interconnects such forces, or dynamic near-regional-points or near-force-points over space-time, which itself is composed of such nearly infinitesimal, dynamic regions – energy and in turn matter from such energy become progressively manifest or developed. The forces become helically organized in such a manner as to become a gestalt of energy – as in a helical electromagnetic (EM) wave – and this energy of helically, intersecting force becomes organized at a higher order into vortical-intersectional dynamic structures of atomic nuclei, regenerating matter. Energy represents a higher order of regenerative force, and regenerating matter represents a higher order of such energy, where the spiral configuration closes in upon itself creating the facets of the spherical, particle mass. Exponential functions that define i/Q in terms of its powers may mathematically express these relationships of increasing orders. That is, the generation of higher orders of forces, such generation extending into the biological realm, may be defined by exponential/logarithmic equations that refer to different exponential powers of i/Q.

Inertial and EM forces would commonly originate, and thus would be united, through this regeneration, an aspect of which could be acceleration. Acceleration is a situation which can simul-

taneously generate inertial and EM forces, a type of integrating process. The inertial and EM forces generated through intense acceleration could evolve into that which one refers to as energy, whose further acceleration through the assimilation of inertial and EM forces could lead to the development of that which manifests itself as matter. Such matter, as a higher dynamic order, would have a dynamical geometry of regenerative, intersecting continuities of entwined forces.

i/Q within the constant of the quantum of action is a manifestation of the repeated intersecting-force regenerations of spirally constructed, dynamic continuities, in which space and time are intimately fused by undifferentiated force. This intersectional generation of force, through which the different types of force may arise, reifies a constant of duration; such generation involves a duration by becoming a regenerative duration. Moreover, that which is referred to as different energy or quantum levels within the outer atom, energy discontinuities and particles, are but manifestations of integrated intersections of dynamical continuities. Such integrated intersections would be manifested as boundaries, boundaries which themselves would become extended, higher-ordered quanta, and which would also be present through the fabric of space-time.

Through the generation of intersectional, dynamic space-time, i/Q could, as indicated, also represent in some exponential manner the localized generation of inertial/gravitational force. Consider, in this connection, the following equation or function that has classically represented a curved line or distance through space:

$S = 0.5gt^2$, where g equals 9.8 meters per sec/sec, a constant of acceleration due to the earth's gravitational force, and t is time in seconds. If one takes the indefinite integral of this function, integrating with respect to t, one obtains the following expression, representing approximately a conical section in space-time units: $S_c = 0.166gt^3 + C$ (a constant). Upon such integration, the configuration of dimensional units has become $(0.166)(9.8)$m-sec^3/sec^2 or 1.62 m-sec or 1.62 space-time. In this context, 1.62 or i/Q could also be seen as referring to a nearly, infinitesimally localized, generation of inertial/gravitational force through the intersectional generation of space-time, where such space-time becomes eventu-

ally shaped or evolved by configurations of gravitational force as described in the General Theory of Relativity. Significantly, in this regard, the universal constant of gravitation, G, is composed of an integer multiple of 1.6 within G's first numerical term, the integer being 4.

In general, the various forces such as the inertial forces, the electrostatic or EM forces, and strong forces may all originate through dynamical intersectional generations represented in different manners by i/Q. For example, the different forces may differ respectively in a representative manner by respective exponential powers of i/Q, where the exponents themselves are seen as differing by different integer multiples of i/Q itself, and these may be either negative or positive exponents as well. The physical constants, such as G, the universal gravitational constant, e, the constant magnitude of electronic charge, and h, the quantum of action, may appear to be unrelated as they appear to refer to different situations or ultimately different types of forces, where, in fact, they may all refer to a common, underlying, generative dynamic or parameter defined by i/Q. Various physicists (e.g., Kaku [1994]) have attempted to unite the various forces by arguing that such forces can be united only in higher dimensional spaces such as one of 16 dimensions, a hyperspace, which, in my view, would be a space of imaginary properties, defined by imaginary or complex numbers, from the standpoint of our reality. In view of this, it is very significant that 16 is 1.6 x the integer 10, or i/Q x 10. Were this hyperspace a facet of ultimate reality, it might very well be structured by spiral generations represented by i/Q. These dynamic structures would be seen as giving a morphology to an infinitely uniform plenum, an ultimate hyperspace of infinite dimension. If one could imagine the morphology of such a 16-dimensional space, it might be a type of complex, compound universal cone composed of an infinite, integrated number of conical helices, or helical waves, within one another. The constant, C, within the previously described equation, may refer to an infinitely-elongated, near-infinitesimally-narrow, inner cone of such vortical waves, a type of inner template.

4. CORRESPONDENCE BETWEEN ALL PHYSICAL SCALES/ORDERS AS REPRESENTED BY THE UNIVERSAL BIOLOGICAL CONSTANT

In view of the above, the wave-properties of matter predicted by De Broglie, and later confirmed by experiment (as described by Born [1951]; Semat [1966]), take a deeper meaning if approached from the perspective presented here. Let us consider the De Broglie equation which describes a relationship between matter and its wave-properties: w = h/mv, where h is Planck's constant, v is velocity, m is matter, and w is wavelength. Using such an equation, one can visualize a situation where as mv approaches 1 as a limit, w would approach h as limit or boundary. 1 would be seen as representing a situation where units as we know them break down or become fused. 1 is seen as a dimensionless constant representing a unifying, higher infinity. This infinity would be the absolute uniform, dimensionless plenum (or ultra-matter) of non-contrasts, in which non-uniformities or contrasts can be generated by means of forces from and by means of such a plenum. The dimensions defining ordinary physical phenomena, e.g., matter, break down or do not apply as mv approaches 1. For this to occur, velocity would have to be infinitesimally greater than the speed of light. If this were to occur, the only boundary between matter and ultra-matter becomes defined by h. However, at this stage, h would not be represented by its regular dimensions. Its regular dimensions would have become fused: h would define a quantum having a fusion of wave, corpuscular, and temporal properties, a fusion of generative forces. Each such quantum would respectively be but a compounded, intersectional component of a dynamic boundary. Such a fusion represented by h would be a quadrant of dynamic intersections of dynamic continuities. Geometrically defined, this would be the quantum generation of force by means of the continuous and near instantaneous imprinting of ultra-matter on itself at such nearly infinitesimal quadrants, so generating vortically spherical space-time of nearly infinitesimal scale. This generation would also be represented by i/Q. The imprinting would be a function of and through a constant and nearly infinitesimal duration, a temporal-source constant having intersectional boundaries, and thus itself a type of quantum.

This would not be surprising in view of the inherent properties of ultra-matter. Such properties could be represented by a famous mathematical equation derived by Euler in the eighteenth century, namely $e^{2\pi i} = 1$, e being a very important logarithmic constant. In the present context, this equation would mean that the unitary plenum, ultra-matter, may have inherent "imaginary" or ultra-physical properties, of which, circular, helical regeneration through constant time may become representative through imprinting. This is further implied by the fact that $Q^{-1} + Q^{-2} = 1$ (Shevelev [1994]), from which follows $Q^{-1} + Q^{-2} = e^{2\pi i}$. This would again indicate in another way that inherent in ultra-matter is the capacity to spirally generate force, and, through such generation, matter (and biological organization) could spirally develop from ultra-matter. Shevelev [1994] does argue that biological form develops from the unity of nature in accord with exponential multiples of 1.618, symbolized by ϕ in his article.

Through Einstein's Special Relativity equation which shows that an increasing velocity, or a continuous acceleration, results in increasing mass, it can be easily shown that if the velocity exceeds the speed of light, c, mass would take on the imaginary parameter, i. This means, from the present perspective, that matter would blend or develop into ultra-matter; and, it would do so, if it were not for that unifying boundary of ultimate, dynamical non-uniformity within the plenum, a higher order quantum, defining an inherent dynamic regeneration, to which quantum an integral of h also refers.

An integral of a particular series of dynamic-quadrant-intersections of curvilinear, forces – each such quadrant being that which h represents – is or also becomes a particular energy band or wave frequency within an atom. Groups of such integrals would be the various energy bands/wave frequencies composing the outer and inner part (nucleus) of the atom. The spectra generated by respective atoms would in turn be generated by the dynamic intersections of these energy or frequency bands of the outer atom, the electrons. The spins of such electrons, which would in effect be vortical waves intersecting with one another, is the basis for the generation of the fine structure of such spectra (Spiradonov [1986]), and, according to this author, Planck's constant is a

measure of unit for such spin.

On each higher order or scale, such vortical energy bands also become replicated as, and thus compose or are represented by on a biological level, the spiral structure and growth patterns of plants, as in phyllotaxis. As we have seen, seed nodules of the pinecone – and the generation of buds in general – morphologically could represent, or are indicative of, quanta of action (and atomic quanta) on a much higher scale due to the constant intersections of spiral growth continuities. The diagrams of phyllotaxis and the photograph of a pinecone illustrate this in a very tangible manner. And, as we have seen, phyllotaxis is not just a dynamic pattern, but it is growth pattern that is adaptively very beneficial.

From this, it is predicted that a very important constant of quantum mechanics, the fine structure constant, which pertains to or defines the generation, from the atomic level, of the spectra bands of fine structure, is also connected to or defines an underlying situation common to such generation and the process of phyllotaxis in plants. This common underlying situation would be the dynamic of spiral (or vortical), intersectional generation operating through all scales and orders, and thus suggestive of a non-relativistic, universal process.

This fine structure constant is a dimensionless number. The reciprocal of this number is 137.03 (Cohen *et al.* [1957]). When one takes the reciprocal of Q and multiplies the square of this reciprocal by 360 degrees, one obtains 137.5 degrees, that is, 137.5 degrees equals 2π radians divided by Q^2 (Cook [1914]). During plant growth, this is the constant angle within a spiral in which buds, and hence leaves, are generated, in a most adaptive manner, with respect to one another (Cook [1914]). Such buds emerge at the foci of intersecting logarithmic spirals. The angle between such foci is this constant of phyllotaxis. The numerical identity between this constant and the reciprocal of the fine structure constant is very significant and emphasizes that both refer to a common process, possibly adaptive. In so doing, these two constants, respectively from apparently two completely different realms or domains or orders, the quantum mechanical and the domain of life, nevertheless point to a deep, underlying dynamic connection between the two. This underlying, adaptive process involves the dynamical,

spiral intersecting-continuities of undifferentiated force represented by i/Q, and through which, the quantum of action, h, becomes defined. This is especially manifested in the fact that the fine structure constant (or its reciprocal) is itself a complex of the four most important constants in nature, namely, h, c (the constant speed through which light propagates or regenerates as an EM wave), π, and e, the constant of electronic force or charge related to other atomic constants, as we have seen. Common to three, if not more, of these constants is Q , and it might also be an underlying unit in the light constant. In this regard, it is especially significant that the phyllotaxis constant equals 2π radians divided by Q^2. Recall in this connection that the Compton wavelength constant of the electron contains the fine structure constant and that the electron wavelength constant can be expressed in terms of Q.

Generally, the phyllotaxis constant and the fine structure constant would point to a common, dynamic unity within scales of order of the physical world. It is also significant in this regard that e, which composes the fine structure constant, and is itself composed of Q, "...furnishes one way of establishing the scale factor connecting all atomic magnitudes with macroscopic magnitudes accessible to measurement by ordinary means" (Cohen *et al.* [1957]).

Q or i/Q becomes the most important universal constant of all, as it defines a dynamic-regenerative unity between the physical and biological realms, and in doing so, it also defines a unity between the quantum realm and the macro-physical realm, such as that defined by General Relativity. It is a constant operating on all scales and orders, probably also as exponential powers of that constant. It demonstrates a principle of universal correspondence, in which, and through which, the study of the dynamic structure of a pinecone can provide insights into the dynamic structure of the atom. It suggests that all of nature has developmental/evolutionary properties whose unifying and constant parameter is the continual, spiral regeneration of intersecting continuities of force on all physical/developmental scales and orders of organization. Dynamic intersection becomes a necessary and universal constant for all scales and types of development in nature, which would include

morphological change through different scales. In fact, through Topology, the visual geometry developed by Poincaré, it can be shown that certain properties of geometrical figures do not change when such figures are transformed: Intersections of lines remain constantly intersections. i/Q would also define the universal constant of dynamic intersection, underlying and through which all reality becomes manifest. Such intersection becomes the ultimate, universal unit or the ultimate quantum of dynamic contrast, and hence diversity; and it is through contrast that nature becomes apparent to us.

Nature would thus appear to have dynamically regenerative, vortical intersectional structures operating through all scales and orders, and so enabling the different scales to dynamically correspond with one another; and this, it is predicted, would include particles at the atomic and subatomic levels. Evidence strongly suggests that particles, such as beams of protons, act as vortices (Lerner [1992]), and that the asymmetrical vortex structure is an inherent property of matter on the micro or quantum level. It may be argued that such vortices are generated in a "fluid-like" ultramedium, the plenum. Whether the forces generated through and of such vortices are attractive or repulsive depends – it can be further predicted – on the particular, complementary asymmetry of the generative vortex and its dynamic context. Evidence from atomic and plasma physics suggests this to be the case (Lerner [1992]). Hence, it is again seen, in another way, that the dynamic morphology at the quantum/atomic level replicates, generatively, the dynamic spiral morphology of a developing plant or pinecone, that of life itself, implying a particular biological unity or biological, spirally regenerative nature operating through all scales and orders (see Fig. 6).

Such unity of spirally regenerative correspondence has very unusual, predictive implications. For example, on the level of biological development, intersections of spiral continuities of undifferentiated force may also replicate or generate, if only very briefly and for very local effect, the extremely cohesive strong forces normally endemic to the atomic nucleus. This local generation would contribute, at critical junctures, to the adaptive stabilization of such development. And, the generation of such strong forces may

in turn intersect spirally with those of the atomic nuclei as a further aspect of such adaptive stabilization. From this, one can predict the existence, if only very briefly, of the strong forces at the level of the biological organism and their possible detection through future experiments. Developing biological systems could thus be used to investigate what has hitherto been considered only a subatomic dynamic, again underlying the unifying biological nature/design of reality on all levels.

Fig. 6 - A rose with a vortical design. Does the dynamic morphology at the subatomic level recapitulate the vortical development of a rose?

By having biological properties, the various phenomena of existence, on various scales, including those represented by quantum mechanical models, could essentially be re-interpreted as being adaptive designs or configurations. From this standpoint, whether light behaves as wave or as a corpuscle depends on what is the most adaptive, dynamic configuration to a given dynamic milieu

of non-uniform forces, a stress; that is, what design of complex, dynamic intersections can be maintained or develop as an integrity in dynamic connection with a milieu of other, intersectional forces. So, even on the scale or order of the quantum mechanical realm, the issue becomes one of what adaptively, and hence necessarily, develops or evolves in a given milieu; and that issue ties into the regenerative-dynamic defined by i/Q and a unifying principle to which i/Q's referent is itself subsumed.

5. CONCLUSION: A UNIVERSAL, INTRINSIC GENERATIVE PRINCIPLE THAT ENABLES ADAPTATION ON ALL SCALES/ORDERS

An intrinsic principle would indeed seem to govern the adaptive generation of helical, configurational intersections, various orders of which would define or give rise to physical "and" biological realms. A derivative principle that may apply is the Principle of Maximum Uniformity described and illustrated fully elsewhere (P. Lieber [1969], and M. Lieber [1996]). Stated briefly, this Principle requires that configurations of forces, on all scales, evolve as design-integrities by generating, via non-uniformities of force, increasing uniformities or equilibria of forces within the non-uniformities of such configurations, with consequential, adaptive enhancement of the integrities. In the present context, this could be expressed as or through a progressive increase – via increased, non-uniform, dynamic imprinting – in the regeneration of spirally intersecting continuities of force as a completing or complementing process. This increasing, complementary regenerative spirality, each complementary regeneration represented respectively by i/Q and i/Q^{-1}, would not only be manifested as an increase in integrity but also as a means to achieve such integrity, a continual (or constant) solution for adapting the dynamic configuration to all niches on all scales, from local to global. Relevantly, as the constant Compton wavelength of the proton and neutron, respectively, can be represented by $6(Q + Q^{-1}) \times 10^{-14}$ cm, then the waves given off could have complementary, regenerative spiral components, which, in their joining, could give a symmetrical,

adaptive integrity to such waves. Thus, in general, intersecting, complementary spiral continuities would provide the adaptive, dynamic integrity to natural designs.

Through and by means of such dynamical regeneration of spirally intersecting continuities of undifferentiated force comes the manifestation of the quantum of action and definition to the particle in adaptive situations; where, in the case of the particle, such dynamic intersections become a self-enclosed, helically grouped complex. Moreover, through such spiral-generated intersections of dynamic continuities, the various forces of the universe, e.g., the inertial forces, the EM forces and the strong and weak forces of the nucleus, might be united in common origin and contribute to the quantum of action. The Principle of Maximum Uniformity applies to all these forces and implies their ultimate regenerative unity in promoting universal adaptation of various design-integrities. The means to achieve such would itself be a intrinsic design operating through higher and higher levels: Such design would be the spiral generation of forces in higher and higher orders of intersectional continuities. As the most significant aspect or property of living matter, that level of matter's organization, is its regeneration, spirally-patterned regeneration, matter's way of maintaining constancy through change, discontinuity through intersectional continuity, then life itself may point the way or be the way to the unification of all such forces. In considering the deeper implications of i/Q, it is seen how discontinuity can arise out of continuity, and how constancy can arise out of change.

i/Q (or i/Q_n) may thus be a prime-universal constant operating on all scales or levels of reality from the spiral galaxies to developing plants and on through to the atom. In so doing, i/Q would provide a window to that unification, on all scales, and thus would be a reflection of a deeper, underlying, and unifying template-realm of Universals to which thought or the source of mathematical abstraction is itself connected, a Platonic reality, inherent in all realms of phenomenological reality.

This prime-constant would compose all, if not most, of the important dimensional, universal constants, because it refers to the regenerative means through which apparent discontinuities of various types of force arise from intersecting continuities of undiffer-

entiated curvilinear-forces, at near infinitesimal regions. Through such intersectional, dynamical regeneration, in other words, this biological dimensionless constant unites the most important physical constants, namely, G, h, e, and, possibly, c, as the latter comes from the adaptive, dynamic regeneration of the EM wave-design, hence of its integrity. This dimensionless constant also marks the dynamic, generation/regeneration and fusing of space-time by continual imprinting of ultra-matter on itself, and hence, for this reason alone, it must be contained in the most important constants of physics, including the gravitational constant. It is through such imprinting of ultra-matter on itself by means of an inner template that all the forces are generated, including the spiral continuities of undifferentiated force, whose generation is also marked by i/Q. Such dynamic regeneration is hence the source of intersecting, dynamical continuities that give rise to apparent discontinuities.

The diverse forces, arising through such intersectional regeneration within quadrants, would together take on the dynamical configuration of well-defined, vortical complexes, that is, vortical quantum-complexes. These would be generated in resonance or complementation with other vortical complexes. This generation of complementing complexes, from undifferentiated force, would be manifested as (or a source of) an adaptive differentiation on all physical scales, with bud generation in phyllotaxis being an example on the biological level. Such dynamic, unifying intersection, on which universal differentiation within nature would be based, resolves continuity with discontinuity, and it shows how change can give rise to continuity through a unifying spiral regeneration. In this context, "the spiral provides a generative intrinsic force to living forms" (G. Sermonti, personal communication) and to those physical structures or phenomena considered as non-living.

The spiral, intersecting continuities of force would certainly indicate a spirally unifying dynamic operating through all scales and phenomena; and, such a unifying dynamic would be reflective of a non-local, global determinism whose domain operates through all space-time scales. Hence, this dynamic determinism would appear to be nearly instantaneous, marked by the time-source constant i, and it would be suggestive of a near instantaneous, non-local adaptive, influencing-communication (via dynamic

connection) within and between dynamic designs. Experimental results from quantum physics are very suggestive of a non-local, apparently near instantaneous, mutually influencing, dynamic connection (or continuity) between light quanta or particulate designs (Aspect *et al.* [1981]). A further and relevant implication is that this deterministic, unifying domain underlies the seemingly statistical domain of observable quantum phenomena, such as light. As i/Q would also refer to this unifying domain, it might also be used within a fractal geometry to predictably illustrate a bridge or a transition between trans-scalar dynamical determinism and the illusionarily statistical aspects of quantum phenomena.

In illustrating such unification by means of what i/Q represents, it can be seen how continuity and discontinuity can emerge and co-exist in a complementary fashion in the physical world, a long-standing dilemma of quantum mechanics. It is also seen how the various forces that give structure or morphology to the universe can have a common generative origin and design from which the adaptation of specific dynamic designs would necessarily derive. Such design could be a Universal: This would be a conical spiral template seated within ultra-matter and replicated through a regenerative imprinting projected throughout different scales/orders of reality, giving coherency to such reality. i/Q would also define a generation of that template and so itself would represent or reflect a generative template. The new perspective given to physics by the dimensionless biological constant i/Q could lead to a truly Unified Field Theory in physics, which, ultimately, would be a Biological Field Theory defining a Universal Principle.

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REFERENCES

Aspect, A. *et al.* [1981], Experimental Tests of Realistic Local Theories via Bell's Theorem. *Physical Review Letters* 47: 460-463.

Born, M. [1951], *The Restless Universe.* Dover Publications, New York.

Clifford, W.K. [Originally published in 1899; republished in 1955], *The Common Sense of the Exact Sciences.* Dover Publications, New York.

Cohen, E.R. *et al.* [1957], *Fundamental Constants of Physics.* Intersciences Publishers, New York.

Cook, A.T. [1914, republished 1979], *The Curves of Life.* Dover Publications, New York.

D'Arbro, A. [1950], *The Evolution of Scientific Thought. Second Edition.* Dover Publications, New York.

Einstein, A. [1916, 1952], *Relativity: The Special and the General Theory.* Crown Publishers, New York.

Einstein, A. [1925], Unified Field Theory of Gravitation and Electricity [Title translated from the German]. *Report of the Prussian Academy of Sciences at Berlin,* pp. 414-419.

Kaku, M. [1994], *Hyperspace.* Doubleday, New York.

Lerner, E. [1992], *The Big Bang Never Happened.* Random House, New York.

Lieber, M.M. [1996], Force, Development, and Neoplasia: Development from Another Perspective as Illustrated Through a Study of in vitro Plant Development from Neoplasm. *Rivista di Biologia/Biology Forum* 89: 245-274.

Lieber, P. [1968], Constants of Nature: Biological Theory and Natural Law. In *Towards a Theoretical Biology I,* C.H. Waddington (ed.), University of Edinburgh Press, Edinburgh, pp. 180-204.

Lieber, P. [1969], Aspects of Evolution and a Principle of Maximum Uniformity. In *Towards a Theoretical Biology II,* C.H. Waddington (ed.), University of Edinburgh Press, Edinburgh, pp. 293-316.

Mandelbrot, B. [1983], *The Fractal Geometry of Nature.* Freeman, New York. French edition first published in 1975.

Morchio, R. [1996], Can Systematics Be Conventional? Or Should It Be Based on Some General Theory of Biology? *Rivista di Biologia/Biology Forum* 89: 279-284.

Semat, H. [1966], *Fundamentals of Physics,* 4th edition. Holt, Rinehart and Winston, New York.

Shevelev, J. [1994], The Golden Numbers and Biosymmetry. *Rivista di Biologia/Biology Forum* 87: 351-370.

Spiradonov, O.P. [1986], *Universal Physical Constants.* Mir Publishers, Moscow.

Thompson, D.W. [1917, republished 1968], *On Growth and Form,* Vol. II, Cambridge University Press, Cambridge.

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LA SPIRALE VIVENTE
Una costante biologica a-dimensionale offre una nuova prospettiva per la Fisica

Riassunto

Nello sviluppo biologico, la spirale è un modello adattativo di rigenerazione. La spirale rigenera se stessa a una velocità costante. Questo rapporto, come una costante a-dimensionale, è una componente delle costanti universali e dimensionali della fisica. Ciò riflette una corrispondenza universale e spiralmente rigenerativa tra i modelli adattativi biologici e quei modelli o fenomeni fisici di ogni scala e ordine in natura, compreso quello dell'atomo e del quantum. Così, il modello biologico di una pigna può permettere di intuire l'atomo o il quantum. La generazione del quantum e diverse forze emergono dalla intersezione di continuità spirali di forza indifferenziata con un plenum, e queste intersezioni possono rappresentare un tipo di fillotassi. La costante biologica a-dimensionale definisce una tale generazione e indica uno stampo universale che si proietta, attraverso un'impronta dinamica, nel plenum, per tutte le scale e gli ordini della natura. Questa proiezione richiede che tutti i modelli naturali siano adattativi attraverso un processo dinamico di complementazione o completamento spirale e suggerirebbe un implicito determinismo a tutte le scale della natura. La generazione adattativa delle intersezioni conformazionali ad elica è governata dal Principio di Massima Uniformità. Questo richiede che, a tutte le scale, la configurazione di forze evolva come integrità di modello, generando, attraverso la non-uniformità della forza, uniformità crescenti o equilibri di forze entro l'uniformità di tali configurazioni, con conseguente aumento adattativo delle integrità. Attraverso tali intersezioni di continuità dinamiche, le varie forze dell'universo possono essere riunite nella loro origine comune e contribuire al quanto d'azione.