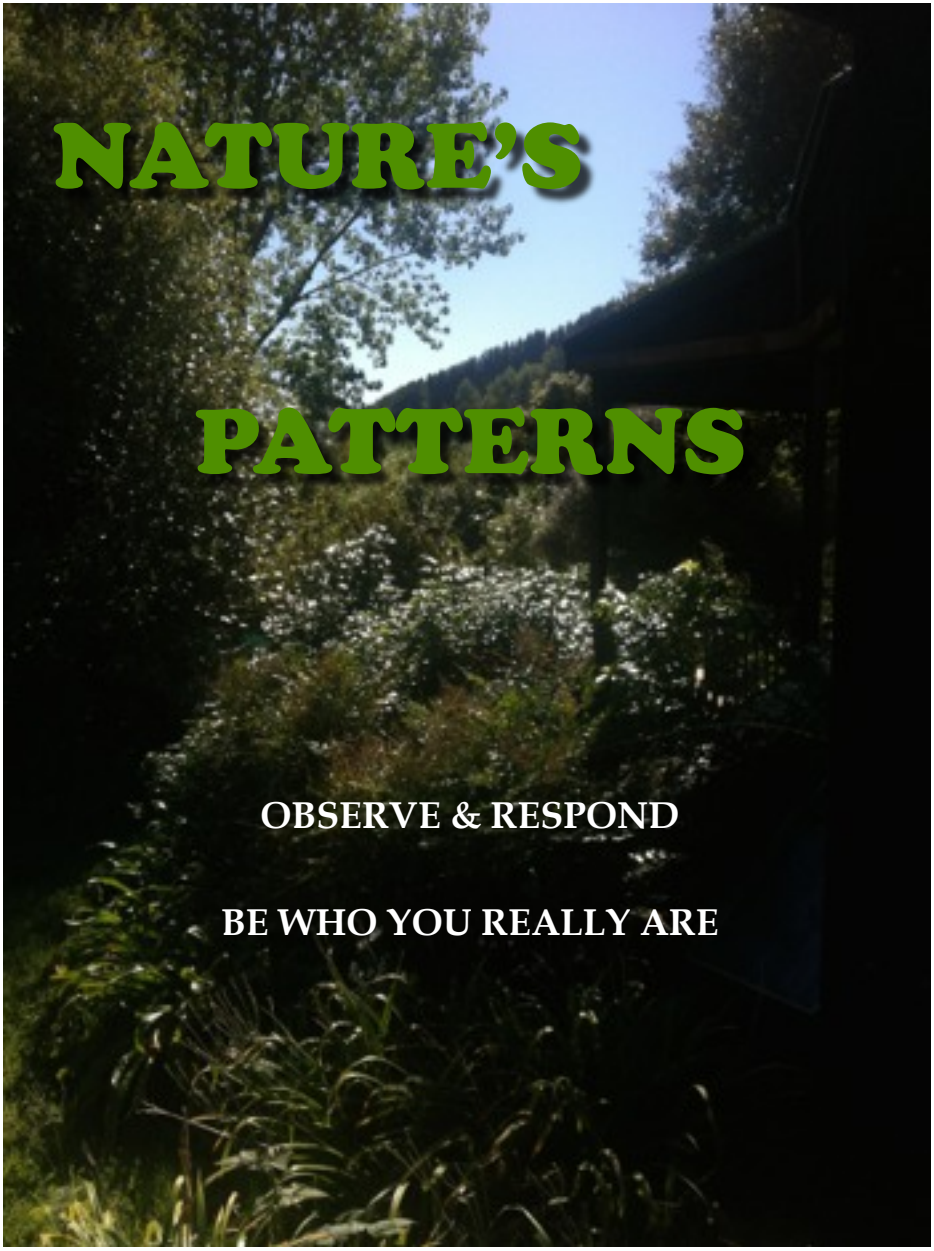

GUIDELINES FOR LIVING – ON EARTH

GARY WILLIAMS

Water & Soil engineer - Biodynamic farmer - Permaculture activist - Natural philosopher

Gary and his partner Emily live on a small farm where there is a wide diversity of farming and forestry activities, from home gardens and orchards to staple crops, animal grazing, firewood and plantation forests, and wilderness. Their stewardship of this land is guided by the principles of permaculture and the practices and methods of organic and biodynamic agriculture. They like to experiment and share their land, and have a bio-filtered swimming pool and an eco-building farm stay for short-term use.

Gary is a teacher of permaculture and provides advise and design assistance to people and communities seeking a more resilient and sustaining way of living, which reflects the nature of their place.

Gary works from home as a professional engineer in the field of water and soil resources. His academic qualifications are: Bachelor of Engineering, Bachelor of Science (Physics) and Master of Commerce.

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> "Community Democracy — A Study in Alternative Economics" 1977, 145 pages.
>
> "Patterns of Exchange — A Study in Human Understanding" 1988, 401 pages.
>
> "Out of the Helix — Essays on Cultural Transformation" 2006, 275 pages.

This pamphlet is about the patterns of nature that guide our perception and our understanding of the world we live in.

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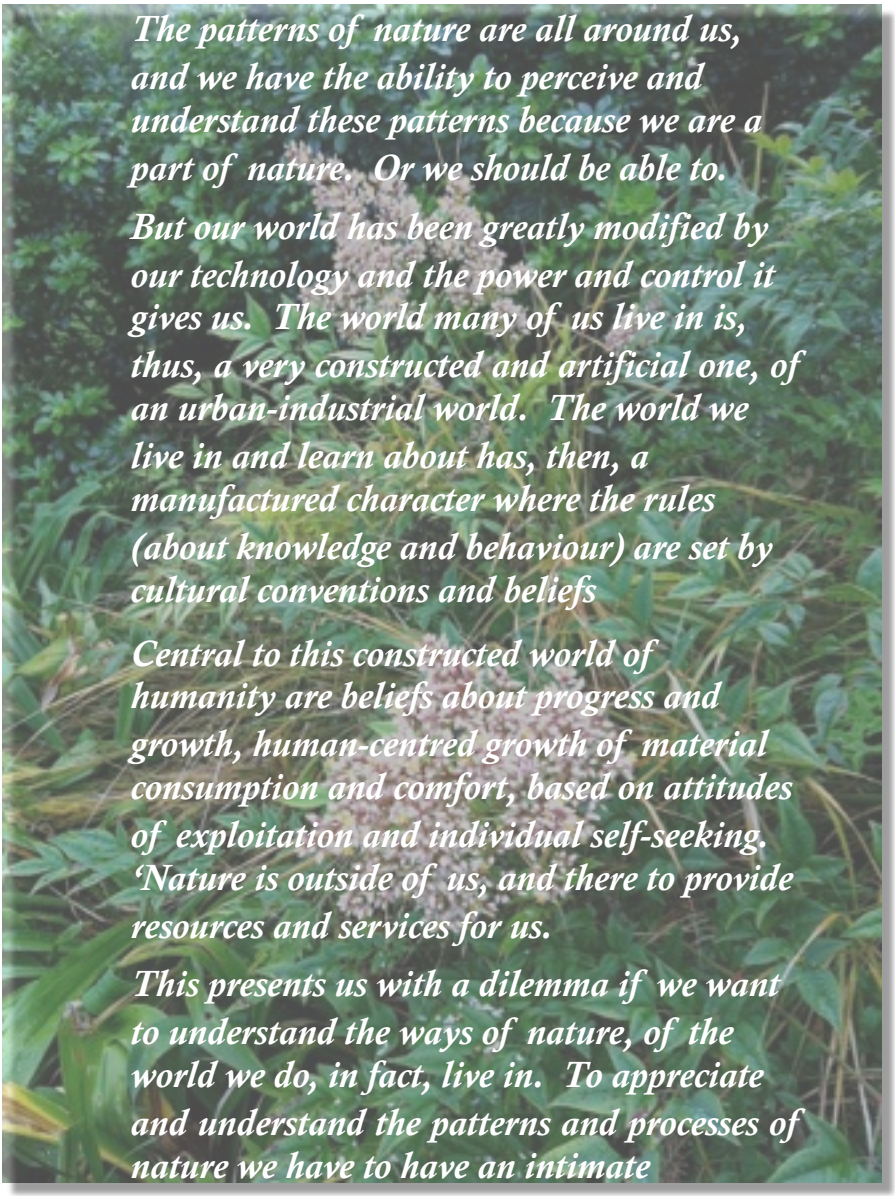


The patterns of nature are all around us, and we have the ability to perceive and understand these patterns because we are a part of nature. Or we should be able to.

But our world has been greatly modified by our technology and the power and control it gives us. The world many of us live in is, thus, a very constructed and artificial one, of an urban-industrial world. The world we live in and learn about has, then, a manufactured character where the rules (about knowledge and behaviour) are set by cultural conventions and beliefs

Central to this constructed world of humanity are beliefs about progress and growth, human-centred growth of material consumption and comfort, based on attitudes of exploitation and individual self-seeking. 'Nature is outside of us, and there to provide resources and services for us.

This presents us with a dilemma if we want to understand the ways of nature, of the world we do, in fact, live in. To appreciate and understand the patterns and processes of nature we have to have an intimate

engagement and awareness of the world around us, as a fully connected being of that world. To be fully connected and intimately engaged, however, we have to appreciate and understand the patterns and processes of life on Earth, the place we inhabit.

Humanity has, though, studied and reflected on its place, for a long time, and there are guides and aids that can assist us in re-connecting and really engaging with the world we share with so many life forms, which are all inter-related in very complex and diversified ways.

Writing about the patterns of nature is an intellectual activity using the formalities of language and cultural conventions. It can only provide some mental aids, but this can be a starting point for a real appreciation of the natural world we are part of.

We do have a natural ability to live in the world we are born into, and we can reclaim our natural heritage, to become a people of the place we live in, understanding and sharing it

in a compassionate and responsible way. Our technology does not have to be alienating and destructive, or our culture one of control and domination.

We can un-learn and re-learn, reclaiming our place in the natural world and our role as a connected and responsive part of the greater scheme of things that is life on this planet.

Reconnecting and experiencing our world in all its wonderful diversity and vitality is not only possible, it is a really practical way of bringing about a transformation in our lives, to a more balanced, healthier and creative way of living. We just need to start doing it.

Then we will change, our worldview will change, and we can be part of the solution instead of the problem.

NATURE'S PATTERNS

PERCEPTION

We are a creature of the world we live in, and thereby can appreciate the ways of this world. We live in it, are a part of it, and perceive the messages that it generates and respond accordingly. Where there is an imitate connectivity there is a direct awareness and responsiveness, and our understanding reflects and is informed by the world around us. As natural beings, made from and for this world, we have an innate ability to recognise relationships and the patterns that form from the interactions of life. Pattern recognition should then come naturally.

We are, though, social creatures with the capacity to remember and respond creatively to circumstances that repeat in a self-similar way. We can recall the past and formulate choices for the future. Memory and the use of memories to direct present behaviour or actions, which is intelligence, gives us an ability to select and hence have a flexibility in our responsiveness. We have a history, as an individual and as a member of a social group, and from this we have a culture — socially agreed conventions about what is accepted (as real) and what is acceptable (behaviour).

We have sensory abilities that are effective in providing us with information about the world around us, presumably from an inbuilt correspondence with that wider world. However, what we perceive as reality depends on what we think we are going to perceive. Our individual learning, and its social context of accumulated and passed on learning, affect the way we see the world and how we understand our place within it. There is an essential interdependence between our perception of reality, the

understanding we have about the world around us, and the way we behave when responding to the information perception provides.

There is no objective reality that is the same for everyone. The world we live in is our world, which has a particular viewpoint, and depends on our history and the influences of cultural beliefs and conventions. As the world of people changes, so do the people. We are creatures of our environment, of the place we live in, whatever the character of that place. Thus the highly modified and technologically manipulated world of urban-industrial living profoundly alters people, and the way they perceive and interact with their world. An artificially built world gives rise to different experiences and conditions our understanding of what is real.

We see the world we believe in, and we will not accept something that does not fit our worldview. It is not a matter of 'evidence', or that an alternative view may be more effective and give better results. If it does not align with our worldview, our understanding of what is real, then it simply has no validity, or even existence. Evidence is what supports our view of the world and what we think should occur, and when 'reality' becomes very manipulated, artificially constructed and continually changed by technological developments, it can become quite fluid.

A lack of an appreciation of a reality that is outside of ourselves, which is larger and more encompassing than ourselves, as individuals, social groups or humanity as a whole, gives rise to a basic disconnection, a loss of a firm foundation and moral compass, and hence a disabling relativity. Reality and values become a matter of taste or even affectation.

Bureaucracies, whether of government or business, become ruled by fashions, with their whimsicality and change for the sake of change. Regulations become self-serving for the regulators instead of being outcome focused, and commerce becomes a self-

serving accumulation for the putative (culturally defined) owners.

A sense of reality, of what is real and what is not, thus requires an acceptance of something outside of ourselves that is determining it, which is beyond our control as humans. There has to be a basic belief that we a part of a much greater whole, beholden to it and completely dependent on its effective functioning and well-being. When we are creatures of nature we can recognise the ways of nature, but for the same reasons, people who are disconnected from that world and live in a closeted and artificially maintained world recognise the manners of its artificiality rather than the ways of the natural world.

PATTERN RECOGNITION

What is the 'natural world' that we are part of and which we can comprehend is not, then, as straightforward as we may think it is, or like it to be. At one level everything is part of the natural world, including ourselves and all the technology we have invented and the alterations to environments we have, as a species, brought about. However, as intelligent social creatures we have constructed remembered histories and cultural conventions, which has, perhaps inevitably, given rise to a separation and a sense of independence from the 'natural world'. Nature is out there, outside of us and our modified environments. Instead of being reality itself, our procreator and supporter of all life, it becomes more a resource to be used, a service provider for our needs and wants.

This separation, and with it a sense of power over nature, becomes more acute as our lives become more artificially enclosed and managed, and our lifestyles technologically manufactured. We become insulated from the pulses and surges of the natural world, and hence from its hazards and dangers. However, this loss of contact comes at a cost, and our

independence from the ways of nature can be replaced by a social dependence and enslavement to artifacts and ideas or conventions about roles and privileges. Instead of arising from our own awareness as a connected and supported creature of this world, our identity becomes tied up with cultural beliefs and conventions imposed and maintained by an elite for their own ends.

Language itself gives rise to a separation, an abstraction from an inherently connected and fluid reality. Words give a fixity to perception and understanding. They split up the complex of sensations into separate objects or processes, which can be labeled as the same. Conceptual thought takes this further, with the development of models of reality, or theoretical constructions about how the world works. These models or theories give us a frame of reference, a consistent measure, to judge our experiences against.

This is very useful in providing guidelines and habits of thought so that we do not have to reconsider all our experiences anew, and can rely on our past experiences as formulated into guiding preconceptions and 'working models of reality'. The more abstract our means of communication, of language and mathematics, becomes, though, the more artificial and disconnected our theories and conceptions can become.

We have a dilemma that has probably exercised the minds of thoughtful people for as long as we have been thoughtful. What is real and what is illusion, what is useful guidance and what is exploiting convention? And how do we know the difference.

The ability to recognise the patterns and relationships of nature comes from an awareness and experience of nature, while this experience comes from an ability to recognise nature's ways. The interdependence of living means there is no outside reference point, or fixed and unchanging foundation, however much we may long for some such reference and absolute assurance. Life is

in the living, in its connective and continuously interwoven dynamic.

There are no certainties or unassailable authorities. There is interaction and exchange, and we can gain understanding through an engaged observation and participating action. An attentive and focused awareness connects us and this in turn provides support and sustenance, of body, mind and spirit. We do have to make judgements and come to conclusions, but they are always incomplete and must be subject to change as our experience increases and we learn more.

A grounded and connected life comes from an full-hearted attentiveness, an open-minded awareness and a spiritual acceptance. Sensitivity gives rise to responsiveness and by responding we take responsibility. Our understanding will always be partial, but it can be sufficient for our purposes as engaged and responsive creatures of this world.

A recognition and understanding of nature's patterns comes from a willingness to be part of nature and guided by the ways of life on this planet Earth.

Given this willingness, how might we perceive and understand these patterns? Accepting the constraints of words and theoretical concepts, what might be a worthwhile and useful description? What follows is one possible description and categorising of the ineffable world we live in.

PATTERNS

The basic pattern of movement and exchange of this world is the **spiral**. It is the pattern of water flows, of inward and outward moving spirals that form interconnected eddies or vortices, scale repeated to fill the whole body of a mass of moving water. Water is the facilitator of exchange. The very simple molecule of H_2O forms very complex relationships through its weak hydrogen bonds between the molecules, and this complex bonding gives

rise to water's unique properties, and to its spiralling movement. This is the blueprint of nature, and all the processes of life, the exchanges of organic chemistry, require the facilitation of water.

There are converging spirals of concentration and maturing, and diverging spirals of expansion and growth, and these counterposing movements are always linked in the dance of life and death. The extended outward spiral tends towards a straight line, and where there is rapid growth we see a more **linear** form. For example, the long leaves of grasses have a very linear form, and there is a linearity to the reaching up of rapidly growing grasses during a spring flush.

This expanding growth spiral is repeated at different scales throughout the plant, as a fractal repetition of self-similar forms. The initial growth pattern is repeated with growth in an outward branching of growing tips, of repeating buds and sprouts. It is this growing tip that is most nutritious and full of vitality. It has the health and vigour of youth. Many of the vegetables we eat are the growing tip, or the mature flower or fruit of the plant. The most nutritious way to eat grains, which also makes it easiest to digest, is to sprout the seeds and eat this initial growing tip. The seeds are chemically quite different and made to last as a concentrated package. Grinding and heating those seeds may making it more digestible, but it does not change this storage-type chemical makeup of the seeds.

The curling inward spiral tends toward a **circle**, of contraction to a maximum packing, for highest density, with the sphere having the greatest volume for its surface area. This circularity is repeated in the lobal form of mineral accretions, and when there is concentrated activity in a relatively small space, we see the repeated infolding of the l**obe** form. Our brains and intestines are very convoluting and infolded, with lobes within lobes. The most intense activities take place in these organs, with the brain's processing of information and management of the nervous system exchanges, and the microbes in our intestines processing

our food for nutrition and the management of our immune systems.

Between these polar opposites of linearity and circularity (and their self-repeating forms), there are various arrangements of connectivity, which we can categorise into a set of patterns. There are various networks of connection, which may be very distributed nets, of evenly weighted connectivity (equal number of links per node), have local nodes of multiple connections or circular connectivity, or have a centralised arrangement of centre and peripheries. All these **net** patterns, while being of various types, relate to connections that allow exchanges between the parts, or flows of energy/information between the parts of a system or entity.

When the net exchanges have a definite directionality to them, then they have a **branching** pattern. There is a repeating division or splitting off into sub-branches that split into further sub-branches to a periphery. This branching pattern has a distributory function, of distributing out and collecting in, to allow exchanges between different parts or organs of a plant or animal. An obvious example is the branching of trees from a central trunk, through branches to the leaves, and the counterpart branching of the root system into the soil. There is an exchange between the leaves in the atmosphere and the fine feeder roots in the soil. The leaves using sunlight, through photosynthesis, form carbohydrates from water and carbon dioxide in the air, for the plant's growth and energy, and to feed the soil life through root exudates or liquid carbon to the soil. The roots, through interactions with soil microbes, absorb nitrogen and mineral nutrients from the soil, and provide these nutrients to the plant, with the sap flows allowing the necessary exchanges throughout the plant.

The fluid flows that are contained within a system (of whatever kind) have characteristic **streamline** patterns. These patterns mimic, and are derived from, the streamlines of water flowing

within a containment, such as a river channel, and occur in plant sap or animal blood vessels. There is an internal directional movement, and the type of streamline pattern depends on the fluid density and its rate of movement or velocity.

Where there are boundaries between fluids or mobile materials and differences in density and mobility have to be accommodated, then **wave** patterns arise at these boundaries. There are, similarly, different types of wave patterns that are characteristic of different boundary interactions. Wave patterns in clouds are indications of the air conditions of weather systems, and the movement and interactions of the cold and warm air of weather depressions and anticyclones.

The **star** formation is an indication of an intense energy/ information exchange or messaging. The radiance of celestial stars suggests an intense messaging that can trigger a psychological response in us, which may then give rise to various uses of stars to guide us, such as for navigation - or for more esoteric guidance. Flowers have a star form when looked down on, and they are radiating a message to insects or birds: 'I am here, come to me'.

Some formations are less formal but still have a characteristic pattern. The clustering of organisms, such as fungal mushrooms on a dead tree trunk, or the gatherings of animals in colonies, have similar and repeating patterns of arrangement. The **clusters** can be more or less dense, but the sub-grouping and arrangement layout between sub-groups will still follow a specific, if diffuse, and repeating pattern. The more complex the arrangements, in space or over time, the harder it is for us to see or appreciate the nature of the pattern or the underlying ordering principles. That does not mean there are no patterns, rather that they are too complex for us to perceive or understand.

The highly variegated but self-similar patterns obtained from **fractal** repetition suggest an underlying or implicated order in

what seems chaotic to us with our limited understanding and perceptional abilities.

The nature of the pattern suggests its ecological or systemic purpose and, for us, its appropriate use and amount of use, and hence overall usefulness as we carry out our part in the scheme of life. Observe the pattern, understand its purpose or ecological principle, and take action or behave in accord with this understanding.

FORM & FUNCTION

Form and function follow from each other. They define each other. Form is the more spatial expression, of the pattern in space, of material layout. Function is the more temporal expression, of process over time, of the dynamics of exchange. As space and time define each other, so do form and function; and matter and energy, particles as objects and waves as events.

A spatial dimension or length is defined by a measurement over time, a distance travelled. A time dimension or interval is defined by a movement or change in space, an oscillation period over a given distance. Time defines space through measurement, and space defines time through movement. Similarly, an object emphasises space, it has shape in space, while an event emphasises time, there being change over time. But an object is really a slow moving event, and an event is a fast changing object.

Form is a shape or pattern that arises from the arrangement of movements, from the functional connections. The type of functions or characteristics of the processes give rise to the spatial layout of the exchanging parts. Function is a dynamic that arises from the relationships of entities that have a specific layout, and the nature of the connectivity defines the functionality of the system.

The patterns of nature, which are inherently spatio-temporal, can be understood or thought about in a spatial sense in terms of forms or a temporal sense in terms of functions. This distinction, and the associated categorising of patterns, is a matter of perspective or focus. All the patterns are present together in everything, as the world we live in is one integral whole, of continual self-similar and repeating exchanges. However, it does help to focus on a particular pattern for a specific purpose, and observe forms in spatial arrangements or the temporal dynamics of functional relationships. It depends on purpose and what we are trying to achieve — through our observation, interpretation and implementation.

We can see the world in terms of material objects laid out according to some sort of spatial pattern, or in terms of energetic flows that interact in accord with some sort of temporal dynamic or time pattern. Is it a wave or a particle, an energetic interaction or a material object? Our universe is made up of energised matter, where movement or exchange takes place through the interactions of matter and energy or the conversion from one form or type to another.

We can use what view is most helpful for the issue at hand. In quantum physics, of exchanges at the very small scale, a wave formulation may work better in some instances and a particle description in other areas of interest. One way of understanding atomic level interactions is not better than the other, it depends on the circumstances, and the question. For similar reasons, at the very large scale of cosmology, the shape and dynamic of the universe can be understood in terms of matter-energy interactions and conversions, as the stuff of the universe undergoes its exchanges and transformations.

We can construct an understanding of our own human behaviour in terms of individual identity and psychology or group dynamics and sociology. One view or conceptual framework is not better than the other, rather they are complementary

descriptions of the complexity that is human behaviour in the world we live in. They serve different purposes. The key is to recognise, and always keep in mind, that any view and its associated framework for understanding reality is inevitably partial and hence incomplete. Different viewpoints improve our understanding, and give a more complete picture about our lives, but they are necessarily inconsistent with each other.

There is not even a pure mathematical system of numbers that is both complete and internally consistent. Our world is by its nature irrational, it is never complete or fully balanced, but always on the move and searching. The spiral, unlike the rationality of a pure circle, never returns to the same point as it rotates, every repeat is always different to some extent. Numbers, with their exact definition and rational manipulation, can not fully represent reality, even with the introduction of 'irrational', 'imaginary' and 'transcendental' numbers.

Unlike numbers, patterns are a composite and inherently about relationships or connections, but they also involve a particular perspective or view of reality. Any categorising of patterns requires a slicing up of the holistic reality, or a selective focusing for particular reasons. The patterns are derived from uses or aims, and keeping this clearly in mind the patterning of nature can be divided as follows, with both a form and function aspect.

TYPES OF PATTERNS

FORM	FUNCTION
SPIRAL	DYNAMIC BALANCE (creativity)
LINE	GROWTH (expansion)
CIRCLE	PACKING (contraction)

LOBE	CONCENTRATION (maturing)
NET	CONNECTION (exchange)
BRANCHING	DISTRIBUTION (directional exchange)
STREAMLINE	FLOW (internal movement)
WAVE	BOUNDARY (adjustment)
STAR	RADIANCE (messaging)
CLUSTER	INFORMALITY (grouping)
FRACTAL	SCALE REPETITION (feedback)

GEOMETRY & ARITHMETIC

We can present these patterns in different ways, to assist our understanding or our actions. Spatial patterns can be represented by geometric shapes, and these shapes can be generated by different types of geometries.

A most basic geometry is one based on straight lines and circular curves, where the shapes or geometric forms can be generated by a straight ruler and compass. These forms are then understood to be idealised or perfect forms, such as squares, rectangles, triangles and circles, with lines of no width and angles that are exactly the same. There are only three regular (2-dimensional) polygons (with identical lengths and angles) that can completely and continuously fill a plane, being a triangle, square and hexagon, and these three shapes are related to each other. There are only five regular (3-dimensional) polyhedra made up of a regular polygon, the platonic solids of: tetrahedron (4 sides), hexahedron or cube (6 sides), octahedron (8 sides) dodecahedron (12 sides) and icosahedron (20 sides). These regular solids are also related to each other. The tetrahedron is a dual of itself in

that a point-to-plane transformation, of apex to face midpoint, gives rise to another tetrahedron, with the cube and octahedron being such duals of each other, as are the dodecahedron and icosahedron.

These regular shapes or solids occur repeatedly in crystals. Physical mineralisation has a well-ordered repetition, where the same shape is exactly repeated at the same scale, as a simple arithmetic progression. There is not the geometric or expanding growth that is characteristic of living processes. Mineral processes can be represented by fixed shapes and number counting using integer or rational numbers, and they can be fully predicted as deterministic systems.

There are other geometries, depending on the defining assumptions, in particular about parallel lines and measurement. If parallel lines are assumed to go on forever and never meet then we have the planar euclidean geometry of continuous flat surfaces. However, if it is assumed that there are no parallels then we have an elliptic non-euclidean geometry of spherically bounded surfaces. If it is assumed that there are a number of parallels to a line then we have a hyperbolic non-euclidean geometry of surfaces that are also unbounded but curved. The theorems of geometry can be transformed between these different geometries, so that what follows in one geometry also follows in the others, but the implications will be different. Geometries thus have a viewpoint, and hence different applications. What geometry one uses depends on the circumstances and aims.

There is also projective geometry, which is based on relationships, between points, lines and planes, and does not depend on or require measurements. It is derived from perspectives, which are how we actually see shapes and forms in space. It treats parallel lines like any other lines, and points at infinite like any other points. Parallel lines then do come to a point at an infinite horizon, as in a perspective view, and this horizon is treated as a

line like any other line. It is thus like elliptic geometry in its treatment of parallels.

Projective geometry allows perspectives to be shifted or transformed, and in this way represent movement, or changing perspectives over time. It works with the whole, and changes in the generic properties of a geometric object, as with a sequence of perspectives, or related views, not with separately measured and defined parts. These shifts can be progressive as arithmetic intervals, or to a geometric or growth measure, which allows living processes to be represented.

In projective geometry there is a polarity or duality of expression, with theorems about points, lines and planes having an interchangeability. Statements about points and lines in a plane can be re-stated as a dual about lines and points in a plane. Similarly statements about planes and points in a line can be re-stated about points and planes in a line. The geometry can be point-wise, one plane of many points, or plane-wise, one point of many planes.

There are different ways of drawing reality, different views and varying perspectives, and understanding this gives rise to an important mental flexibility and open-mindedness. Reality is relational, without any absolute reference points.

Geometric shapes can be represented more abstractly through conceptual relationships as in the equations of algebra, and this allows reformulations or transformations through mathematical manipulations and calculations. Transform calculations can then be undertaken between the different dimensions or power orders of line, area and volume. Calculus integration gives the area under a curve or an amount over time, and differentiation converts distances travelled to speed and then to rates of change of speed, of acceleration or deceleration.

This mathematics is based on fully defined entities and fully determined processes, which can be represented by equations,

that is, statements of exact equality. However, the real world is not so simply defined and ordered, and to better represent some of the complexities of the real world mathematics has to use non-rational, or non-countable, numbers. Rational numbers are integers or fractions of integers, but even the simplest of mathematical representations of geometric shapes require 'irrational' or without ratio numbers.

The relationship between the side and diagonal of a square requires an irrational number, $\sqrt{\mathbf{2}}$, as does that between the diameter and circumference of a circle, notated as $\boldsymbol{\pi}$. These 'numbers' can not be exactly written out using real numbers, and as a decimal number, the number sequence goes on for ever without any repetition. To represent more complex relationships, such as that of electricity and magnetism in electromagnetic wave propagation, 'complex numbers' are used, made up of a real and imaginary part, with the imaginary part defined by the $\sqrt{1}$. Then there are 'transcendental numbers'. An infinite series of numbers can be summed to a finite figure, while different levels of infinity have been defined for mathematical purposes.

Fractal geometry is a geometry of variable dimension, of dimensions between 1 and 2, or 2 and 3, which is formed through a feedback loop, where the output of a mathematical equation becomes the input for the next iteration, and this looping can go on forever, developing more and more complexity, but with a self-similarity throughout because of the form of the generating equation. These fractals are as similarly problematic as irrational numbers and other number artifacts, in terms of the relationships between mathematical expressions and the objects and processes of the real world. Are fractals, then, just endless geometrical processes, as irrationals are endless number sequences, or do they serve useful purposes in our representations of the real world?

It is the self-similar scaling that is fundamental to fractals, and why they provide realistic representations of landscapes and living processes. There is a similar look to coastlines when they

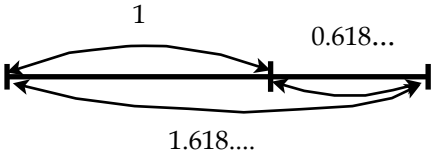
are mapped at different scales, with repeating forms or characteristic shapes. The branching networks of blood vessels, nerves and other connecting systems that scale down to the individual cells of an organism, have a self-similar type of repetition. Where there is a systematic irregularity, with repetitive similarity under changes of scale, fractal geometry provides a useful representation and aid to understanding. And nature is full of systematic irregularity, where what appears to be random chaos really has a complex ordering. From the turbulent flows of fluids to the form of waterway systems, from the bark of trees to rugged mountain ranges, there is a fractal irregularity of scale repeating self-similarity.

Number counting, of 1, 2, 3 etc, requires objects that are the same, and a mathematics of rational numbers assumes the world can be split up into distinct objects or entities, and that they can be grouped into identical sets. This, though, is a very primitive view, and reducing natural systems into separate parts undermines their very integrity, as essentially inter-dependent and connected systems. To be realistic, mathematics has to incorporate, by some means, the irrational connectivity and scale repetition of the real world.

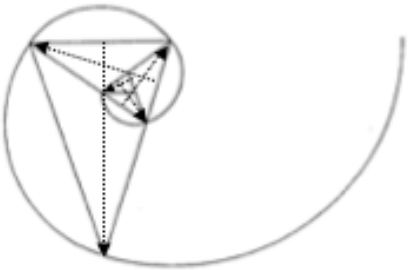
LIFE'S PROPORTION

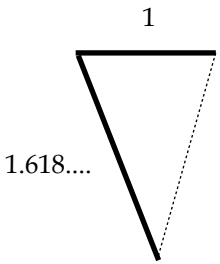
What are the basic workings of living systems, and how can we appreciate and understand the processes and behaviour of living creatures? Nature loves simplicity, and builds a vast array of diversity from the simplest of relationships. The growth measure of life is another irrational proportion, called the 'Golden Ratio', and it is denoted by $\boldsymbol{\phi}$. Through a repeated application of this proportion, in different arrangements, life grows and diversifies into extraordinarily extensive and complex but always interconnected systems within systems.

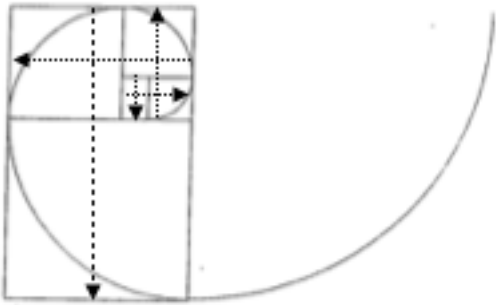
The ratio ϕ is the most basic of proportions, about the division of a line into two parts. It is the only division where the larger and the smaller parts are in the same ratio as the larger part to the whole. If the larger part has a unit length of 1, then the small part is an indefinable irrational number, which in decimal form starts as 1.618…. In number terms this ratio is expressed as ϕ = 1/0.618… = 1.618…/1.

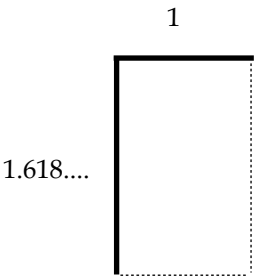


This ratio allows a direct repetition, from one step to the next, as the longer side becomes the shorter side for the next step. The proportions remain the same with each increment, as a simple repeatable shape or movement, always the same ratio but enlarging or diminishing, expanding or contracting, with the output at one level being the input for the next. The ratio can be of different shapes or with different generating angles, as a triangle or rectangle that contracts within itself by a repeated application of the golden ratio, or expands outward. This repetition gives rise to spirals, which diverge or converge, and living processes consist of interwoven diverging and converging spirals, as the movement of water in eddies or vortices is made up of interconnected diverging and converging spirals.









The spiral arises from the golden ratio, and its inherent repeatability, and it is the basic pattern of water and of life. The spiral, though, never completely encloses or fully dissipates, and the interrelatedness of spirals provides both some identity of distinguishable entities and the exchange and support of system connections. Spirals lie between the central point or circle of unity and the straight line of infinite extension. They are the exchanging reality, between the polar extremes of ideal conceptions, the movement of a fluid and changing universe. Spirally flows are, then, in all their complexity, fully encompassing (of space/time). There are no sudden voids or explosive impacts in a body of water flowing down a stream channel. At ever diminishing scales of minutest detail, and ever expanding scales of the cosmos, everything is repeated again and again — until there is nothing at all.

It is the irrationality of the proportion, that ϕ does not have a well-defined ratio, that allows all the space to be filled. Movement by rational proportions keeps coming back to the same places, as exactly repeated steps, for example in a quarter stepping around a circle, whereas an irrational ϕ stepping around a circle always lands on a different point, and in the end can fill the whole circumference of the circle.

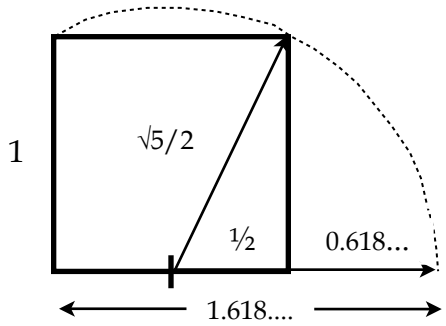
There is an inherent unpredictability in the 'irrational movement' of spirals, an indeterminism despite the basis of the movement being a deterministic process. In the repetition of mathematical fractals, the generating equation is determined, but the outcome of the continuous repetition is open-ended and indeterminate. Living systems are, similarly, open-ended and creative because of their multiple connections and feedback relationships.

It is this complexity and creativity that makes pattern recognition important, and in particular spiral patterns with their ϕ proportionality.

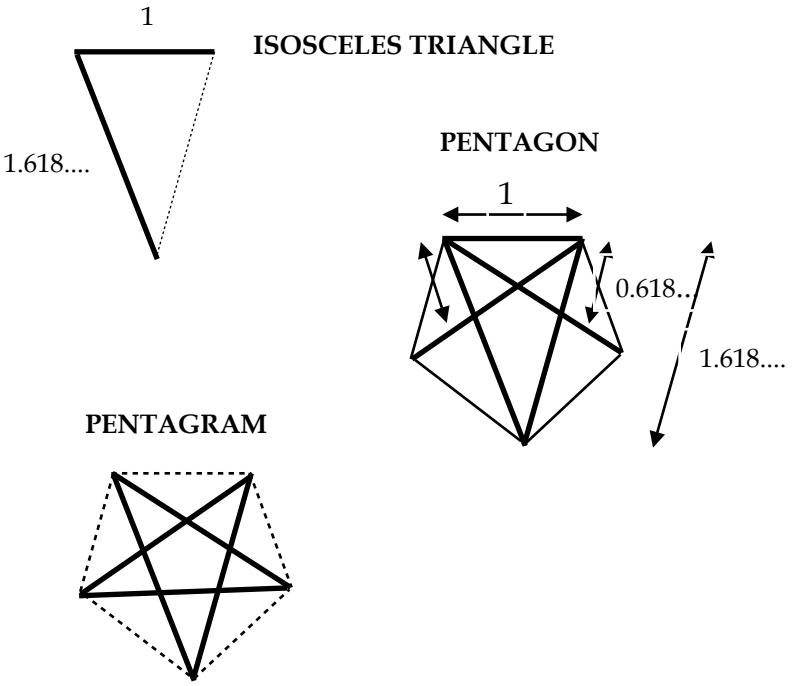
Generated by the repeated application of the golden proportion, expanding and contracting hyperbolic spirals appear everywhere in nature, from galaxies to whirlpools to election energy fields, from the arrangement of our muscles and the shape of our bones, to the horns of animals and the shells of sea creatures. It is the basic growth ratio of nature, and hence the 'ideal proportion' of aesthetics.

SHAPES & NUMBERS OF LIFE

The ratio of ϕ can be represented by numbers and drawn geometrically, and the shapes that have ϕ ratios have a special significance in the patterns and relationships of nature. The number that relates to ϕ is 5, the mid number of our base 10 number system, and the number of fingers and toes we have — neither of which are random outcomes. The golden proportion can be very easily drawn from a square (given a unit length of 1), by joining a side midpoint to a corner, and then using this length as a radius drawing an arc down onto the side (of the midpoint). By the Pythagoras theorem for right-angled triangles, $\phi = (1+\sqrt{5})/2 = 1.618\ldots$ or $1/\phi = (1 - \sqrt{5})/2 = 0.618\ldots$



The 5-sided regular polygon, or pentagon, is full of ϕ relationships, and made up of isosceles triangles of ϕ proportion. These triangles give rise to the 5-stared pentagram, which fits inside a pentagon, which fits inside a pentagram.



The ratio ϕ can also be generated from a specific number series, which starts with 1, 1, and then each successive number is the sum of the two preceding numbers. This is the Fibonacci series of: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 etc. The ratio of two adjacent numbers becomes closer and closer to ϕ or $1/\phi$.

1	1	2	3	5	8	13	21	34	55	89	144	etc
1	1/2	2/3	3/5	5/8	8/13	13/21	21/34	34/55	55/89	89/144		
	0.5	0.66	0.6	0.625	0.6154.	0.6190.	0.6176.	0.6182.	0.6180.	0.6181.		

$\Rightarrow$ 0.61803…..

These fractions or ratios of the two numbers oscillate above and below the value of $1/\phi$, coming closer and closer to the (irrational) value.

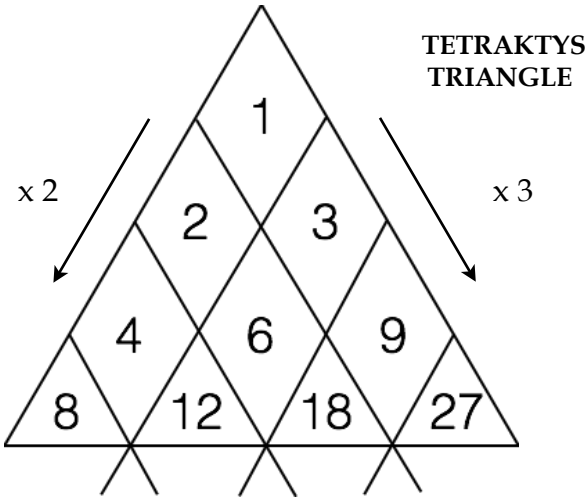
The numbers of the series show up in the arrangement of natural elements or units of a whole. The small number proportions in particular (of 3/5, 5/8, 8/13), which approximate the golden ratio, and seen in many different sets in nature, such as in the packing of seeds in a pine cone or the arrangement of petals on a flower head and leaves around a stem etc. The elements are arranged or packed in interwoven spirals of these number ratios. For instance, in a pine cone the seeds are packed together in a way that forms spirals that cross over each other, one way (steeper) and the other way (flatter) with the number of spirals being adjacent numbers of the Fibonacci series, of 5 one way and 8 the other, or 8 one way and 13 the other, etc.

There are relationships between numbers, shapes and the processes of life that can be useful in aiding our observations and understanding of the world we live in. They can represent real relationships or be mnemonics about relationships that can guide and improve our appreciation of reality. When dividing up or categorising our experiences or our understanding of the world,

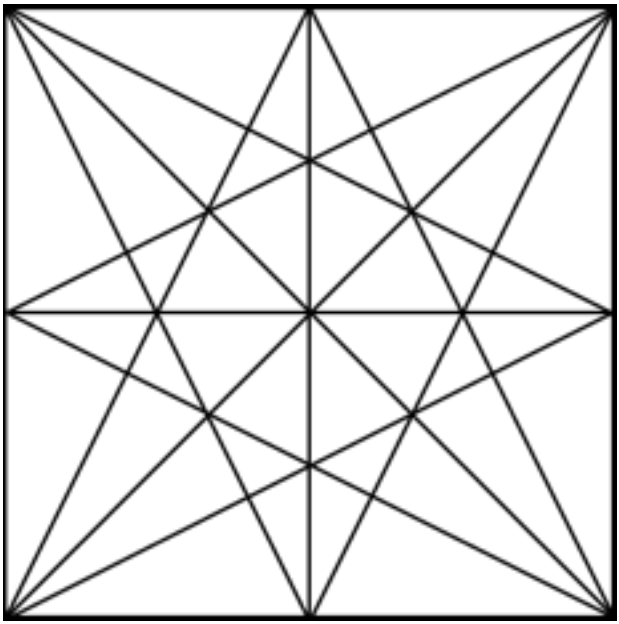
the most basic categories tend to be 5-way, and then associated with the points of a pentagon or pentagram. The ancient Greeks had 5 fundamental elements, of fire, earth, air, spirit and water, and associated them with the 5 regular polyhedra of the platonic solids. The 5 elements of the Chinese, that are associated with numbers (from 1 to 10), are fire, earth, metal, water and wood.

The most basic and intuitive ranking is either 3-way (low/ medium/high), or 5-way (very poor/poor/average/good/very good). We have difficulty remembering number sequences greater than 7, and many lists are made up of 7 items or names, from the 7 days of the week to the 7 'wonders of the ancient world'. A regular 7-sided polygon or 7-pointed star is hard to draw as it does not have an inherent symmetry that can guide a rigorous geometric construction. Similarly, there is no straightforward and rigorous way of constructing a 9-sided polygon.

Numbers can be formed into sequences that represent energy frequencies or musical tones and harmonics, such as in the Tetraktys triangle of multiplication, where the numbers aligned down one side of the triangle are 2 times multiples, and 3 times down the other side.



A square divided by its diagonals and mid-point axes, and then inscribed with triangles between the midpoints and the opposite corners, generates a geometric figure that gives rise to many proportions and length or area ratios, including ϕ proportions. It is a pattern of proportions, that has had many historical uses.



Numbers and shapes can then be symbolic and seen as representing aspects of life or living processes. The following table gives one such set of symbolic associations, for the base ten numbers 1 to 9, and the scale repetition 10, plus 12.

NUMBER SYMBOLS

NUMBER	SHAPE	SYMBOLISM
1	Point Circle	Oneness Unity
2	Line Vesica	Movement Polarity
3	Triangle (up or down)	Resolution Stability
4	Square Tetrahedron	Vibration Dual-Polarity
5	Pentagon Pyramid	Repetition Proportionality
6	Hexagon Cube	Purity Balance
7		Creativity Marginality
8	Octagon Octahedron	Harmony Fluidity
9		Completion Fixity
10	Decagon Icosahedron	Renewal Scalability
12	Dodecahedron	Imagination Divisibility

Number sequences have patterns and geometric shape have patterns, and these formalised aids, or constructs, can assist our understanding of the patterns of nature, and the functions or purposes they embody.

PATTERN UNDERSTANDING

We can recognise the patterns of nature when we are immersed in the nature world with a sense of connection or relationship, and

we are connected to our place in the world when we can see and understand its patterns. It is a matter of visceral experience. An intellectual knowledge, and even a heart-felt desire, is only some starting guidance or motivating starter. Life is, though, a pulsing dynamic, and there is a iterative relationship between conceptual models and the realities of experience, between theory and practice. If we treat ourselves, others and the world at large with compassion, then we can learn and un-learn, see and feel anew, undergo transitions and at times transformations.

Engaging or re-engaging in a really meaningful way shifts our perspective, whatever the engagement, and it necessarily changes our view of ourselves and the world we live in. Every journey starts with the first impression, and the way to proceed is to take small steps initially, checking, accepting feedback and modifying until one has gained a yield, which can in turn lever the next step.

Humans have developed incredibly complex and powerful technologies that provide people with the tools to greatly modify their living environments. There is then a feedback loop between the knowledge and understanding to design and construct this technology and the modified and artificially protective environments that results from it. We are becoming creatures of technology, of a metal and silicon world rather than an organic carbon world. We do become what we believe in, and live in the world those beliefs give rise to. There is an existential trap, and it takes a leap of faith to jump out of this comprehensively managed and finely constructed world, and understand reality differently, or a different reality.

For all our power and control, however, we remain dependent beings. We are not separate and independent beings, however we may view ourselves, and we do require the support and sustenance of the natural world, which is not outside us, but within and through as well as around us.

Our technology does not have to be exploitive and destructive of the world, or its aids and artifacts so isolating and constraining.

We can have a different technology and a different way of life that is constructive and nourishing. We can un-learn, become more empathetic and be an intelligent and compassionate part of the web of life on this planet.

The repeating patterns of life can guide us in our searches for appropriate responses in an interconnected world. The interwoven patterns of spiraling flows, and their various expressions for different purposes or functions, provides a guiding template for living in this world. Instead of the rigid rectangular patterns of the urban-industrial world we can accept the uncertainty and dynamic tensions of the spiral. We can live within the meta-balance of spirals, between the explosive (excessively dynamic) extreme of the straight line or the implosive (excessively rigid) extreme of the point or circle.

The flow patterns of fluids clearly demonstrate these patterns of exchange, of responsive connection and pulse dynamics. The faster the flow the more complex the pattern, with step transitions from smooth and uniform (laminar) flow to shedding eddies and then more complex patterns of vortices and eddies within eddies, as the flow becomes increasingly turbulent. As living processes or organisms become more complex the pattern of interaction becomes denser, more finely structured and more differentiated while being more inter-related. As we interact in more complex and inter-dependent ways, our cultural values, norms and organisational structures must become more complex, and we can do this by mimicking the approach, processes and patterns of nature.

To obtain a more resilient and healthier future, based on a sharing of nature's abundance, we need to re-gain our understanding of nature and natural processes, but without losing the insights gained from a clear-sighted intelligence and dispassionate observation. While retaining a sophisticated technology, we need one that builds on nature, through the mimicking of natural processes and not by suppressing or destroying nature. We need

to re-connect and re-build diverse community relationships, without losing our individuality and the self-respect and valuing of human life that comes from it.

An understanding of the patterns of nature and the guidance these patterns give for healthy and creative living is essential to shift us from the present culture of power, privilege and exploitation. Then there can be a paradigm shift away from the fragmentation and reductionism of our culture and its control mechanisms of power and fear. To a culture based on the responsive fluidity of an interdependent world, where there is always the living tension of incompleteness, a pulse dynamic of alternating flows and shifting alliances, step transitions, identity as well as community with diffuse boundaries and a fuzzy logic. A connected spiral view of the world.

Gary Williams Summer 2016

Otaki, Aotearoa/New Zealand

www.waterscape.co.nz

Be responsive and act responsibly.

Observe, understand, act & feedback.

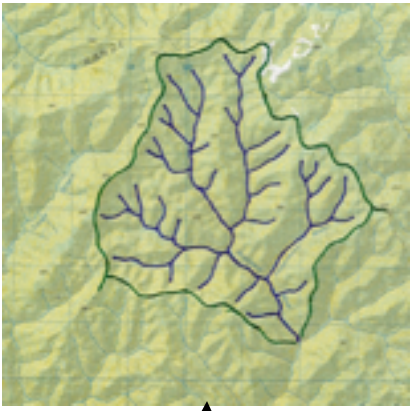
With thanks to clear-sighted, open-minded, full-hearted activists.

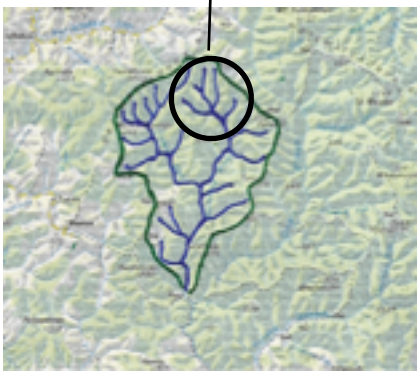
First Responses:

- Be present,
- Observe with care,
- Stop and accept feedback,
- Give yourself time and space
- Become more engaged and aware,
- Question the obvious and doubt certainties,
- Reflect, be responsive, and take responsibility,
- Appreciate the patterns and look for scale repetition,
- Immerse yourself in the details, the eddy, the flower, the sunset,
- Go with the flow, and enjoy the journey,
- Be accepting of life and what it brings,
- Look for the messages and meanings,
- Change what you can with compassion,
- Be honest with yourself and others,
- Have faith, and take the leap,
- Reclaim your heritage,
- Think spirals,
- Take heart,
- Be active,
- Do it.

FRACTAL REPETITION — Of branching waterways in a catchment. Pattern repeats at different scales, as shown by maps at different scales.

An idealised representation of the repeating shape — of branching. The actual waterway pattern depends on the landscape and its variability. The more uniform the geology, the more self-similar the distribution pattern.



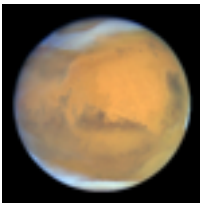


SPIRAL

FRACTAL

LINE

CIRCLE

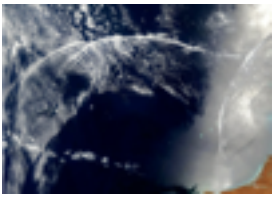


NET

BRANCHING

STREAMLINE

WAVE



LOBE

STAR

SPIRALS
OF
CONNECTION

A WORLD OF

IDENTITY - EXCHANGE - CONNECTION
MEMORY, INTELLIGENCE & HISTORY
INTEGRATED DIVERSITY

LIVING AS NATURE INTENDED