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INCLUSIONALITY AND THE ROLE OF PLACE, SPACE AND DYNAMIC BOUNDARIES IN EVOLUTIONARY PROCESSES

Alan D. M. Rayner

ABSTRACT

Inclusionality expresses the idea that *space*, far from passively surrounding and isolating discrete, massy objects, is a vital, dynamic inclusion within, around and permeating natural form across all scales of organization, allowing diverse possibilities for movement and communication. This way of understanding natural form radically affects the way we interpret all kinds of irreversible dynamic processes. Boundaries that from a conventionally rationalistic perspective are regarded as discrete, fixed limits - smooth, space-excluding, Euclidean lines or surfaces - are seen inclusionally as pivotal places. Here, complex, dynamic arrays of voids and relief both emerge from and pattern the co-creative togetherness of inner and outer domains, as in the banks of a river that simultaneously express and mould both flowing stream (and what this stream contains) and receptive landscape (and what this landscape is contained in).

At the heart of inclusionality, then, is a radical shift in the way we frame reality, from fixed to dynamic. We thereby move from a conventionally rationalistic, *impositional logic* of *discrete*, assertive (independent) *objects* (simple *entities*) transacting in Cartesian space, to a relational, *inclusional logic* of *distinct*, inductive *places* (interdependent, complex *identities*) communicating between reciprocally coupled *insides* and *outsides* through *intermediary* spatial domains. This inclusional logic removes the paradoxes of completeness characteristic of atomistic thought and enables evolution to be understood primarily as a process of *contextual transformation* rather than the operation of external selective force on discrete informational units lacking internal agency.

1. Perceptions of Space and Boundaries, Logical Premises and the Framing of Reality

In this article, I will suggest that the logical premises upon which we human beings consciously and unconsciously base our interpretations of the world and universe about us depend most fundamentally on our

perceptions of space and boundaries. Moreover, I will try to show how these logical premises, in their turn, powerfully influence our understanding of evolutionary processes of irreversible change and the way we consequently relate to one another, other life forms and our environmental living space.

Early in our cultural history and individual ontogeny there is a tendency for us to form highly subjective impressions in which our 'individual self' is not clearly differentiated from our surroundings. The world about us, perceived in this way, is filled with magical and, for all we may know, boundless possibilities. The 'World is our Oyster', a 'Whole', a complete 'Oneness', a 'Totality' within itself, the source of a Holistic 'Perennial Philosophy' (Huxley, 1946; Spowers, 2002).

Later, there is a tendency to replace this subjective view with its antithesis - the rationalistic 'objectivity' that culminated in the Enlightenment and Scientific Revolution and lies at the heart of philosophical 'modernism' (e.g. Tarnas, 1991; Spretnak, 1999). This objectivity can be understood readily as the outcome of a change in our perception of space and boundaries that is related to our biological needs, as land-inhabiting creatures unable to digest herbage, to find and catch or grasp local sources of food and to avoid or overcome danger. To make distinctions between ourselves and amongst others, aided by our physical senses - especially our primates' binocular vision, is essential to our survival. But, by so doing, we become focused on the explicit substance that appears to constitute our bodies and the ground beneath our feet. We may then come to regard whatever is insubstantial, invisible and intangible to our physical senses, as 'nothing' - a non-interactive, 'absence of presence' or 'void' that puts distance between one 'thing' and another.

The perception of a 'something or nothing' world composed primarily of solid, particulate objects separated and surrounded by void space has dominated our philosophical and governmental concepts and methodologies at least since the time of Aristotle. This perception, however, actually conflicts with our modern scientific findings, which show that space cannot be totally excluded from matter at any scale. There is no evidence, despite exhaustive investigations, for the indivisible, atomic 'point masses' envisaged by Newton and Democritus. But there is much evidence for an uncertain quantum realm where the observer cannot be isolated from the observed, and the position and

momentum of 'fundamental particles' cannot be known at the same time (e.g. Coveney & Highfield, 1992). Moreover, the development of relativity theory dispensed with what Einstein & Infeld (1938) called the 'two frightening ghosts' of an inertial reference frame and absolute time, and the advent of non-linear theory has shown that simple, linear, cause-effect relationships are the exception rather than the rule in Nature (e.g. Gleick, 1988).

Although 'solidity' is an illusion, the premise of discreteness and independence that it gives rise to continues to be cherished as the epitome of 'evidence-based' 'rationalism' and 'realism' and to underlie the various logical systems, from Aristotelian to Boolean, that I describe here as *'impositional logic'*, or, more familiarly, *'box logic'*. This form of logic *imposes* absolute boundary limits around and within reality, notwithstanding that these limits cannot exist in a dynamic system open to energy transfer and growth. It breaks reality up into definitive 'building block' components and reassembles these into superficially manageable *constructs* that can at best only *usefully simulate* the most circumscribed aspects of reality, and at worst may profoundly misrepresent its more evolutionary forms.

The incongruence between impositional logic and the dynamic reality it seeks to contain and predict is evident both in the inconsistencies and 'paradoxes of completeness' that it produces, some of which will be discussed below. This incongruence is due fundamentally to the abstraction of space from matter and the resultant *dislocation* of *informational content* from *spatial context*. The latter are thereby placed in a disempowering *adversarial relationship* with one *imposed upon* or *imposed upon by* the other, rather than an empowering *complementary relationship* of one reciprocally *with* the other. The construction of social reality on the basis of impositional logic therefore leads human beings to inhabit an 'Anti-culture', as I have called it (Rayner, 2002), that is diametrically 'out of phase' with natural dynamic processes, and hence capable of engendering great environmental, and possibly also psychological and social damage.

Awareness of the damage that we may be doing to ourselves and our environment through our dislocation from natural processes has led to the emergence of movements variously described as 'Post-modern', 'Green' and 'Holistic' (e.g. Tarnas, 1991; Spretnak, 1999; Spowers, 2002). These movements are impeded, however, by their lack of a realistic form

of reasoning that both acknowledges and obviates the source of incongruence in modern thinking that lies in the fixed framing of space and boundaries. They therefore either attempt to *confront* impositional logic *using* impositional logic – recognizing the problems of assuming discreteness, whilst still seeking to 'fix' or 'exclude' these problems – or abandon all notion of structure whatsoever.

Correspondingly, one reaction, that of deconstructionists and relativists, to the rationalistic claim to have an 'objective', 'value-free' hold on 'reality' has been to argue that no-one can be free of the power relations of their social context, and hence that reality is beyond our individual reach. *Every* 'truth' claim is thereby regarded as a 'social construction' that can be rigorously dissected by discourse analysis (cf. Bluehdorn, 2003). Although this approach is often regarded as synonymous with 'postmodernism', it is in fact rooted in the impositional logic that underlies the socio-political context of our constructed 'Anti-culture'. It might therefore be more aptly described as 'hypermodern', in contrast with what Spretnak (1999) describes as 'ecological postmodernism'.

Whereas deconstructionism takes the unrealistic consequences of rationalism to the opposite extreme by denying access to natural reality and so 'losing the baby whilst reclaiming the bath water', ecological postmodernism questions the *realism* of the premise of 'isolation' or 'independence' and the implicit denial of 'relationship'. This form of postmodernism has been most widely expressed in the 'Green' and 'Holistic' movements' claims for 'unity in diversity', 'wholeness' and 'interconnectedness' and associated metaphors like 'web of life' (e.g. Spowers, 2002). Protagonists of these movements have a strong tendency, however, to deny the reality of *any* distinction between 'inside' and 'outside' and hence to develop a totally internalized, subjectively immersed view. In effect, they *equate* the 'baby with the bath' as an 'ecocentric' or 'ecological', as opposed to 'egocentric' 'self' (Macy, 1991). They substitute the binary/dualistic, 'many wholes/parts' view of isolated entities for a unitary/monistic 'non-dual', 'one whole' view of 'no boundaries' and 'no separation', akin to that we may have before we begin to develop the notion of a distinguishable 'self'.

This 'return to origin' by 'Green' and 'Holistic' thinkers is sometimes accompanied by claims to 'higher consciousness' and demands for 'change' in order to 'save the planet' (e.g. Laszlo, 2002). But the

change demanded is from one kind of unrealistically imposed framework (isolated boxes) to another (all in one box) and so may be just as restrictive and denying of the human condition, if not more so. By explicitly or implicitly denying the *existence* of boundaries, holistic thinkers are prone to ignore the very place through which the dynamic relationships and diversity that they propound are mediated. They end up speaking mysteriously about 'interconnectedness', complex 'webs' of relationship, 'self-organization', 'subtle energies', 'vibrations', 'Gaia theory', 'tight coupling', 'yin-yang' etc, without anywhere to relate these concepts to.

Here, I suggest that it is not the *existence*, but rather the *perception* of boundaries, through which inner-outer distinctions are made, that can bring about difficulty. If we change our perception of boundaries as *discrete limits*, to pivotal places of co-creative relationship, i.e. 'togetherness', then the *vital contextual space* that *otherwise* would be *excluded* is brought back into our consideration. We do not therefore have to *abandon* all we have learned and invented through making distinctions, but we do need to *recover* all the creative potential we have lost, and heal the environmental, and thereby possibly also social and psychological, damage we have engendered, by regarding these distinctions as absolute.

This change in perception may be possible through a change of perspective, from which it can be recognized that *space*, far from passively surrounding and isolating discrete, massy objects, is a vital, dynamic inclusion within, around and permeating natural form across all scales of organization, allowing diverse possibilities for movement and communication. This change of perspective, which I, together with others, have called 'inclusionality' (Rayner, 2003), is consistent both with our scientific findings and our philosophical account of boundaries. It has the effect of bringing our subjectively immersed and objectively detached views into complementary, creative correspondence with one another, whilst revealing that neither of these views can be realistic in their own right. It enables a simple shift in the way we frame reality, from fixed to dynamic, and so provides scope for the development of a relational, *inclusional logic* of *distinct places*, rather than discrete objects. Here, space is understood as a resistance-less and hence *inductive* 'presence of absence', an *attractor*, whose heterogeneous and ever-varying *shape and intensity (curvature)*, inseparably included within,

through and around the distribution of energy-matter, governs the dynamic frame of evolutionary *possibility*. Correspondingly, communication occurs between reciprocally coupled *insides* and *outsides* through actively *intermediary* rather than passively *intermediate* spatial domains or boundaries. And 'context' is neither 'outside of' (as in reductionism) nor the product of fusion/interconnection/dissolution (as in holism) of 'contents': rather, *content is contextual* - a locally distinct expression of energy-space, with inner, outer and intermediary aspects.

As I will try to show in the following sections, inclusional logic could radically transform the way we have interpreted all kinds of evolutionary processes. It enables these processes to be understood primarily in terms of *contextual transformation* rather than the operation of external selective force on discrete informational units lacking internal agency.

2. Impositional and Inclusional Logic in the Mathematical Underpinning of Scientific Inquiry into Dynamic Systems

Mathematics is the *lingua franca* of science through which researchers and theorists seek to compare and contrast their findings, secure in the knowledge that they are working from a common base and according to the same 'rules'. But if this common base arises from a misconception of reality, then continued adherence or 'loyalty' to the 'rules' will perpetuate this misconception until and unless the rules are honestly called into question. In the history of science, the relation between loyalty and honesty has shaped the making and breaking of many 'paradigms' (Kuhn, 1970). But, throughout, one form of loyalty has held fast: loyalty *in practice* to the foundations of mathematics in the idealized, abstract notions of discrete numbers and Euclidean geometry, even though mathematicians themselves have long recognized the *theoretical* limitations of these notions. And this loyalty has, in turn, reflected a continued adherence to the impositional logical premise in which these notions have their origin. So, as our researches continue to reveal the complex reality of evolutionary processes in the inclusionality of space, we fall short of addressing this reality because of our insistence on trying to describe and analyse it impositionally.

Useful though it may be in performing linear calculations, the

treatment of numbers as independent, space-excluding entities representing pure 'substance' or 'content' freed from 'context' - as 'figures' freed from 'ground' - is deeply paradoxical. As was demonstrated by Kurt Gödel in his mathematical formulation of the famous Cretan liar paradox, in which a Cretan informs you that all Cretans are liars, the problem is one of assuming 'completeness'. Any 'complete' or 'entire' object that thereby has nothing outside itself is inescapably self-referential and so impossible to verify or falsify 'independently' (e.g. Hofstadter, 1980).

Yet further paradox arising from focusing on content abstracted from context is contained in the second great foundation of mathematics, Euclidean geometry. A 'point' can have no dimension, a line no width and a plane no depth only by distilling all the space out of it until we are left with some infinitesimally 'pure' content. Henri Poincaré, whose theory of relativity preceded and arguably exceeded in scope that of Einstein, appreciated this only too well. "Space," he stated (Poincaré, 1905 – the following is a complex quotation gathered from different parts of his treatise), "is another framework we impose upon the world ... here the mind may affirm because it lays down its own laws; but let us clearly understand that while these laws are imposed on *our* science, which otherwise could not exist, they are not imposed on Nature ... Euclidian geometry is ... the simplest, ... just as the polynomial of the first degree is simpler than a polynomial of the second degree ... the space revealed to us by our senses is absolutely different from the space of geometry." Here, Poincaré was, in effect saying that the mathematical structure we impose on space is unlike the space that we sense, which provides possibility for movement and communication.

Conventional mathematical framing of reality is therefore as inadequate as the impositional logic upon which it is based. This is of especial significance to the understanding of dynamic processes. The practice of differentiating these processes into a sequence of 'freeze frames' inevitably entails losing something vital – the continuity of the original space – when the isolated fragments are re-integrated into the 'whole'.

The dislocation of content from context could be obviated by the development of mathematical systems based on *inclusional* rather than impositional logic. Any such mathematical formulations would necessarily be *ternary*, rather than binary or unitary, in needing to account for the

reciprocal, simultaneous dynamic relationship between *inner* and *outer* through necessarily incomplete and fluid *intermediary* spatial domains. Correspondingly, rather than treating numbers as an expression of pure *content*, with 'zero' representing 'absence' and 'infinity' representing 'limitless amount', it would make sense *contextually* to regard zero as 'inner-outer balance' (stationary boundary condition) and infinity as inner and outer spatial possibility. By the same token, since boundaries are not complete and final limits, each outer spatial possibility has the potential to be the inner spatial possibility of a yet larger outer spatial possibility. This arrangement gives rise to a geometry of '*nested holeyness*' of inner, outer and intermediary dynamic energy-spaces arrayed in series from microcosmic to macrocosmic scales and all under one another's mutual influence. Here, every intermediary boundary directly relates both to every inner set of nested spaces it contains and every outer nested space it is contained within. So by focusing on boundary properties at a particular scale it may be possible to gain insight into processes operating simultaneously at any larger or smaller scale. In this way, the microcosm expresses the macrocosm and *vice versa* – the small picture really can reflect the big picture, just as applies to a hologram that can be fragmented into smaller holograms each expressing the same image.

Given the impositional foundations of mathematical practice, however, there has as yet been little explicit attempt made to develop ternary logic systems. For the most part, even when dealing with dynamic processes, mathematical analysis begins with discrete, space-excluding definition(s) of its frame(s) of reference (entities and initial conditions). Although the effect of incorporating space is evident from analyses of 'non-linear dynamical systems', 'fractal geometry' and associated 'irrational' and 'imaginary'/complex numbers (see below), what appears as 'emergent' from these analyses may therefore 'really' be a manifestation of what is already implicitly present in natural process geometry.

Fractal geometry is the nearest approach conventionally fixed-framed mathematics has made to the natural geometry of 'nested holeyness'. It was developed by Mandelbrot (1977) to describe structures whose boundaries, unlike Euclidean surfaces, appear progressively more complex/irregular, in 'self-similar' patterns, the more closely they are observed. A famous example is the 'Mandelbrot set', made by mapping the distribution of points in the 'complex plane' that do not result in

infinity when iterated according to the rule, $z \rightarrow z^2 + c$, where z begins at zero and c is the complex number corresponding to the point being tested. Here, a 'complex number' is a number that consists of a combination of a 'real' and 'imaginary' component, the latter being a derivation of, *'i'*, the square root of -1. The complex plane is formed in the space defined by placing all 'real' numbers, from $-\infty$, through 0, to $+\infty$ along a horizontal line, and all 'imaginary' numbers, from $-\infty i$, through 0, to $+\infty i$, along a vertical line, and using these Euclidean lines as co-ordinates. In effect, it represents a way of increasing the 'possibility space' for numbers to inhabit, as discrete entities, from one to two dimensions.

The remarkable feature of the Mandelbrot set is the extraordinarily complex boundary that occurs between points within and points outside the set, in effect between an inner attractive space of zero and an outer attractive space of infinity. Such complex boundaries formed between neighbouring attractive spaces or 'attractors' have more generally been referred to as 'fractal basin boundaries', and they are clearly at least analogous to the complex, ternary boundaries of natural process geometry. Where, however, the conventional abstract mathematical representation of such complexity *begins* prescriptively with an implicit or explicit *definition* of content and container that replaces their *simultaneous* reciprocal relationship with *sequential* 'feedback', the natural might be said to *originate* in *indefinition* - a realm of endless possibility. And there is at least one notable body of mathematical work that has attempted to represent this realm in a truly inclusional way - the fluid logic number system and associated spiral geometry and infinity mechanics of Shakunle (1994). Here, numbers are identified not as singletons but as triplets that include their inner (smaller) and outer (larger) as well as intermediary aspects in a way that enables them all to relate fluidly with one another over all scales. For example the conventional 'natural' number, '2', is represented as '1,2,3', and the 'natural' number, '3', is represented as '2,3,4'. This kind of system, when it is more widely developed and appreciated, may hold the key to a truly 'evolutionary' mathematics of the future.

3. Impositional and Inclusional Logic in the Scientific Explanation of Evolutionary Processes

Despite the logical and practical impossibility of isolating matter from space (and *vice versa*), and despite its own findings in relativity, quantum mechanics and the dynamics and irregular geometry of non-linear (complex) systems, scientific investigation and interpretation continues largely to be underpinned by impositional logic-based mathematical approaches and concepts. Correspondingly, objective scientific methodology always starts by imposing a rigid frame, actual or theoretical, around some isolated fragment of nature from which the observer is excluded, and then proceeds to test 'falsifiable hypotheses' about events occurring within this frame by means of quantification and experimentation. Nature is brought into laboratories, contained in various vessels, purified from 'contaminants' and located in 'controlled environments' where the effects of 'one variable at a time' can be tested. But the question of how what can be quantified within this isolated and hence de-contextualized frame actually relates to the reality beyond the frame cannot be addressed. This inability results in the paradoxes of completeness implicit in Heisenberg's uncertainty principle and 'wave-particle duality' and expressed in such notorious conundrums as Schrödinger's cat, whose uncertain 'state' of 'life or death' is an artefact of being *sealed* in a box with a vial of cyanide (see, e.g. Coveney & Highfield, 1992).

This is not to say that objective scientific methodology is useless as a tool of inquiry – only that it cannot *in itself* offer or yield an adequate representation or explanation of natural dynamic processes. If an effort is made to compare the behaviour of isolated fragments with actual experience of natural systems, then insights which change fundamental conceptions may be found in the differences and similarities that show up. For example, a comparison between the behaviour of water in a river and in a cup dipped into the river may revealingly inform us about the effects of isolation on the natural mobility of fluids, and hence deepen our contextual understanding of the latter. Nonetheless, the tendency has been to use the behaviour in isolation not in *comparison* with, but as a *predictor* and *explicator* of, natural dynamics.

Nowhere is the resultant dislocation of discrete contents from their dynamic spatial context more obvious, or more profound in its influence

on the way we regard our relationships with one another and other life forms, than in the evolutionary biological notions of 'natural selection' and 'survival of the fittest'. The implicit 'fixed framing' in these notions, following on from Malthusian principles of limits to population growth, is evident in the way that 'natural selection' is commonly portrayed as a 'pressure'. This pressure intensifies as population growth squeezes out available resource/space so that ultimately only those entities with particularly favoured characteristics can endure.

There are deep inconsistencies embedded in these notions, arising from the associated *dislocation* of *changes in organisms* (and their genes) from *changes in their environment*. This dislocation results in the loss of co-creative power and coherence from the dynamic system, and their delegation to some external agency, rather as with a cine film that requires a projector and an observer lacking resolving power to create the illusion of movement captured in its freeze frames. Moreover, the resultant placement of action and reaction in linear sequence raises endless, unanswerable questions of precedence and origin: 'which came first' - 'nucleic acid' or 'protein', 'nature' or 'nurture', 'chicken' or 'egg' etc, and where did these agencies come from, and how? And it renders the evolution of complex form from disparate 'independent' components astronomically unlikely – celebrated examples being the vertebrate eye and, even more fundamentally, the living cell with all its closely co-ordinated relationships between fine structure and metabolic processes.

On the one hand, the environment is treated as a 'given' - a passive fixture imposed upon its living contents. On the other hand these contents are treated as passive, pre-formed, discrete units, lacking relationship with others, that can thereby only respond in a prescriptive way to the environmental circumstances on which they are imposed. Although changes in organisms *and* changes in environment are *both* recognized as essential to evolution, the actual mechanism(s) underlying their *simultaneous* and *complementary* relationship is obscured, so that this relationship appears instead to be *sequential* and *adversarial*.

Attention then focuses on how, as the putatively primary evolutionary mechanism, *adaptive* and purely *genetic* changes in these contents are enforced through competition in a confined space, rather than how the *context*, which actually *includes* and *simultaneously* both shapes and is shaped by these contents, *transforms*. Far from creating the observed

diversity of living form, the effect of adaptation and competition in a fixed space would actually be the inexorable drive towards hegemonic monoculture, through the removal of variation implicit in the notions of 'competitive exclusion' and 'adaptive peaks' (e.g. Futuyma, 1986). Such hegemony conflicts not only with the observed diversity in natural biological communities, but also with the widespread occurrence within and between closely related populations of the process of sexual 'reproduction' (a contradiction in terms, since the word, 'reproduction', implies 'more of the same' whereas sexual *recombination* produces variety). This process has always been a conundrum because it reduces the ability to make more of the same genetic self (i.e. truly to 'reproduce'), which is the putative basis for evolutionary 'fitness' under 'short term selection pressure' (cf. Maynard Smith, 1982). Meanwhile, far from enhancing 'fitness' in the form of 'efficiency', the operation of systems at their most intensely competitive under conditions of 'resource-limitation' would greatly increase the wastage that is actually prevented under such conditions in natural systems by pooling and reduced consumption. Natural selection, as it is most widely and popularly represented, is a profoundly *counter*-evolutionary mechanism, which, if it existed, would greatly reduce the energy-efficiency and impede the innovation that it is supposed to promote (Rayner, 1997). Furthermore, the notion of producing increasing order *and* complexity through natural selection is not only self-contradictory, but also appears to contradict another derivation from impositional logic, the second law of thermodynamics, which views the irreversibility of natural processes in terms of the inexorable increase of 'entropy' (e.g. Coveney & Highfield, 1992).

Inclusional logic, by contrast, radically changes our understanding of irreversible (evolutionary) change, according to principles that are common to all kinds of physical, chemical and biological systems, and that restore co-creative power and coherence to the dynamic relation between content and context. Rather than beginning, through the imposition of a fixed reference frame, with an assumption of stasis that then has to be 'forced' into action from 'outside', the very nature of nature is understood to be dynamic. And with this understanding, our concepts of causality and uncertainty also change. Rather than regarding change as externally enforced and measurable as a progression *through* space referenced to intervals of absolute time, all change is understood

to involve the *transformation* of space and consequent *simultaneous* alteration in both content and context and their reciprocal relationship. And this simultaneous, reciprocal alteration, where content and context co-creatively shape one another can be thought of as *attunement* or *resonance*, rather than *adaptation*.

So, unlike the impositional logical perception that when only one thing moves, everything else remains fixed, in inclusional logic when one 'thing' – a place *somewhere* – moves, the shape of possibility space *everywhere* transforms. And this transformation is experienced uniquely at every location as a shift in the inductive pull of a potential energy field, extraordinarily rich with ever-changing evolutionary opportunity. This field is invisible and intangible to the external observer, but provides the locale for the emergence of complex form through synergistic processes that have been referred to, albeit from the perspective of impositional logic, as 'self-organization' (e.g. Goodwin, 1994).

Since such transformation necessarily involves a change in content-context, it is by its very nature *irreversible* and *unrepeatable* - unable to return directly or indirectly to *exactly* the same *place* that it emanated from. Far from being *reproductive*, producing more of exactly the same, natural processes are continually *recreative* and *autocatalytic*- opening up and building upon new possibilities. As was said so long ago by Heraclitus, 'you can never step in the same river twice'. Content and context, stream and catchment, continually re-shape one another in an ever-transforming flow of *place*. This place is dynamically framed by itself as a resonant coupling of inner with outer *energy-space*, as was effectively recognized, albeit in a conventional mathematical framing, by the communication theory of Dennis Gabor (1946). Long neglected scientifically, but now being rediscovered, this theory provided the basis for Gabor's Nobel Prize-winning invention of holography, key to which was the notion of a 'complex signal' as a reciprocal combination of *real* and *imaginary* components, rather than an independent pulse of information.

4. Impositional and Inclusional Logic in 'Simple' and 'Complex' Depictions of 'Self', 'Death' and 'Community'

Taken to extremes, the primacy given to individual survival in natural

selection theory can result in the conclusion that 'there is no such thing as society/community', because the requisite co-operation in such a collective organization would compromize individual 'self-interest'. Both diversity and co-operation are deeply problematic concepts according to this view, and so, if they are to be desired or tolerated at all in human societies, can only be sustained by legal and educational enforcement. As Dawkins (1989), ironically put it, 'Let us try and *teach* generosity and altruism, because we are born selfish'!

However, such conclusions about the nature and occurrence of 'self-interest', 'selfishness', 'altruism' and 'survival' inevitably depend very fundamentally on how the notion of 'self' is actually perceived. Here can be found perhaps the most far-reaching difference between impositional, fixed framing and inclusional, dynamic framing of evolutionary processes, with regard to how we relate to one another and our living space.

Using impositional logic, the notion of 'individual self' as an independent body annihilated by death is simple and unambiguous, and the conclusion that evolution thereby entails inherently 'selfish' processes focused on the survival of genes that prescriptively define this 'self' is inescapable (e.g. Dawkins, 1989). But with this conclusion come the paradoxical inconsistencies and lack of coherence described in the previous section.

Using inclusional logic, however, the *isolation* of the simple, fixed notion of self becomes subsumed by the *togetherness* of complex, dynamic forms (in effect 'flow forms') comprising inner, outer and intermediary spatial domains, *all* of which are *vital* to their distinct, but not discrete, *identities*. Rather than being unitary or binary, ecocentric or egocentric, such *'complex selves'* represent ternary couplings of inner with outer, of the kind alluded to by Shakunle's 'fluid logic numbers' (see above). Their behaviour is therefore ultimately intractable to impositional logic, as was implicitly acknowledged by Newton 'himself' in his analysis of the 'three body problem' (Montgomery, 2001). Moreover, this behaviour can neither be regarded as intrinsically 'selfish' nor 'altruistic', because neither the disregard of the outer ('collective'/'we') nor inner ('individual'/'I') aspect is evolutionarily sustainable in such a co-creative system.

The concepts of 'complex self' and 'nested holeyness' were anticipated by Koestler (1976) in his descriptions of 'holons' - as 'Janus-

faced' entities combining individual and collective aspects, and 'holarchies' - as nested arrays of holons, in his 'Open Hierarchical Systems Theory' (Rayner et al., 1984; Wilber, 1996). Even more pertinent was the description of a 'Russian doll' kind of nesting, by Caldwell et al (1997), who recognized that the resultant conflation of 'information' deriving *both* from content *and* context was inconsistent with the notion of an external 'natural selector'. This recognition is made all the more potent when the necessary incompleteness, and consequent transformability (indeterminacy) of space-incorporating boundaries is introduced. We then can make the full transition from a view of 'self' as an *object*, to an appreciation of self as a *place*. Not only is every 'place' necessarily both a grouping of smaller 'places' and grouped with others in some larger 'place', but the incompleteness of boundaries ensures that there is communicative spatial relationship and the possibility for transformation across all scales.

Only through the development of an explicitly *ternary* logic, via the introduction of a dynamically balancing, intermediary agency, can the paradoxes resulting from the severance of inner from outer be avoided. In this ternary, 'dynamic framing', complete sealing of boundaries would disrupt and stifle flow, whereas total dissolution of boundaries would end in featurelessness. So both the pursuit of absolute individual autonomy (independence and immortality) through the completion of external boundaries, and of absolute collective unity (dependence and self-abandonment) through the obviation of internal boundaries are evolutionarily untenable. By contrast, a holey (i.e. space-including and hence permeable or porous) intermediary boundary provides the possibility for energy transfer between dynamically coupled inner and outer inductive domains. Closing *in* (decreasing holeyness) of boundaries results in '*in*formation', the constructive shaping of local 'features' and increased resistance to energy transfer both from outer to inner (*in*spiration/ in-welling) and from inner to outer (*ex*piration/out-welling). Opening *out* (increasing holeyness) of boundaries results in '*ex*formation', and consequent decreased resistance to energy transfer.

The complementary interdependence of generative and degenerative processes via dynamic boundaries between inner and outer is therefore inescapable. Space, though we may perceive it rationalistically as 'imperfection', cannot be excluded from a vital, evolutionary system, try as we might in the pursuit of 'perfection' in the form of individual or

collective completeness (wholeness). Such 'perfection' would imply eternal stasis. Rather, in the excitable, dynamic world and universe that is drawn towards balanced relationship, outside yields to and feeds the growth of inside, which yields in turn to outside in natural renewable cycles and spirals. These natural inspirations and expirations are disrupted, and even reversed, by the severance of one from the other.

In this inclusional view, there is therefore nothing problematic about co-operation and diversity, nor, for that matter, about outwardly 'aggressive' behaviour that sustains diversity through the assertion of local identity (Rayner, 1991, 1996, 1997). Rather, what we have, as many ecologists implicitly or explicitly recognize in natural 'ecosystems' and development of their increasingly complex and interdependent inhabitant 'communities' through autocatalytic stages (i.e. 'seres') of succession (Rayner, 1997), is a dynamically creative 'togetherness in diversity' or 'complementarity of labour'. Here, the collective and individual, 'the forest and the tree', both necessarily incomplete, continually reconfigure one another as they explore and manifest their common-space realm of possibilities.

Nonetheless, we continue to find it virtually impossible to apply this understanding to evolutionary co-creativity and communication, due to our continuing adherence to impositional logic. Even when we proclaim 'interconnectedness', we are prone mentally to envisage connections as solid transactional 'strings' or 'ties' *across* space that are *inserted* between initially discrete entities, rather than as conduits or 'pipelines' of included space that *grow* relationally into place. This transactional 'joining up of dots' is evident in the metaphor of 'web' and in modern 'network theory' (Buchanan, 2002; Barabási, 2002) whereby each of the connected entities is regarded as a 'node' or 'hub' whose influence corresponds with the number of connections that radiate out from its self-centre. Such thinking is being applied increasingly not only to human organizations but also to natural ecosystems, where the most influential hubs represent what have been called 'keystone species' (Scott Mills et al, 1993), with the inference that less connected entities are more readily dispensed with. Although such *constructs* of *entities* plus *connections* are portrayed as highly effective communication systems, examination of their structure reveals them to be highly resistant to flow and transformation as well as fundamentally unlike actual biological networks like blood systems, nerve systems and fungal mycelia (K.J.J. Tesson and

A.D.M. Rayner, unpublished). The latter consist of variably permeable and deformable tubes capable of highly versatile and re-distributive responses to their local circumstances. The formation of lateral connections or 'anastomoses', which connect the tubes 'in parallel', greatly increases the conductivity of these systems (Rayner, 1997), as does their lack of hubs, which would actually serve as 'bottlenecks'.

5. Paradox Lost? - Creative Boundaries and the Diversity of Organic Life as an Embodied Water Flow

During the twentieth century, impositional logic combined with two dramatic technical breakthroughs to produce a new and for many people alienating vision of the nature and origin of life and living things, including human beings. The discovery of the genetic code and advent of modern computers projected an image of evolution as the spread and diversification of genetic information, and of life forms as information processors - computational machines.

The inclusional view challenges this model, leading to an appreciation of life forms as relational places that manage the dynamic relationship between their inner and outer space above all through the medium of flowing water. Life forms, in other words, can be thought of as embodied water flows. Their DNA is not 'information in itself', which means the same anywhere, but rather gives and is given meaning through its dynamic relation with protein in the contextual medium of water retained within boundaries of variable deformability, permeability and continuity. Correspondingly, we see riverine form whenever we look at life as an ever unfolding, enfolding presence, rather than in freeze-framed snapshots giving the illusion of discrete individual entities. We see it in the branching and anastomosis of fungal mycelia, blood systems, trees, leaf veins, nervous systems, wildebeest herds, ant swarms and all kinds of evolutionary pathways (Rayner, 1997, 1998; Rayner & Way, 1999). Simply by 'attuning', through a variety of biochemical and physical mechanisms, the 'holeyness' of their inner-outer boundaries to relate to internal and external availability of oxidizing and reducing agents, life forms change pattern and process as they create and respond to changes in their dynamic context. They 'self-differentiate' outwardly, through the proliferation of inner-outer boundaries when and where there is plentiful

external energy-supply, and 'self-integrate' inwardly through the fusion, sealing and redistribution of these boundaries when and where there is external shortage (Rayner, 1997, 2000; Rayner et al., 1999). In this way, without contradiction, and at least until now, they have shaped and been shaped by the expanding diversity of Earth's 'biosphere'.

University of Bath

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REFERENCES

Barabási, A-L (2002) *Linked: the New Science of Networks*. Perseus Publishing.

Bluehdorn, I. (2003) Inclusionality-exclusionality: environmental philosophy and simulative politics. In *Towards and Environment Research Agenda – a second collection of papers* (A. Winnett and A. Warhurst, eds.), pp. 21-45. London: Palgrave Macmillan.

Buchanan, M. (2002) *Nexus: Small Worlds and the Groundbreaking Science of Networks*. W.W. Norton & Co.

Caldwell, D.E., Wolfaardt, G.M., Korber, D.R. and Lawrence, J.R. (1997) Do bacterial communities transcend Darwinism? *Adv. Microbial Ecol.* **15**, pp. 105-191.

Coveney, P. and Highfield, R. (1992) *The Arrow of Time*. New York: Fawcett.

Dawkins, R. (1989) *The Selfish Gene*. New edition. Oxford University Press.

Einstein, A. and Infeld, L. (1938) *The Evolution of Physics: From Early Concepts to Relativity and Quanta*. Cambridge University Press.

Futuyma, D.J. (1986). *Evolutionary Biology*, 2nd Ed. Sunderland, Massachussets: Sinauer Associates

Gabor, D. (1946) Theory of communications. *Jour. Inst. Elec. Eng. (London)*, **93**, 429-457.

Gleick, J. (1988) *Chaos*. London: Heinemann.

Goodwin, B. (1994) *How the Leopard Changed Its Spots: The Evolution of Complexity*. London: Weidenfeld & Nicolson.

Hofstadter, D.R. (1980) *Gödel, Escher, Bach: An Eternal Golden Braid*. England: Harmondsworth.

Huxley, A. (1946) *The Perennial Philosophy*. London: Chatto and Windus.

Koestler, A. (1976) *The Ghost in the Machine*. London: Hutchinson.

Kuhn, T.S. (1970) *The structure of scientific revolutions*, 2nd Ed. Chicago: University of Chicago Press.

Laszlo, E. (2002) *We Can Change the World: A Practical Guide to Thinking and Living in the 21st Century*. Club of Budapest.

Macy, J. (1991) *World as Lover, World as Self*. Berkeley: Parallax Press.

Mandelbrot, B. (1977). *The Fractal Geometry of Nature*. New York: Freeman.

Maynard-Smith, J. (1982). *The Evolution of Sex*. Cambridge University Press.

Montgomery, R. (2001) A new solution to the three-body problem. *Notices of the AMS* **48**, pp. 471-481.

Poincaré, H. (1905) *Science and Hypothesis*. Dover Publications. Walter Scott Publishing Company Ltd.

Rayner, A.D.M. (1991) The challenge of the individualistic mycelium. *Mycologia* **83**, pp. 48-71.

Rayner, A.D.M. (1996) Interconnectedness and individualism in fungal mycelia. In *A Century of Mycology* (BC Sutton, ed), pp. 193-232 Cambridge University Press.

Rayner, A.D.M. (1997) *Degrees of Freedom - Living in Dynamic Boundaries*. Imperial College Press, London.

Rayner, A.D.M. (1998) Presidential address: fountains of the forest - the interconnectedness between trees and fungi. *Mycol. Res.* **102**, pp. 1441-1449.

Rayner, A.D.M. (2000) Challenging environmental uncertainty: dynamic boundaries beyond the selfish gene. In *Towards an Environment Research Agenda vol. 1* (A. Warhurst, ed), pp. 215-236. London: Macmillan.

Rayner, A.D.M. (2002) The formation and transformation of 'Anti-culture': from 'survival of the fittest' to 'thrival of the fitting'. http://www.bath.ac.uk/~bssadmr/inclusionality.htm

Rayner, A.D.M. (2003) Inclusionality - an immersive philosophy of environmental relationships. In *Towards an Environment Research Agenda - a second collection of papers* (A. Winnett and A. Warhurst, eds.), pp. 5-20. London: Palgrave Macmillan.

Rayner, A.D.M., Coates, D., Ainsworth, A.M., Adams, T.J.H., Williams, E.N.D. and Todd, N.K. (1984) The biological consequences of the individualistic mycelium. In *The Ecology and Physiology of the Fungal Mycelium* (D.H. Jennings and A.D.M. Rayner, eds), pp. 509-540. Cambridge University Press.

Rayner, A.D.M., Watkins, Z.R. and Beeching, J.R. (1999) Self-integration—an emerging concept from the fungal mycelium. In *The Fungal Colony* (N.A.R Gow, G.D. Robson and G.M. Gadd, eds), pp. 1-24. Cambridge University Press.

Rayner, A.D.M. and Way, C. (1999) Evolutionary waterways: the contextual dynamics of biological diversity. *Frontier Perspectives* **8** (2), 33-37.

Scott Mills, L., Soule, M.E. and Doak, D.F. (1993) The keystone-species concept in ecology and conservation. *BioScience* **43**, 219.

Shakunle, L.O. (1994) *Spiral Geometry. The Principles (with Discourse).* Hitit Verlag, Berlin, Germany.

Spowers, R. (2002) *Rising Tides.* Edinburgh: Canongate Books.

Spretnak, C. (1999). *The Resurgence of the Real: Body, Nature and Place in a Hypermodern World.* New York: Routledge.

Tarnas, R. (1991). *The Passion of the Western Mind: Understanding the Ideas That have Shaped Our World View.* New York: Ballantine Books.

Wilber, K. (1996). *A Brief History of Everything.* Boston: Shambhala Publications.