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6 Why the metaphor of complementary dualism, and metaphor itself, are foundational to achieving sustainability

Edmond Byrne

Men do not know how that which is drawn in different directions harmonises with itself. The harmonious structure of the world depends upon opposite tension like that of the bow and the lyre.

(Heraclitus, ca 500 BCE, fragment 45, 1907: 150)

The metaphor of complementary dualism, the idea that polar opposites are inherently necessary and mutually obligatory for system progress and endurance and indeed in conceiving reality itself has found resonance across human civilisations throughout history. Eastern traditions such as Taoism and Zen Buddhism espouse the complementary intermingling opposites of yin (black; freedom) and yang (white; structure/constraint) in a way similar to the early Greek philosopher Heraclitus, who considered that the universe could be understood by observing the *relationship* between opposition and unity, such that one can only begin to grasp reality by seeing apparently opposing forces as parts of one whole. Nietzsche considered the ancient Greek tragedy in *The Birth of Tragedy* (Nietzsche, 1872), and decried the use of Socratic rationalism, which he attributed to the demise of original Greek tragedy, since it compromises the necessary balance between the complementary opposites found through opposing Apollonian and Dionysian tendencies. Apollo and Dionysus, as sons of Zeus, are respectively recognised in this context as the god of truth and knowledge (Apollo; broadly representing structure and reason) and the god of the vine (Dionysus; broadly representing unrestraint and disorder). Later, the twentieth century Nobel prize winning atomic physicist, Niels Bohr, incorporated the Taoist yin and yang symbol when designing a coat of arms ahead of his receipt of the Royal Danish Order of the Elephant knighthood in 1947, incorporating the motto: "*contraria sunt complementa"* (Figure 6.1).



Figure 6.1 **Niels Bohr's coat of arms.**
Source: GJo, 2010.

This was consistent with his philosophy, informed by his paradigm breaking work around his 'principle of complementarity', whereby he articulated the reality that atomic entities could espouse apparently contradictory properties through existing simultaneously in both wavelike and particulate form.

The metaphor of complementary dualism is also, as Heraclitus points out in the quotation which opens this chapter, a metaphor which appears both paradoxical and counter intuitive. A simpler, more

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rational (though not reasoned) approach would, by contrast, support an attempt to optimise systems, by seeking progress and viewing reality through the "either/or" preferment of one tendency at the expense of the other. In this way, efficiency is invariably prioritised over redundancy, deterministic control over random chance, structure over chaos, and linear progress over contingent process. Indeed, this has been the hallmark of the project of modernity, which has promoted a paradigm of control, certainty, reduction, and separation. This paradigm has been incredibly successful over the past four centuries, and, inspired by neo-Cartesian rationality, it now transcends all of our increasingly globalised society(/ies). Cartesian dualism opposes and critically differentiates from Heraclitian/Taoist dualism in that the former is antagonistic (envisaging mutual exclusivity), while the latter is agonistic (envisaging interconnection and overlap). The neo-Cartesian worldview can also be held responsible however for an increasingly dangerous anthropogenic hubris, in part a consequence of casting away the myth, mystery, mysticism, and enchantment of the pre-modern worldview. The once dominant (pre-modern) worldview, which determined that a singular truth could be revealed from a divine created order, was thus displaced by another that ordained that a singular truth could be revealed through a largely reductionist conception of "science". However, as neuropsychiatrist Ian McGilchrist (more anon) has put it: 'there may be no single truth, but no single truth does not mean no truth'. In addressing a science which would seek reductionist certainty, McGilchrist proposes:

> The origins of science lie in open-mindedness, flexibility in applying models, empirical observation of the world of experience …Don't get me wrong: detailed scientific knowledge is hugely important. We rely on such minute information to inform the bigger picture. But it is a necessary, not sufficient, condition, of being a good physician. Without a way of understanding and interpreting it at a deeper level, more detailed knowledge will achieve precisely nothing, and will lead us ultimately to let our patients down. It will close our reality down into what we imagine to be certain, where an appropriate awareness of the limitations of our knowledge would have liberated us and our patients into a world much richer than we can suspect.
>
> (McGilchrist, 2011: 1069)

A complex, contingent and entangled, though ultimately a more fruitful (and authentic) complementary agonistic dualism is thus a more difficult concept to hold and pursue than a simpler antagonistic dualism; "good or bad", "either/or", "for or against", "control or be controlled", conception of incompatible opposites. The latter however, by seeking to stamp out diversity, actually denies the possibility of procuring emergent (radically new) knowledge through transcending both extremes, or of achieving authentic evolutionary progress, or novel creativity. By focussing exclusively on (seeking to increase) system efficiency and constraint, this only serves to reduce system resilience and capacity for authentic growth. Such an approach, as has been shown in the context of ecosystem network flows (Ulanowicz, et al., 2009) and extended in terms of economic and financial sustainability (Goerner, et al., 2009; Kharrazi, et al., 2013; Levin and Lo, 2015; Fath et al., 2019)), is inherently unsustainable.

An intriguing aspect of this metaphor, however, is that it is replicated in the structure of the organ which facilitates our very construction of reality, the brain. Indeed, it is contended that we seek to construct a conception of reality which mirrors the structural composition of the brain, mediated through the relationship between the respective hemispheres (McGilchrist, 2009). The nature and import of such a structure has been described by the aforementioned Ian McGilchrist, in a seminal book on the nature of the brain *The Master and his Emissary* (McGilchrist, 2009). In it, McGilchrist describes two asymmetrically different though complementary hemispheres, extending the work of others such as Ornstein (1997). He explains with great precision how the two hemispheres conceive the world in radically different ways and compete to impose their perspective of the world around them, and then (literally) construct it accordingly. However, he also contends that it is precisely *because* our brains (and those of other animals) are constructed with two anatomically separate asymmetrical hemispheres which are connected via a rather small amount of neural tissue, centred around what is called the corpus callosum, rather than a single spherical lump (which would be, after all, a more efficient use of headspace), that we have been able to evolve and progress as we have done. Indeed, he emphasises the degree of physical separation between the respective hemispheres by pointing out that while most of the nerve cells of the corpus callosum promote communication between the hemispheres, nevertheless a significant proportion of them actually act in an inhibitory fashion (McGilchrist, 2009: 17). Yet, he points out that the resultant separation and complementary duality does not just merely act as a useful means of refining control, it is essentially 'a tool for grappling with the world. It's what brings the world about.' (McGilchrist, 2009: 19).

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Moreover, in the case of humans, the frontal lobes (in both hemispheres) have developed significantly (representing as much as 35 per cent of the human brain, as against about 17 per cent for lesser apes, and about 7 per cent for relatively intelligent animals, such as dogs (McGilchrist, 2009: 21)). This has had the effect of enabling us to stand back from the world, from 'the immediacy of experience …to plan, to think flexibly and inventively, and in brief, to take control of the world around us rather than simply respond to it passively.' (McGilchrist, 2009: 21), traits which enable us to exhibit both calculated detachment and empathetic trust; thus turning us 'famously, into the "social animal", and into an animal with a spiritual dimension.' (McGilchrist, 2009: 22).

In terms of the hemispherical differences, McGilchrist describes the approaches to reality adopted by each hemisphere. The left hemisphere takes a literalist, rationalist, mechanistic, atomistic, explicit, generalised, functionalist, decontextualised, and "either/or" approach to the world around it and it attempts to shape reality on these terms. The right hemisphere, however, takes an integrative (facilitating "both/and") approach, while seeking both context and (inter)connection, is comfortable with the implicit, and can "get it" beyond the functional and utilitarian world of rational models, deterministic algorithms, and (necessarily) reductionist words (Table 6.1). It thus communicates through (and understands/appreciates the inherent value of) art, images, poetry, music, and indeed metaphor. In this way, the right hemisphere can (exclusively) access implicit (though authentic) feelings and connotations through music, art, poetry, and other creative or spiritual experiences, including in a communal setting, to (metaphorically) *move* a person or group, and/or to attain overall understanding, clarity, or "aha!" moments, in ways which literally 'cannot be put into words'. The communicative discrete building blocks of the left hemisphere by contrast are wholly inadequate to such tasks, since (mere) words and denotative language alone literally cannot reach places that that the right hemisphere can reach via these media and constructs. Metaphor, as with irony and humour, is a facility accessed and understood exclusively by the right. If, for the benefit of the left hemisphere it needs to be explicated (through surrogate words), it is unavoidably reduced and stripped of its full (implicit) meaning.

Of course, both hemispheres are required to operate effectively. McGilchrist elaborates on how both hemispheres function independently but concurrently by instancing the example of a bird, who when it is feeding, employs both its left hemisphere for the necessary precision requiring a "local" strategy of seeking out grain among grit, while at the same time it employs the right hemisphere to capture an equally necessary big picture "global" approach and keep an eye out for potential predators:

> In general terms, then, the left hemisphere yields narrow, focussed attention, mainly for the purpose of getting and feeding. The right hemisphere yields a broad, vigilant attention, the purpose of which appears to be awareness of signals from the surroundings, especially of other creatures who are potential predators or potential mates, foes or friends; and it is involved in bonding in social animals. It might be that the division of the human brain is also the result of the need to bring to bear two incompatible types of attention on the world at the same time, one narrow, focussed, and directed by our needs, and the other broad, open, and directed towards whatever else is going on in the world apart from ourselves. In humans, just as in animals and birds, it turns out that each hemisphere attends to the world in a different way – and the ways are consistent. The right hemisphere underwrites breadth and flexibility of attention, where the left hemisphere brings to bear focussed attention. This has the related consequence that the right hemisphere sees things whole, and in their context, and broken into parts, from which it then reconstructs a 'whole': something very different. And it also turns out that the capacities that help us, as humans, form bonds with others – empathy, emotional understanding, and so on – which involve a quite different kind of attention paid to the world, are largely right hemisphere functions.
>
> (McGilchrist, 2009: 27)

He concludes in his articulation of the differences between the right and left hemispheres respectively as 'at its simplest, a world where there is 'betweenness', and one where there is not. These are not different ways of thinking about the world: they are different ways of being in the world.' (McGilchrist, 2009: 31,emphasis is the original)

Table 6.1. Characteristics of respective brain hemispheres

Left Hemisphere Thinking	Right Hemisphere Thinking
Asymmetrical: doesn't recognise right side thinking ("*either-or"* hemisphere)	Asymmetrical: can accommodates left side thinking (*integrative* hemisphere)
Analysis, categorisation	Whole picture "*gestalt"*
External "view from nowhere"	Relational "view from somewhere"
Seeks control, certainty	Embraces contingent uncertainty
Symbols, models, musical notes, (denotative) language	Music, spirituality/religion, (connotative & emotive) language: metaphor, irony, humour, poetry
Reduction of whole into separate discretised parts	Interconnectedness, interactions, "betweenness"
Technocratic	Technosceptic
Mechanistic/deterministic; cause and effect	System emergence; propensities
Knowledge as fixed: obtained from facts	Knowledge as contextual: (unique) personal experience required
Individualistic, competitive	Relationships/collective, cooperative
Self-considered "objective" and "value-free" (though (ironically!) actually value laden)	Recognises values as inherent
Utilitarian (e.g. economic) values	Relational moral values and empathy
Ever optimistic (even hubristic/in denial)	Pessimistic/melancholic/realistic
Seeks decontextualisation (as context!)	Embraces context
Stumped by paradox and ambiguity	Embraces and values paradox and ambiguity
Closed system in discretised time (*zeitraffer*/timelapse)	Open systems in flux (process)
Utility and predictability	Novelty and creativity
"Law of excluded middle" (Plato/Aristotle)	"Logic of the included middle" (Nicolescu, 2008)
Build on understanding through adding piece by piece sequentially	Develop understanding through recursive process, considering various aspects of whole at once
Dogmatic	Pragmatic

Source: Based on McGilchrist, 2009.

It is on this neurophysiological basis that McGilchrist proceeds to develop his thesis which contends that, while the two hemispheres emerged as a means of progressing biological evolution (enabling both decontextualised focus and global breadth), at different points in human history the relative ascendency of either hemisphere towards the other has changed. He suggests that in the modern period (over the past four centuries), and in particular in more recent times, we have privileged the rationalistic decontextualisation of the left hemisphere over the integrative "betweenness" of the right hemisphere. The result is 'the world as machine metaphor' which we've inherited and developed from Descartes and Newton (Montuori, 2017: 147). The ultimate result though, he contends, may be to our existential detriment, since 'alone they [the two hemispheres] are destructive….right now [with left hemisphere dominance] they may be bringing us close to forfeiting the civilisation they helped us create.' (McGilchrist (2009: 93)

The dominance of the left hemisphere is particularly problematic, and since it is the "either/or" hemisphere, it envisions that either *it* has the unique and "correct" view of the world or it doesn't; and *it* must be right:

> Each hemisphere delivers a vital aspect of experience, and nothing good comes from relying over much on one alone. But that itself is the view of only one of the hemispheres. The other thinks that it can go it alone. (McGilchirst, 2011: 1069)

The right hemisphere, asymmetrically, takes an integrative "both/and" view, and can see the value in a plurality of perspectives. (Hedlund-de Witt's integrative worldview framework is useful in this context, seeing as it compares respective traditional (premodern), modern, postmodern, and integrative worldviews (Hedlund-de Witt, 2013; see also Byrne, 2017a: 56)). Indeed, it finds the singular approach of the left to be an inadequate conception of reality (mirroring by analogy, the differences between an

intolerant group and a tolerant group – whereby at the extreme, the latter are faced with a conundrum around whether to tolerate intolerance, while the former group has no such problem).

The left hemisphere bias has manifested itself through the dominant modern worldview, which has underpinned enlightenment modernity, and to an ever-increasing extent has rolled forward in contemporary society. It represents a paradigm of separation and reduction (as described above), and we have constructed our modern contemporary world based on this paradigm; one (at least from a right hemisphere perspective) envisaged largely through a linear "one-eyed" conception of progress, a sort of (metaphorical) machine lavishly oiled by techno-optimistic hubris, as critiqued for example by Barry (2017). "Sustainability", by this worldview is epitomised for example, by utopian ideals such as India's 'One Hundred Smart Cities' project, where cities compete to be included in grand "entrepreneurial urbanisation" projects (Datta, 2015). These would effectively produce privatised technocratic control and monitoring centres, moderated through the likes of smart access cards, with the promise of being "efficient", "clean", "smart", and "sustainable". Contemporaneously, lakes literally burn as a result of extraordinary concentrations of toxic flammable waste in the sprawling IT hub of Bangalore (Bhasthi, 2017; Bhat 2017), a metaphorical cry of anguish from a neglected environment subject to extreme and ongoing anthropogenic degradation. The idea of clean smart cities juxtaposed with market-driven restricted access raises serious concerns around equity, social exclusion, and democracy, quite apart from ecological implications for such "sustainable" constructs (Unnikrishnan, and Nagendra, 2015; Mundoli, et al. 2017).

The modern worldview and its outworking has, it must also be noted, brought us great good, not least in terms of material wealth, an unprecedented abundance of goods, energy, food, and information. Yet, it has also brought us to a contemporary crisis of unsustainability and all that that entails; including unprecedented biodiversity loss and unprecedented environmental degradation, increasing societal inequality (coupled with emerging global issues around food, water, and energy equity and security), and "social recession" characterised by increasing health issues around anxiety, depression, suicide, obesity, well-being, etc., on top of the increasing impacts and hardships around climate change. As Wessels rhetorically queries: 'is progress truly possible if its wake continually generates loss – loss of connections to place and community, loss of clean air and water, loss of other species who are truly part of our ancestral family tree?' (Wessels, 2013, xiv). In this context, McGilchrist's characterisation of the brain's hemispheres and the implications for how this impacts on the way society both envisions and structures its lived-in world has resonated with many, prompting them to consider the implications of his model for contemporary (un)sustainability challenges and narratives (Gare, 2013; Kras, 2015; Ehrenfeld, 2017, 2019).

Complementary dualism and sustainability narratives

The pervasive concept of complementary dualism is one which has informed conceptions around sustainability (Byrne, 2017a). It has been applied by Ulanowicz when quantitatively applied to ecosystem networks (Ulanowicz, et al., 2009), and qualitatively for socio-technical systems by Stirling (2014) (see also Byrne, 2017a for a description of each). Essentially, Ulanowicz has shown that flourishing (sustainable) ecosystems operate between the mutual agonistic tendencies of constraint (efficiency/control) and freedom (disorder) (Ulanowicz, 2009a, 2009b), while evolution occurs (and can only occur) in the space between (genetic) causal determinism and directed chance in Kauffman's zone of the "adjacent possible". (Kauffman, 2010: 64). This challenges a reductionist neo-Darwinian conception of biological evolution fundamentally and exclusively predicated on a linear conception of progress driven by competitive 'survival of the fittest'. As Ulanowicz (2017, 14) puts it: 'Natural selection no longer involves only elimination but is driven by a mutualism that is more fundamental than even competition.' This aligns with the neurobiologically informed critique of McGilchrist, who sees hemispherical difference and cooperation writ large on the universe and reality in Heraclitean fashion:

> The relationship between the hemispheres is not straightforward. Difference can be creative: harmony is an example. Here differences cohere to make something greater than either or any of the constituents alone… Before there can be harmony there must be difference.
>
> The most fundamental observation one can make about the observable universe - is that there are at all levels forces that tend to coherence and unification, and forces that tend to incoherence and separation. The tension between them seems to be an inalienable condition of existence, regardless of the level at which one contemplates it. The hemispheres of the human brain, I believe, are an expression of this necessary tension. And the two hemispheres

> adopt different stances about their differences: the right hemisphere towards cohesion of the two dispositions, the left hemisphere towards competition between them.
>
> (McGilchrist, 2009: 128–129)

On considering complementary dualism as a universal phenomenon, Byrne (2017b) highlights how the universe itself goes about its business of existing (and expanding) amid the mutually opposing though necessary drivers towards dissipation (in the form of second law entropy) and attraction (e.g. gravitational force). To highlight the universality of this phenomenon, Byrne (2017b) also demonstrates how complementary dualism has informed complexity informed approaches across a range of disciplinary spheres, including quantum physics, thermodynamics, electrical power systems, organisational management, and process theology. Indeed, process thinking, which has developed most notably from the works of Whitehead (1929), is based on an abiding complementary dualism recognised right through from early civilisation(s), and presents itself as a (right hemisphere) counterbalance to a reductionist neo-Cartesian representation of reality and progress. In this vein, Ulanowicz identifies:

> an ongoing tension between countervailing tendencies that plays out in living systems. That is, the prevailing dynamic is not one of uniform progression towards some maximal efficiency, but rather a Heraclitean dialectic between order building and decay. This new dynamic also mirrors well the Eastern emphasis on the importance of the nonexistent, and the Chinese dialectic between Yan (constraint) and Yin (freedom). With its roots in both Western and Eastern philosophies, process ecology holds forth the possibility of a more equitable common developmental road towards scientific progress.
>
> (Ulanowicz, 2017: 13)

The narrative of agonistic dualism can be framed too in a transdisciplinary context, in particular with reference to Nicolescu's 'logic of the included middle' (Nicolescu, 2008: 7), which would contend that emergent creative evolutionary knowledge and physical and social constructs (and hence progress) can only materialise through a productive interplay between respective agonistic and interdependent opposites (Mullally, et al., 2017, pp. 32–37). This can be applied too in conceiving education and learning more generally, which can be characterised as a dialectic relationship between general subject excitement provided by the teacher, followed by precision and mastery performed by the student, and finally general re-presentation by student application and 'the creative freedom that issues from the discipline of hard work' (Schindler, 1991: 72).

Such a complexity informed view of reality would envisage such ("both/and") terms among disciplines, whereby each respective discipline legitimately conceives the world and reality at different levels (for example, characterising a person from the perspective of various disciplinary "object world" views such as for example, at the level of, respectively, atomic physics, biochemistry, biology, neuroscience, psychology, the humanities (the human condition), and sociology (persons in relation to others). Each disciplinary perspective offers wholly legitimate knowledge, and each is capable of adding unique insight, but none is capable of unilaterally describing *all* of human reality. Moreover, only together can disciplinary knowledge and insights facilitate an emergent and transcendent conception of (multi-level) reality from the resultant "in-betweenness". This is the sort of transdisciplinary thinking, it is argued, the embodiment of the metaphor of complementary dualism, which behoves authentic sustainability narratives, and which is ultimately required for making a necessary transition from a world and society constructed as it currently exists, based on assumptions of separation and reduction, to one which is authentic fit-for-purpose in conceiving and cohering with complex reality.

The left hemisphere conception of the world by contrast would seek to construct techno-optimistic models and conceptions of sustainability, which would see sustainability as a largely unproblematic and linear one-way journey coherent with conceptions of societal progress. "Sustainability", as thus envisaged, is underpinned by quantifiable metrics and is to be engaged within the context of a growth-based consumerism (thus providing companies who engage with it with a valuable marketing opportunity for growth). By such measure, John Ehrenfeld would contend that 'it has become merely a label for strategies actually driven by standard economic and institutional mechanisms around efficiency' (Ehrenfeld and Hoffman, 2013: 3), and a model of consumption which 'places no limits on demand or want' (Ehrenfeld, 2008: 127). This contrasts starkly with Ehrenfeld's purposely qualitative proposed definition of sustainability, the metaphor of *sustainability-as-flourishing* (Ehrenfeld and Hoffman, 2013: 3). Mirroring the brain hemispherical discourse above, he proposes 'we

need to move away from the purely objective, quantitative and "rational" reasoning to consider the spiritual, experiential, and pragmatic.' (Ehrenfeld and Hoffman, 2013: 19). Work by Elphinstone and Critchley (2016) has suggested a positive correlation between left hemisphere mechanistic thinking and the materialistic goals and values which underpin consumerist society, while Dittmar et al. (2014) suggest a link between enhanced materialism and reduced well-being. Each of these outcomes in turn oppose the realisation of sustainability as framed by Ehrenfeld.

Of course, to extend the metaphor with another; a boat with one oar just goes around in circles. Continuing the theme, Petersen counters by conceiving of sustainability as more a contingent, context-dependent *process*, than some linear pre-determinable finite journey (see Byrne, 2017a: 49):

> Like a pot of gold at the end of the rainbow, sustainability is more of a moving target never quite to be reached. Using a navigational metaphor thus captures the concept more comfortably: sustainability discourses help us steer in a sea of future challenges and navigate around the rocky patches of undesirable solutions. In this capacity, as a navigational device, the specific sustainability discourses are also locally defining the legitimacy of new socio-material arrangements, such as technological systems. (Petersen, 2013: 2)

The foundational value of metaphor in general

Only the right hemisphere has the capacity to understand metaphor.

(McGilchrist, 2009: 115)

McGilchrist's above proposition has significant import. He elaborates, suggesting that 'this is not a small matter of a quaint literary function having to find a place *somewhere* in the brain.' (McGilchrist, 2009: 4), but actually helps us understand the fundamental role metaphor plays in 'our understanding of the world, because it is the *only* way in which understanding can reach outside the system of signs to life itself. It is what links language to life' (McGilchrist, 2009: 115).

He outlines how the left hemisphere (it being the "explicit" hemisphere) cannot help but recognise metaphor as being nothing more than a mere superficial collection of words, colours, notes, blocks, or fabled stories, devoid of potential for any additional, implicit, connotative, emergent, or transcendent value. McGilchrist argues though that it is this left hemisphere view that gets in the way of us understanding the real value of metaphor; for metaphors are not just merely useful devices to comparatively or approximately describe reality, but in fact it is the other way around: our basic understanding of the world around us is primarily *framed* through metaphor in the right hemisphere. It is only then "translated" into left hemisphere words and language:

> Metaphor (subserved by the right hemisphere) comes *before* denotation (subserved by the left). This is a historical truth, in the sense that denotative language, even philosophical and scientific language, are derived from metaphors founded on immediate experience of the tangible world. (McGilchrist, 2009: 118, emphasis is the original)

To put this more succinctly, citing Lakoff and Johnson (1999: 123); 'metaphorical language is a reflection of metaphorical thought'. However, metaphor necessarily loses some meaning when converted into (mere reductive) words, since:

> Metaphor *embodies* thought and places it in a living *context*. These three areas of difference between the hemispheres – metaphor, context and the body – are all interpenetrated with one another. (McGilchrist, 2009: 118, emphasis is the original)

The right-left dialectic is maintained in the interplay between the implicit metaphor and explicit language:

> The point of metaphor is to bring together the whole of one thing with the whole of another, so that each is looked at in different light. And it works both ways, as the coming together of one thing with another always must. You can't pin one down so that it doesn't move, while the other is drawn towards it: they must draw towards each other. As Max Black says: 'If to call a man a wolf is to put him in a special light, we must not forget that the metaphor makes the wolf seem more human than he otherwise would'.
>
> (McGilchrist, 2009: 117)

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In this context, it is hardly surprising that a key outcome of an increased dominance of left hemisphere rationality (over right hemisphere (common sense intuitive) "reason") is a loss in the perceived value and power of metaphor (and also indeed, as Evan Boyle eloquently identifies elsewhere in this collection, of myth). And this has hugely significant implications for both narratives and conceptions of sustainability, and the ultimate realisation of same. For a start, it demonstrates why there are competing conceptions of sustainability. Such conceptions range from the right hemisphere "sustainability-as-flourishing" model espoused by John Ehrenfeld, which would see it as at heart, an ethical issue, to a left hemisphere conception which would reduce sustainability to mere quantifiable techno-scientific metrics such as carbon emissions and energy efficiencies. Indeed, Ehrenfeld explicitly examines the implications of McGilchrist's work for sustainability narratives more recently (Ehrenfeld, 2019). The left hemisphere focusses on constructing algorithmic models of the world as it aims to (ever more perfectly) mimic and predict. It strives to do this increasingly through a range of technological silver bullets including geoengineering, nanotechnology, synthetic biology, virtual reality, artificial intelligence, etc., all aimed at assuring unrelenting progress in the face of any problem, even increasingly existential ones concerning (un)sustainability (around climate, food, water, energy, etc.), each euphemistically labelled "grand challenges".

However, a right hemisphere approach would critique the left, by suggesting that this simply proposes more techno-optimism as a proposed "fix", but in fact one which inevitably can only lead to failure through inevitable knock-on "unintended consequences". In other words, like an addict, it merely seeks to satisfy a need with more of the same of that which is implicated in the addiction in the first place (Ehrenfeld, 2008: 35). Thus, the reductionist neo-Cartesian worldview which has caused the problem of unsustainability promises to solve it with even more of the same.

A right hemisphere approach on the other hand would hold that its preferred integrative worldview is necessary in order to construct a sustainable world which actually coheres with the actual "real" world in all its authenticity (rather than a world reduced to algorithmically modelled virtual reality). It would thereby seek to develop such a world through empirical experienced reality and associated metaphor. Any transition to a sustainable societal construct it would suggest can only be accessed through the use of metaphorical thinking, rather than through (restating) rational facts alone.

If this perspective is accepted, it promises to reveal a tantalising insight into perhaps why, despite knowing a myriad of facts about climate change, biodiversity loss, and degradation across several other environmental and social indicators, we are generally and collectively unmoved to take action. It also holds the prospect of metaphor (and its cousins; narrative, story, and myth, as well as other right hemisphere constructs such as art and music) is really the only means of sufficiently moving people, communities, societies, and individuals so as to precipitate the type of transformational change that is required to achieve authentic sustainability (as flourishing).

Indeed, it appears that the penny may be finally dropping, so to speak, in this regard in relation to funding of research into areas such as climate change and energy transitions to identify just two. While up to very recently research funding agencies at national and international levels have generally only considered research in the STEM areas (Science, Technology, Engineering and Mathematics) as being legitimate disciplines for carrying out such research, there appears to be quite a perceptible turn in recent times towards funding research which explicitly demonstrates multi-, inter-, and trans-disciplinary aspects and which clearly and explicitly incorporates and values disciplinary input from the humanities and social sciences. It may well be that this has less to do with a turning away from the narrow focus that a left hemisphere rational approach would imply to a more global right hemisphere approach, and more to do with the fact that an exclusively "scientific" based approach has largely singularly failed to communicate the realities of climate change with public(s) in a way which would precipitate significant transformative change. Nevertheless, research projects in this area are routinely, and to an ever-greater extent, required to allocate portions of the budget allocation to public understanding and communications.

A bolt-on approach here, whereby social scientists are sought out and then charged with going out and communicating or finding the best way to manipulate societal behaviour and views once the physical scientists have done the "real" work, i.e. the heavy lifting of gathering the data, developing suitable algorithms, and designing appropriate technologies, would merely be just another outpouring of a left hemisphere separation (and prioritisation) of disciplinary tasks. Only a genuine (right

hemisphere) transdisciplinarity, which would value the real and central input that the social sciences and humanities can and must provide can meet with ultimate success.

Sustainable salvation through myth, metaphor, and the sacred?

The concepts of myth, metaphor, and the sacred are all closely related and tied up in the right hemisphere of the brain while all are equally incomprehensible and superficial to the reductionist left. As Boyle demonstrates in his chapter on myth in this collection, myth is a story that is not just known but "believed" and is regarded as important or sacred. Keohane (2017: 161) highlights 'the central importance of sacred symbols to sustainable future communities' while citing the value of the sacred in developing the origins of respective civilisations in Mesopotamia, Greece, and Rome, for example, as well as in their ultimate destruction:

> By virtue of sacred symbols, a cosmos becomes structured and ordered, synchronically and diachronically. [On the other hand] …the collapse of civilizations into dark ages, similarly, it is not military defeat or even natural disaster that is the crucial thing, but the dissolution and eclipse of the sacred symbols that organize the cosmos, that make any particular form of life meaningful, worth fighting for and worth defending.
>
> (Keohane, 2017: 161−162)

This is an utterly foreign and ridiculous concept to the rational left hemisphere, which would conceive of the sacred (as with myth and metaphor) as just an emptied, fossilised, antiquated pre-modern conception with little or no use beyond a status as a quaint museum piece among other pre-modern interesting peculiarities.However, the fact remains that the ancient human conception of the sacred has succeeded spectacularly over the ages in preserving and sustaining that which no other means could preserve. Striking examples include that of Bsharri grove, also known as the 'Cedars of God', one of the very last extant historic cedar groves in the Lebanon, and Mount Athos in Greece, a sacred space which managed to maintain its trees and vegetation throughout the millennia, unlike most other Greek mountains which have long been shorn by grazing capricious goats. These remnants of the past have been preserved by virtue of their historic statuses as sacred places, places where it is utterly and eternally taboo to defile, and which therefore have been rendered immune to the economic whims of market forces, whereby 'nothing is sacred' and everything has a market(able) monetary value.

Perhaps therefore, therein lies a key for how we might manage to protect the Amazonian forests or those of Indonesia, where the market forces of globalised agri-food system dictates that indigenous species and communities are less valuable than globally traded marketable commodities. Similarly, for our oceans, which have become dumping grounds for everything from plastics to excess atmospheric carbon while we continually overfish them. If these were to be designated as "sacred" in our collective minds, and if it were deemed to be taboo to desecrate them, then regardless of *any* monetary or market driven incentive, they too could have a far healthier prognosis. Indeed, perhaps this is the only way we can save them from ourselves. The relatively recent legal turn towards indoor smoking bans could only have worked because it quickly became a cultural norm; to such an extent that it is now expressly taboo to smoke indoors in a public place, and is thus simply not done, regardless of any nominal fine or penalty. Such penalties thus remain not called in, because the new cultural norms and constraints dictate that there is no need for legal policing, because it is simply unacceptable to smoke in company in an enclosed public space. The breathable common air in such spaces has been effectively designated as "sacred", and not for wanton contamination by known carcinogens.

We can thus seek to reinvigorate this right brained conception of "sacred", with or without its traditional religious connotations, if we seek to re-enchant our world and environment as something inherently worthy of (beyond materialistic) awe and respect. While the conception of sacred is typically associated with the explicit value set and beliefs of various pre-modern indigenous peoples, it can also find value in contemporary scientific settings. Examples include the work of eminent biologists David Suzuki, author of *The Sacred Balance: Rediscovering our place in nature* (Suzuki and McConnell, 1997) and Stuart Kauffman, who comes at things from a secular scientific biological perspective, in his book, a critique of reductionism entitled *'Reinventing the Sacred: A new view of science, reason, and religion'*. Kauffman implores that we can refashion our attitude to the world around us:

> if we reinvent the sacred, invent a global ethic, come together, and gradually find reverence – meaning, awe, wonder, orientation and responsibility in the world we share. Can I logically force you? No. Can the creativity in the universe invite you? Oh, yes. Listen. (Kauffman, 2010: 442)

Byrne, E. (2022) Why the metaphor of complementary dualism, and metaphor itself, are foundational to achieving sustainability. In: Metaphor, Sustainability, Transformation: Transdisciplinary Perspectives. I. Hughes, E. Byrne, G. Mullally, and C. Sage (eds.). pp. 119-136 Oxon: Routledge.

Indeed, Kauffman would consider the self-organised "partially lawless" creativity that is fundamental to the evolution of the universe to be "God enough" for him, and indeed for many others, ahead of the idea of a six day Abrahamic "Creator God":

> I believe the latter is so stunning, so overwhelming, so worthy of awe, gratitude and respect that it is God enough for many of us. God, a fully natural God, is the very creativity in the universe. …This view of God can be a shared religious and spiritual space for us all.
>
> (Kauffman, 2010: 9)

Others, coming from a religious and theological perspective, such as former Harvard theologian Gordon Kaufman would agree in conceptualising God as Creativity rather than as a hands-on controlling Creator God (Kaufman, 2000). We thus see how secular and religious interpretations can cohere, and even meet, when posited in a right hemisphere context, in ways that are simply impossible from the perspective of the left. This was clearly manifest in an open letter from several eminent scientists (including Nobel Laureates) to the religious community at a 1990 Global Forum of scientists in Moscow entitled *'Preserving and Cherishing the Earth: An Appeal for Joint Commitment in Science and Religion'*:

> As scientists, many of us have had profound experiences of awe and reverence before the universe. We understand that what is regarded as sacred is more likely to be treated with care and respect. Our planetary home should be so regarded. Efforts to safeguard and cherish the environment need to be infused with a vision of the sacred.
>
> (Global Forum, 1990: 2)

It is therefore perhaps unsurprising that constructs around the sacred, as well as myth and metaphor cohere so well in both spiritual/religious settings and integrative secular settings (such as described above), since all are accessed via the right hemisphere, while religious language itself is fundamentally mediated through myth and metaphor and the idea of the sacred.

John Ehrenfeld elaborates that his conception of *sustainability as flourishing* requires an ethic of *care* across four domains; *care* for oneself, *care* for other human beings, *care* for the material world (the environment), and *care* for that which is not in the material world (the transcendent and spiritual), thereby recognising various levels of interconnectedness (Ehrenfeld and Hoffman, 2013: 87−88). Again, this only makes any sense from the perspective of the right hemisphere. And again, though he speaks from a secular perspective, this language can also have resonance in religious and theological contexts. Directly echoing Ehrenfeld's four domains of *care*, Pope Francis, in his encyclical on sustainability and inequality, Laudato Si' (Francis, 2015: 45) suggests that 'disregard for the duty to cultivate and maintain a proper relationship with my neighbour, for whose care and custody I am responsible, ruins my relationship with my own self, with others, with God and with the earth.' He emphasises that 'everything is interconnected' and thus 'social love moves us to devise larger strategies to halt environmental degradation and to encourage a "culture of care" which permeates all of society.' (Francis, 2015: 140)

Moreover, coming from a similar perspective, Josef Zycinski, one time archbishop of Lublin, wrote of a contemporary 'elimination of any kind of moral taboo', which has manifested itself as 'an alienation in which our ties to God, neighbour and nature are subordinated to illusory visions remote from God's plan of creation'. He suggests that this "alienation" flows from 'man's aspiration for absolute autonomy' and is thus (metaphorically or theologically) akin to 'the contemporary persistence of original sin' (Zycinski, 2006: 242). The value and need for a complementary dualism is evident here again; humans clearly have a particularly well-developed autonomy and freedom to generate relationships with each other and the world around us (rather than, as Laplace would have it, being deterministically controlled (by his "Demon"), as programmed automata). However, it would seem grossly hypocritical of us then if we were to seek to exercise this freedom abusively to try to wholly control (as separate, uncaring agents) the world around us (and thus seek to deny autonomy for others or the natural world around us), and thereby seek, in a fashion of "controlling gods", to wholly dictate and manipulate our self-created world to the detriment of others (people, species, etc.). This approach, suffused with both myopia and hubris (and typically laden with left hemisphere controlling techno-optimism), cannot succeed in producing some sort of utopian (or dystopian) outcome, but can only result in a sort of modern Promethean conclusion (itself the subtitle of the Frankenstein story). We would thus be fated to make the same mistakes over and over, in a futile attempt to escape from our current predicament. Einstein's oft quoted (if perhaps misattributed) definition of insanity springs to mind!

Byrne, E. (2022) Why the metaphor of complementary dualism, and metaphor itself, are foundational to achieving sustainability. In: Metaphor, Sustainability, Transformation: Transdisciplinary Perspectives. I. Hughes, E. Byrne, G. Mullally, and C. Sage (eds.). pp. 119-136 Oxon: Routledge.

Conclusion

The metaphor of complementary dualism, writ large in the physical manifestation of the hemispheres of the brain, is seen to be both robust and pervasive. Sustainable progress, it is argued, can actually only be achieved through suitable contingent *balance* between control and freedom or between structure and chaos, in an ever-changing and evolutionary interconnected world and universe. Moreover, metaphor itself is key to both recognising and realising sustainability, since it can stimulate people and societies to be *moved* in a way that any amount of cold rational facts cannot. We have therefore come full circle: Metaphor, the language through which both of CP Snow's famous two cultures communicates (albeit implicitly in science), facilitates and indeed demands the healing of the rift between these two cultures.

By this measure, only a humble and open transdisciplinarity, moulded by recursive and complementary creative learning, can help realise a vista of authentic sustainability. If we accept, as McGilchrist suggests, that the relative influences of the respective hemispheres of that malleable complex organ that is the human brain have varied over time, history and context, then there are important consequences. Given that the relationship between respective hemispheres has helped provide a basis upon which we have conceptualised and built the very world around us, there has to be hope that we can recalibrate this complementary relationship as necessary to achieve a proportionate hemispherical balance (as McGilchrist has pointed out). Such a recalibration would facilitate the brain in helping realise its full potential to deal with complex contemporary and emerging existential challenges. Perhaps also, such a recalibration can rebalance hubristic (left hemisphere) tendencies with an appropriate level of (right hemisphere) groundedness and melancholy, thus imbuing the human temperament with an adequate balance to successfully tackle present and imminent challenges, while also, critically for us, facilitating recognition of their deep significance. In this way, the metaphor of complementary dualism as well as the construct of metaphor itself can be regarded as requisite companions in conceiving a successful and sustainable onward journey along the path of human civilisation.

References

Barry, J. 2017. Bio-fuelling the hummer? Transdisciplinary thoughts on techno-optimism and innovation in the transition from unsustainability. In: E. Byrne, G. Mullally and C. Sage, eds. *Transdisciplinary perspectives on transitions to sustainability*. Abingdon: Routledge, pp. 106–123.

Bhasthi, D. 2017. City of burning lakes: Experts fear Bangalore will be uninhabitable by 2025. *The Guardian*, 1 March 2017. [online] Available at: http://www.theguardian.com/cities/2017/mar/01/burning-lakes-experts-fear-bangalore-uninhabitable-2025 [Accessed 2 September 2019].

Bhat, H. 2017. Because the lake burns. In: L. Bremner and G. Trower, eds. *Monsoon [and other] airs*. London: University of Westminster. pp. 77−82.

Byrne, E. 2017a. Sustainability as contingent balance between opposing though interdependent tendencies. In: E. Byrne, G. Mullally and C. Sage, eds. *Transdisciplinary perspectives on transitions to sustainability*. Abingdon: Routledge, pp. 41–62.

Byrne, E. 2017b. Paradigmatic transformation across the disciplines; snapshots of an emerging complexity informed approach to progress, evolution and sustainability. In: E. Byrne, G. Mullally, and C. Sage, eds. *Transdisciplinary perspectives on transitions to sustainability*. Abingdon: Routledge, pp. 65–82.

Datta, A. 2015. New urban utopias of postcolonial India: 'Entrepreneurial urbanization' in Dholera smart city, Gujarat, *Dialogues in Human Geography*, 5(1), pp. 3–22.

Dittmar, H., Bond, R., Kasser, T., and Hurst, M. 2014. The relationship between materialism and personal well-being: A meta-analysis. *Journal of Personality and Social Psychology*, 107(5), pp. 879−924.

Ehrenfeld, J. R., 2008. *Sustainability by design*. New Haven: Yale University Press.

Ehrenfeld, J. R., 2017. Flourishing and the right brain. [online] Available at:

http://www.johnehrenfeld.com/flourishing_and_the_right-brai/ [Accessed 2 September 2019].

Ehrenfeld, J. R., 2019. *The right way to flourish: Reconnecting with the real world*. Abingdon: Routledge.

Ehrenfeld, J. R. and Hoffman, A. J., 2013. *Flourishing: A frank conversation about sustainability*. Redwood City: Stanford University Press.

Elphinstone, B. and Critchley, C., 2016. Does the way you think and look at the world contribute to being materialistic? Epistemic style, metaphysics, and their influence on materialism and wellbeing. *Personality and Individual Differences*, 97, pp. 67–75.

Fath, B.D., Fiscus, D. A., Goerner, S. J., Berea A. and Ulanowicz. R. E., 2019. Measuring regenerative economics: 10 principles and measures undergirding systemic economic health. *Global Transitions* 1, pp. 15–27.

Francis, 2015. *Laudato Si', encyclical letter of the Holy Father on care for our common home*. New York: Melville House. [online] Available at: http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html [Accessed 2 September 2019].

Gare, A., 2013. The grand narrative of the age of re-embodiments: Beyond modernism and postmodernism. *Cosmos and History*, 9(1), pp. 327–357.

GJo, 2010. [online] Available at: https://upload.wikimedia.org/wikipedia/commons/d/da/Coat_of_Arms_of_Niels_Bohr.svg [Accessed 2 September 2019]. [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)]

Goerner, S.J., Lietaer, B., and Ulanowicz, R.E., 2009. Quantifying economic sustainability: Implications for free-enterprise theory, policy, and practice. *Ecological Economics*, 69(1), pp. 76–81.

Global Forum, 1990. *Preserving and cherishing the earth: An appeal for joint commitment in science and religion*. Moscow: Global Forum. [online] Available at: https://fore.yale.edu/sites/default/files/files/Preserving%20and%20Cherishing%20the%20Earth.pdf [Accessed 2 September 2019].

Hedlund-de Witt, A., 2013. *Worldviews and the transformation to sustainable societies*. PhD thesis. [online] Available at: http://dare.ubvu.vu.nl/handle/1871/48104 [Accessed 3 April 2018].

Heraclitus, 1907. Early Greek thinkers, in *The library of original sources: Volume II (the Greek World)*, O.J. Thatcher, ed. New York: University Research Extension.

Kauffman, S.A., 2010. *Reinventing the sacred: A new view of science, reason, and religion*. New York: Basic Books.

Kaufman, G.D., 2000. *In the beginning … Creativity*, Minneapolis: Augsburg Fortress Publishers.

Keohane, K., 2017. Sustainable future ecological communities: On the absence and continuity of sacred symbols, sublime objects and charismatic heroes. In: E. Byrne, G. Mullally and C. Sage, eds. *Transdisciplinary perspectives on transitions to sustainability*. Abingdon: Routledge, pp. 158–169.

Kharrazi, A., Rovenskaya, E., Fath, B.D., Yarime, M., and Kraines, S., 2013. Methodological and ideological options quantifying the sustainability of economic resource networks: An ecological information-based approach. *Ecological Economics*, 90, pp. 177–186.

Kras, E., 2015. How we think: How it affects sustainable thinking. *Problems of Sustainable Development* 10(2), pp. 63–69.

Lakoff G. and Johnson, M., 1999. *Philosophy in the flesh: The embodied mind and its challenge to western thought*. New York: Basic books.

Levin, S.A. and Lo, A.W., 2015. Opinion: A new approach to financial regulation. *Proceedings of the National Academy of Sciences*. 112, pp. 12543−12544.

McGilchrist, I., 2009. *The master and his emissary*. Yale: Yale University Press.

McGilchrist, I., 2011. The Art of Medicine Paying attention to the bipartite brain. *The Lancet*, 377, pp. 1068−1069.

Mundoli, S., Unnikrishnan, H. and Nagendra, H. 2017. The 'Sustainable' in smart cities: Ignoring the importance of urban ecosystems. *Decision*, 44, pp. 103.

Montuori, A., 2017. The evolution of creativity and the creativity of evolution. *Spanda*, 7, pp. 147–156.

Mullally, G., Byrne, E. and Sage, C. 2017. Disciplines, perspectives and conversations. In: E. Byrne, G. Mullally and C. Sage, eds. *Transdisciplinary perspectives on transitions to sustainability*. Abingdon: Routledge, pp. 21–40.

Nicolescu, B., 2008. *Transdisciplinarity: Theory and practice*. Creskill: Hampton Press.

Nietzsche, F., 1872. *Die Geburt der Tragödie aus dem Geiste der Musik*. Leipzig: Verlag.

Ornstein, R. E., 1997. *The right mind: Making sense of the hemispheres*. New York: Harcourt Brace.

Petersen, R.P., 2013. The potential role of design in a sustainable engineering profile.In: *Engineering education for sustainable development (EESD13)*, University of Cambridge, 22–25 September 2013. Cambridge: EESD.

Schindler, S., 1991. The Tao of teaching: Romance and process. *College Teaching*, 39(2), pp. 71–75.

Stirling, A., 2014. From sustainability, through diversity to transformation: towards more reflexive governance of technological vulnerability. In: A. Hommels, J. Mesman and W. Bijker, eds. *Vulnerability in technological cultures: new directions in research and governance*. Cambridge, MA: MIT Press.

Suzuki, D. and McConnell, A., 1997. *The sacred balance: Rediscovering our place in nature*. Vancouver: Greystone Books.

Ulanowicz, R.E., 2009a. *A third window: Natural life beyond Newton and Darwin*. West Conshohocken: Templeton Foundation Press.

Ulanowicz, R.E., 2009b. The dual nature of ecosystem dynamics. *Ecological Modelling*, 220 pp. 1886–1892.

Ulanowicz, R. E., Goerner, S. J., Lietaer, B. and Gomez, R., 2009. Quantifying sustainability: Resilience, efficiency and the return of information theory. *Ecological Complexity*, 6, pp. 27–36.

Ulanowicz, R.E., 2017. Towards a more global understanding of development and evolution, *Progress in Biophysics and Molecular Biology*, 131, pp. 12–14.

Unnikrishnan, H. and Nagendra, H., 2015. Privatizing the commons: Impact on ecosystem services in Bangalore's lakes. *Urban Ecosystems*, 18, pp. 613–632.

Wessels, T., 2013. *The myth of progress: Toward a sustainable future*. Vermont: University of Vermont Press.

Whitehead, A. N., 1929. *Process and Reality*, New York: Macmillan.

Zycinski, J., 2006. *God and evolution Fundamental questions of Christian evolutionism*. Washington, DC: The Catholic University of America Press. DOI: 10.4324/9781003143567-9