



laetus in praesens

Alternative view of segmented documents via Kairos

27 November 2017 | Draft

Cognitive Osmosis in a Knowledge-based Civilization

Interface challenge of inside-outside, insight-outsight, information-outformation

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Introduction

A major challenge of the times can be framed metaphorically in terms of consumption, osmosis and circulation -- as well as their subsequent consequences. These processes have the advantage of being widely comprehensible with respect to the human body, especially given that osmosis is the process whereby oxygen from the air passes through the lungs into the bloodstream (with an equivalent in plants). The question is what these processes suggest in terms of the processing of information, insight and knowledge.

An argument can be made that there is a case for looking at "information diseases" for clues in this respect (*Memetic and Information Diseases in a Knowledge Society: speculations towards the development of cures and preventive measures*, 2008). In those metaphorical terms, does society face a challenge of "lung disease" and "circulatory disease" -- to say nothing of "nervous disorders" and those of the "digestive system"?

As a process, osmosis is especially significant in that society faces a major difficulty at the interface between "outside" and "inside", whether with respect to outgroups and ingroups, marginal and mainstream disciplines, or insights restricted to the few which are transferable to the many only with difficulty (as may be true of the reverse). There are obviously major social issues with regard to being on the "inside" (namely "in the loop") or on the "outside" ("out of the loop"). The emerging concern with recycling suggests that there are major difficulties that could be usefully understood in terms of the system of consumption and waste disposal.

The widespread recourse to psychoactive drugs suggest that issues of "outside" and "inside" are already of deep concern, whether because of the appeal of "inside" or the consequences of alienation from "outside". Possibilities may be variously explored (*World Introversion through Paracycling: global potential for living sustainably "outside-inside"*, 2013). Under the circumstances, the manner of current economic preoccupation with "import/export" and "input/output" suggests that these may be obscuring systemic dynamics of greater import.

Expressed otherwise, many of these matters have been extensively debated -- seemingly to questionable effect. The difficulty is partly the quantity of information and the form it takes. Have key "insights" become virtually impossible for many to ingest fruitfully? Are they successfully embodied? Are they essentially indigestible? What of their ejection when no longer appropriate?

The issue explored here is whether the challenge can be framed otherwise and more generally through patterns articulated in a different mode -- following the adage **a picture is worth a thousand words**. However, rather than doing this through imagery which has already been deployed to this end, the concern is whether there are patterns which have both a degree of cognitive appeal as symbols (exploiting the potential of 3D and virtual reality), as well as offering further significance from the disciplines with which they are more especially associated.

Basic to this approach is the torus and the transformations to which it lends itself -- including the unusual possibility of its eversion. Not to be forgotten is the sense in which the human body (as with many animals) can be understood as a segment of a torus -- ingesting at

one end, egesting at the other, and forming part of a cyclic system in which **what goes around, comes around**. The concern is whether forms related to the torus and its adaptations constitute a suggestive set of complementary patterns that can be briefly indicated as a catalyst for further consideration.

One key central to this exploration is the long-valued symbol of the **ouroboros** -- currently used to frame the more fundamental preoccupations of cosmology. The symbol typically features a dragon-like serpent. This has the particular merit in this period of engaging popular imagination due to its extensive use in video games and fantasy movies with their improbable appropriation of a multitude of conventionally deprecated traditional symbols. What is being enabled or sought by such engagement?

The argument clarifies the poorly recognized experiential need to "proprioceive" consciously -- in contrast with a detached degree of academic interest in the topic of **proprioception** as a form of cognitive appropriation. The argument highlights the potential implications of "unproprioception" arising from the ambiguity between detachment and attachment -- whether appropriate or inappropriate, as intimately related to property, its obsessive acquisition and sequestration.

Given the challenges of possession and "letting go", and the widespread preoccupation with "analysis", is this coincidentally indicative of a civilization handicapped to an unexplored degree by "**anal retentiveness**"?

Clues to recognition of a more general pattern?

Although the term "cognitive osmosis" is unusual it is indeed occasionally used in reference to contexts in which there is "learning by osmosis", as in the acquisition of experience. Various understood, the many references may then have reservations regarding that process (Bill Marshall, *Does Learning by "Osmosis" Really Work?* *Ezine@articles*, On 30 January 2006; Dan Pontefract, *Learning by Osmosis*, 24 June 2013; *Learning by osmosis isn't a thing*, *StudyRight*; *Learning by Osmosis: the importance of using context clues*, *Fluencia*, 14 August 2015; Carolyn Hoessler, *Learning Through Osmosis*, *Educatus*, 31 July 2013; *How to Learn by Osmosis: the traits of a successful affiliate*, *FinchSells*, 20 November 2012). As "cognitive osmosis" there may be other implications.

In the light of the indications above, it would seem that clues could be sought from the following -- and more especially from the metaphors with which they are associated:

- **eating**: whether understood simply as ingesting food, masticating and swallowing -- or as in "eating up" the opposition, a new rumour (news, etc), the miles (when driving a car). The physiology of **oral processing of food** offers insights through labial movement, use of the teeth and tongue and peristalsis, and how these all work together to process the food prior to absorption of nutrients in the stomach. As a metaphor it may be used to frame the consumption of resources in general, and by extension to the exploitation of non-renewable resources being "eaten up". Potentially more problematic is the manner in which a group will "eat up" newcomers -- processing them from being "outsiders" to becoming "insiders" -- as with **hazing rituals** in educational institutions, the military and prisons. Also of relevance is the sense of "sucking meaning" out of experience, or "sucking dry" the resources of others.
- **breathing**: whether understood in terms of respiration (inspiration, expiration) -- or as in deriving inspiration from people, media, nature, etc. The physiology offers particular insights from the operation of the lung surfaces and there are a number of available animations of that process. As a metaphor its use with respect to new information as "fresh air" is obvious, as with the effects of inhaling polluted air. There is a considerable tradition of meditation on the cognitive implications of inspiration and expiration. Whereas osmosis conventionally refers to transfer of molecules, there is some exploration of how it might be understood in terms of memes (Shane Greenup, *Critical Thinking by Osmosis*, *Medium*)
- **acquisition and appropriation**: understood in the various senses in which possession of elements of the environment is sought and achieved opportunistically, competitively -- "won" or "grasped" -- usefully framed through a play on words as "mining":
 - acquisition of property and "making a profit" -- as is typical of business and entrepreneurship
 - appropriation of intellectual property -- as is typical of surveillance, restrictive control of knowledge in secret, and its "classification" by security services and other interests
 - strategic acquisition and control of territory (hegemony) -- long framed in terms of military conquest and domination
 - sport and the achievement of eminence it offers -- notably promoted as a mark of national preeminence (as exemplified by investment in the Olympic Games)
 - accumulation of merit -- whether in this world or in expectation of a life hereafter (as a primary preoccupation of Buddhism, for example)
 - explanation and "making sense": whether framed as the quest for knowledge by science, or as the articulation of a world view through philosophy and theology
 - gathering experience: whether in life skills, personal relationships, or travel to satisfy curiosity -- exemplified by tourism and the discovery it offers
 - education: whether understood as the acquisition of skills, self-development or as a spiritual quest
- **driving a vehicle**: given the attentive focus to the road ahead as the driver -- or understood as driving (running) an organization, or progressing an ideological or other agenda, following a strategic pathway. These offer insights from conscious control of the driving process, speed, direction, road surface and obstacles, gradient, etc -- and engagement with them, exemplified by the phrase "let's roll". Canoeing offers a variant of the sense of driving a vehicle, notably in the light of the metaphor "pushing the river versus guiding the canoe". A contrasting variant is offered by the sense of boring a tunnel, "driving" a tunnel, and driving through it -- possibly framed in terms of expectation of the "light at the end of the tunnel".

- **self-promotion:** to attract attention in quest of re-cognition, possibly involving "re-invention" of oneself through the image projected -- exemplified by obsession with the accumulation of "likes" on social media.
- **breaking wave:** whether as most commonly recognized at a beach and the possibilities of surfing -- clarified by insights from fluid dynamics. In the latter case a **breaking wave** is one whose amplitude reaches a critical level at which some process can suddenly start to occur that causes large amounts of wave energy to be transformed into turbulent kinetic energy. At this point, simple physical models that describe wave dynamics often become invalid, particularly those that assume linear behaviour. The sense of an advancing wave or a new wave is indicative of how encountering the future may be experienced. Used as a metaphor, it may describe the onset of some form of change -- possibly in fashion, in public opinion (as on social media), or at the onset of revolution. There is extensive use of "third wave" (as in **Third-wave feminism**, **Third Wave Democracy**, *The Third Wave* (1980) by Alvin Toffler).

Missing from their appreciation as distinct processes is the manner in which each may undermine qualities associated with others. This is exemplified by the sacrilegious treatment of graves by archaeologists at the service of museums -- totally lacking in respect for what was sought by those buried and their cultures.

Eating offers the most obvious insights into "cognitive osmosis", given the gustatory process of tasting and **mouthfeel** -- especially cultivated in **wine tasting**. The cognitive engagement in music appreciation offers another striking example. By contrast, an associated process of metaphorical significance is offered by the bidirectionality of respiration (inspiration/expiration) and eating (whether as regurgitation or as spitting, notably a characteristic of the wine tasting process).

As seemingly disparate processes, the argument here is that these all suggest or imply the possibility of a more generic understanding, namely of how they offer complementary insights into a process which calls for cognitive appreciation. Their apparent variety invites efforts to cluster them according to drivers they variously share to different degrees, such as curiosity, possession, education. The examples may draw valuable attention to aspects of what is presumably a very complex process -- one which is non-linear and probably multidimensional in ways which call for new approaches to their visualization.

The focus follows from the work of **Mark Johnson** (*The Meaning of the Body: aesthetics of human understanding*, 2007; *The Body in the Mind: the bodily basis of meaning, imagination, and reason*, 1987), **George Lakoff** and **Mark Johnson** (*Philosophy in the Flesh: the embodied mind and its challenge to western thought* 1999) and **Maxine Sheets-Johnstone** (*Movement as a Way of Knowing*, *Scholarpedia*, 8, 2013; *The Primacy of Movement*, 2011).

A related exploration took a different form (*Clues to Movement and Attitude Control*, 2002; *Combining Clues to Movement and Attitude Control*, 2002) as part of a larger concern with **metaphoric entrapment** (*Navigating Alternative Conceptual Realities: clues to the dynamics of enacting new paradigms through movement*, 2002). There is a case for recognizing that the current global civilization is cognitively "trapped" by its own preferred metaphors. This recalls the insight of **Geoffrey Vickers**: **a trap is a function of the nature of the trapped** (*Freedom in a Rocking Boat: changing values in an unstable society*, 1972).

The quest for clues, and the possibility of new forms of visualization, relates to the need for mnemonic catalysts (*In Quest of Mnemonic Catalysts -- for comprehension of complex psychosocial dynamics*, 2007). This in turn can be understood as a challenge to the imagination (*Imagining the Real Challenge and Realizing the Imaginal Pathway of Sustainable Transformation*, 2007).

Given the strategic concern with **Global Sensemaking**, the question is how to benefit from the clues offered by a proprioceptive exploration of the senses (John O'Dea, *A Proprioceptive Account of the Sense Modalities*, 2011).

Complementary visual patterns: Ouroboros, Möbius strip, Klein bottle

The focus in the following examples is on some form of injection dynamic. However "inappropriate", it is of course of great interest to recognize examples with respect to ejection in a later portion of what is necessarily to be understood as a cycle. The patterns presented here are all based on the **torus**, derived from it, or associated with it in some way. In its more commonly recognized form as a ring or halo, its appreciation as a much-valued symbol should not be forgotten.

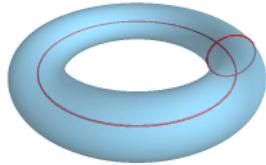
Of particular relevance is the topological relation between the torus and the sphere -- given the importance currently associated with globalization and the challenges of the spherical globe as a widely indicated symbol. It is in this respect that the seeming improbability of **sphere eversion** (without tearing or creasing) merits attention. This possibility was first proven by **Stephen Smale** (*Classification of Immersions of the Two-Sphere*, 1958). The process is demonstrated in various videos (Sandra Streams: *Turning a Sphere Inside-out*, *YouTube*, 1994; **Justin Bruckman**, *How to Turn a Sphere Inside Out*, *YouTube*, 2007).

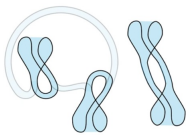
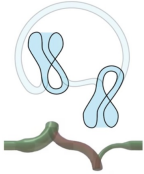
Given the fundamental importance of the symbol, the implications of eversion for any form of global understanding and insight are another matter, as separately argued (*World Introversion through Paracycling: global potential for living sustainably "outside-inside"*, 2013).

Whether the symbolic focus is through the sphere or the torus, of particular interest is the sense they offer of enveloping -- possibly through "grasping" and "grabbing". Related processes include: englobing, encompassing, enwrapping, enclosing and encircling. The latter is highlighted in the phrase "**circling the wagons**". Such processes variously imply a sense of embodiment -- with the possible further implication of entitlement. A particular sense of the process is offered by the processes in the game of go, whose significance with respect to the promise of artificial intelligence have been recently highlighted (*AlphaGo Zero: Google DeepMind supercomputer learns 3,000 years of human knowledge in 40 days*, *The Telegraph*, 18 October 2017).

Torus -- its inversion and eversion: Standard tori fall into four categories. namely the relatively familiar **ring torus**, a **horn torus** with the rotating circle touching the axis of rotation, or a self-intersecting **spindle torus**, with the sphere considered as a degenerate case.


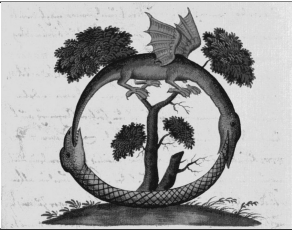
Inversions of the standard tori are known as [cyclides](#) (or [Dupin cyclides](#)), of which the [ring cyclide](#) is especially relevant to the following visualizations. Others include the [horn cyclide](#) and the [spindle cyclide](#).

Animation of torus-sphere transformation (Reproduced from <i>Wikimedia</i>)	
	<p>Discussed in:</p> <ul style="list-style-type: none"> • <i>Comprehension of Requisite Variety for Sustainable Psychosocial Dynamics: transforming a matrix classification onto intertwined tori</i> (2006) • <i>Enabling Wisdom Dynamically within Intertwined Tori: requisite resonance in global knowledge architecture</i> (2012) • <i>Visualization in 3D of Dynamics of Toroidal Helical Coils -- in quest of optimum designs for a Concordian Mandala</i> (2016) • <i>Toroidal configurations as fruitful looperly</i> (In: Changing Patterns using Transformation Pathways, 2015) • <i>Cognitive implication of toroidal forms and dynamics</i> (2011) • <i>Toroidal cognitive container?</i> (2011)

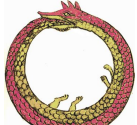



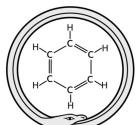
Animation of torus inversion/eversion		
		<p>Videos showing torus eversion (inspired by the possibility of sphere eversion):</p> <ul style="list-style-type: none"> • Arnaud Chéritat: <i>Torus eversion: turning the torus inside out</i> (YouTube, 2017) • Greg McShane: <i>Torus eversion</i> (YouTube, 2008) <p>Images on the left from Carlo H. Séquin (<i>Torus Immersions and Transformations</i>). See commentary and imagery on smooth torus eversion (<i>Mathematics Stock Exchange</i>, 2013)</p>

Ouroboros (Uroboros): The [ouroboros](#) symbol has been of fundamental importance to alchemy and continues to be so, as extensively studied by [Carl Jung](#) (*Psychology and Alchemy*, 1944; *Mysterium Coniunctionis; an inquiry into the separation and synthesis of psychic opposites in alchemy*, 1970) and by [Marie-Louise von Franz](#) (*Alchemical Active Imagination*, 1997). The ouroboros is central to a current exhibition on *Never Ending Stories: the loop in art, film, architecture, music and cultural history* (Kunstmuseum Wolfsburg) as summarized and illustrated by [Joobin Bekhrad](#) (*The Symbol that Spanned Millennia*, BBC: *Art History*, 4 December 2017).

The BBC summary uses as its primary image one of a double dragon-serpent. This features with related images in an extensive account by Iona Miller (*Jungian Genealogy: Jung on the Serpent*). The coloured image, variously available, has been reversed and depicted in a black-and-white version below.

Image of double dragon-serpent Ouroboros	
Reverse colour	Black-and-white
	
<p>Original image from <i>Clavis Artis</i>, an 18th century manuscript on alchemy attributed to Zoroaster (Biblioteca dell'Accademia Nazionale dei Lincei, Rome)</p>	

The symbol continues to be widely valued in jewelry and iconography, with many imaginative variants in torcs, pendants and clasped bracelets. Of considerable significance in this respect is its appeal as a symbol by-passing a plethora of explanations and commentary. However it is the manner in which the intertwining of its elements is explored that merits recognition of an intuitive appreciation of forms of complexity understood through symmetry. Some forms recall the widely recognized symbol of infinity with which the ouroboros is closely associated. That on the right below recalls the association with the [dream of August Kekulé](#) enabling the discovery of the structure of the benzene molecule so fundamental to organic life.

Contrasting depictions of the ouroboros -- and its associations with infinity symbol				
				

The relation between two dragons in variants of the symbol can be usefully compared with continuing popular appreciation of the [dragon dance](#) of Chinese culture. The dragon is often led by a person holding a spherical object representing a pearl. There are many depictions of intertwined dragons in pursuit of a pearl. Other cultures have engendered comparable symbols as with references to a pair of serpents. The [omphalos in the temple of Apollo in Delphi](#) is associated with the myth of the meeting point of two eagles sent by Zeus. Images of the Mayan deity [Quetzalcoatl](#) tend to be considered comparable to the ouroboros.

The coiling of two serpents around an axial rod forming the [caduceus](#) dates from the Mesopotamian deity [Ningishzida](#) and has associations with trade, eloquence, negotiation, alchemy and wisdom. [As a symbol of healthcare, it has been [mistakenly appropriated as a symbol of medicine](#) in modern times -- confused with the [Rod of Asclepius](#) of Greek mythology, the internationally recognized symbol of medicine, but having only a single serpent.]

The ouroboros has been used to frame considerations of cosmology, notably in the form of a frequently reproduced image by [Nancy Ellen Abrams](#) and [Joel R. Primack](#) (*Cosmic Ouroboros*, 2006; *The View From the Center of the Universe*, 2007). For a civilization in crisis globally this suggests a final cognitive frontier -- in several senses (*Being the Universe : a Metaphoric Frontier*, 1999; *Metaphors To Die By: correspondences between a collapsing civilization, culture or group, and a dying person*, 2013). This would follow from the arguments of [Henryk Skolimowski](#) (*The Participatory Mind: a new theory of knowledge and of the universe*, 1994).

Related issues are discussed in:

- [Engaging with Globality through cognitive lines, circlets, crowns or holes](#) (2009)
- [Designing Cultural Rosaries and Meaning Malas to Sustain Associations within the Pattern that Connects](#) (2000)
- [The-O ring: Theory, Theorem, Theology, Theosophy? a playful intercultural quest for fruitful complementarity](#) (2014)
- [Engaging with a fundamentally integrative perspective](#) (2014)



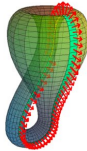
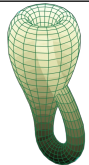
With respect to intuitive recognition of the challenges of some form of "cognitive osmosis", it could be argued that this is evident to a degree in current interest in a [Triple Helix concept](#) in sustaining innovation -- as promoted by the [Triple Helix Association](#). This is partially inspired by the [double helix of DNA](#) -- with which both the single-serpent and double-serpent varieties of DNA can be readily compared ([Jeremy Narby](#), *The Cosmic Serpent: DNA and the origin of knowledge*, 1998). As argued by [Jamie Davies](#) (*A Closed Loop, Aeon*, 26 September 2014):


The DNA helix gave 20th-century biology its symbol, but the more we learn, the more life circles back to an older image... The helix is too well-established an icon to be deposed any time soon. And yet, a simple loop would be a much more universal symbol of how life works at all of its scales and levels. Perhaps the Ouroboros, beloved of gnostics and alchemists, has been an ideal symbol waiting in the wings for centuries: there can surely be no more evocative symbol of feedback than a snake growing by devouring its own tail.

The Triple Helix approach has been recently extended to advocacy of Quadruple Helix and Quintuple Helix models. To the extent that such helices constitute a contemporary recognition of cognitive "serpents" between which communication has been inadequate, the ouroboros may well be understood as potentially made up of multiple strands between which osmosis of some kind is required (as further discussed below).

Möbius strip and Klein bottle: The intricacies of some variants of the ouroboros symbol notably anticipate the paradoxes of the [Möbius strip](#). The torus itself is discussed extensively in relation to the ouroboros, the Möbius strip and the [Klein bottle](#) by [Steven Rosen](#) (*Science, Paradox, and the Moebius Principle: the evolution of a "transcultural" approach to wholeness*, 1994; *Dreams, Death, Rebirth: a multimedia topological odyssey into alchemy's hidden dimensions*, 2014). This concern includes recognition that the wholeness implied by the ouroboros is fundamentally characterized by paradox ([Steven Rosen](#), *Wholeness as the Body of Paradox*, *Journal of Mind and Behavior*, 18, 1997).

Rosen is especially articulate with respect to the process of proprioception in relation to phenomenology and -- following the inspiration of [David Bohm](#) -- with the implications for proprioceptive dialogue (*Practicing Proprioceptive Dialogue, Embodying Cyberspace*). Proprioception is discussed further below.

Möbius strip		Discussed in:
		
Klein bottle		Discussed in:
		
Animation by Konrad Polthier (<i>Imaging Maths: inside the Klein bottle</i> , <i>+Plus Magazine</i> ,	Two-dimensional representation of the Klein bottle immersed in three-dimensional space	<ul style="list-style-type: none"> • Intercourse with Globality through Enacting a Klein bottle: cognitive implication in a polysensorial "lens" (2009) • Strategic Complexity -- Attracting Consensus: Klein is beautiful -- Sustaining identity in time (2011)

September 2003; [click for animated version or explore java applet]	(reproduced from <i>Wikipedia</i>)	
Toroidal adaptation of Klein bottle (stretched image from <i>Wikipedia</i>)		
		

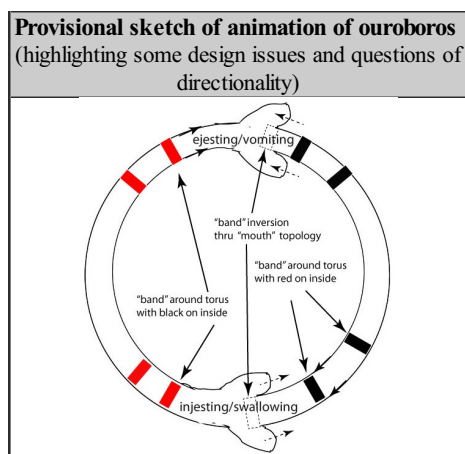
A symbol such as the ouroboros is therefore at the nexus of the paradoxical cognitive challenges of integrative embodiment as may be variously discussed (*Embodying Strategic Self-reference in a World Futures Conference*, 2015; *Embodying a Way Round Pointlessness ?* 2012, *Embodying the Paradoxes and Contradictions of the Pursuit of Happiness*, 2011; *Defining the objective & Refining of the subjective ?! Explaining reality & Embodying realization*, 2011, *Embodiment of Change: Comprehension, Traction and Impact? Discovering enabling questions for the future*, 2011)

Configuration and animation possibilities in 3D

The concern in what follows relates to the possibility that new forms of animation may render more comprehensible the interface between "insight" and "outside" in support of intuitive experience of that interface. The idea is that beyond conventional representations of the Klein bottle, and the subtlety of its 4D implication, there may be other forms to be explored as a stimulus to the imagination. Especially relevant to this possibility is that **an animation of any symbol in virtual reality allows the user to interact with it and to shift the perspective to a variety of viewpoints, notably those within the form intimately related to any understanding of injection or ejection and of "cognitive osmosis"**. Such a feature cannot be enabled with such facility in relation to the Klein bottle or the perspectival marvels of [M. C. Escher](#).

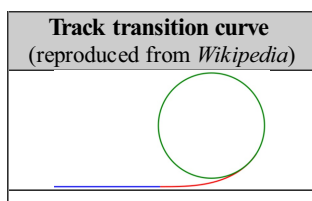
The sketch on the left below indicates one possibility using a toroidal ring. The two "heads" may be understood as moving in relation to that ring -- along it -- with the ring passing through the head. In digesting or ejecting the ring, each mouth/head is necessarily to be understood as itself taking the form of a ring. The join between the head and the torus can be understood as continuous with the head better understood as a wave motion moving integral to the surface of the torus -- rather than the head sliding over the torus.

The adaptation of the torus as sketched below could invite far greater speculative engagement through the following images regarding the locus of "osmosis", namely in the "mouth" of a toroidal adaptation of the ouroboros. How might the process of paradoxical reversal, from outside to inside, be variously imagined? And then from inside to outside? Again, the points from which the user can view the symbol include **"through the eyes of the dragon"** -- if that is the preferred design metaphor, rather than as driver of a vehicle (for example).



The preliminary focus in what follows is the dynamics of what happens within the "mouth". However there is the further concern as to the direction in which the heads are facing, including the possibility that those directions might alternate to hold other insights. The issue in that respect is how an injecting head/mouth might function in relation to an ejecting head/mouth -- possibly more reminiscent of an anus.

Transition curve (Euler spiral / Cornu spiral / Clothoid / Spiro): The [Euler spiral](#) is a curve whose curvature changes linearly with its curve length (the curvature of the circular curve is equal to the reciprocal of the radius). Euler spirals have applications to diffraction computations. They are also widely used as [track transition curves](#) in railroad engineering/highway engineering for connecting and transiting the geometry between a tangent and a circular curve.



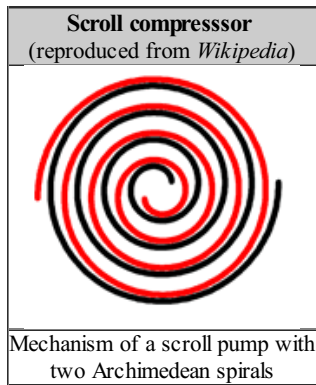
The red Euler spiral is an example of an easement curve between a blue straight line and a circular arc, shown in green.

Given the problematic consequences of "linear thinking", arguably there is urgent need for "track transition" from linear to circular, and for easement curves of a psychosocial nature.

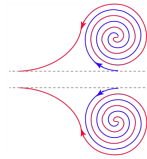
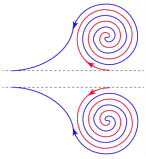
The nonconventional orientation on the left below, and the duplication on the right, are used as a very preliminary suggestion of what might be achieved with a configuration in 3D. That on the left is suggestive of how the ouroboros might have a "transitional twist" from one "head" to another. That on the right is somewhat suggestive of how the "mouths" might function.



Archimedean spiral in 3D: The [Archimedean spiral](#) (also known as the arithmetic spiral) is the locus of points corresponding to the locations over time of a point moving away from a fixed point with a constant speed along a line which rotates with constant angular velocity. Fundamental to the design of a [scroll compressor](#) (spiral compressor, scroll pump), this uses two interleaving scrolls to pump, compress or pressurize fluids such as liquids and gases. Operated in reverse, a scroll compressor is known as a scroll expander (see [Scroll Expander Animation](#); [video](#)), and can be used to generate mechanical work from the expansion of a fluid, compressed air or gas.



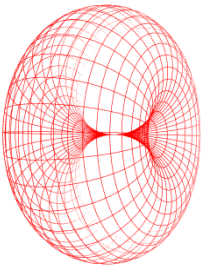
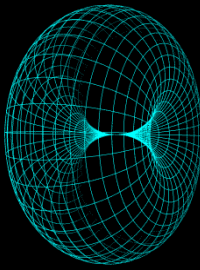
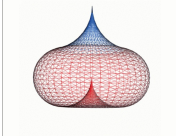
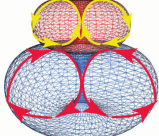
How might such processes be understood with respect to psychosocial "fluids" -- namely movements of opinion.

Contrasting operation of "mouths"		Significance of this spiral in 3D is discussed in :
Cross-section of "Head Out"	Cross-section of "Head In "	
		<ul style="list-style-type: none"> • <i>Psychosocial Learnings from the Spiral Form of Hurricanes: implications of the triple helix and the 3-fold triskelion as "cognitive cyclones"?</i> 2017 • <i>Forms of the triskelion in 3D of potential significance</i> (In: <i>Cognitive Implications in 3D of Triadic Symbols Valued in 2D</i>, 2017) • <i>Framing Cyclic Revolutionary Emergence of Opposing Symbols of Identity</i>, 2017 <p>Illustrative animations in virtual reality enabled in the above by Sergey Bederov of Cortona3D</p>

As cross-sections it is appropriate to repeat that the Archimedean spirals for each head are a continuous 3D "lip structure" of a mouth around the torus. These depictions, together with the scroll pump/expander animations, focus attention on the nature of the "osmosis" of concern here, namely how "outside" can be understood as transformed into "inside" -- and "inside" into "outside" -- through some analogue to a [semi-permeable membrane](#). As noted above, the obvious example is lung operation in respiration, whereby oxygen is extracted from the atmosphere and transferred into the bloodstream, and carbon dioxide is transferred from the bloodstream into the atmosphere, in a process of [gas exchange](#).

Horn torus and cardioid in 3D: The [horn torus](#) is one of three [standard tori](#) which is however a tangent to itself at the point (0, 0, 0). The animations below are adaptations, with permission, of an animation by [Wolfgang Daeumler](#) (*Horn Torus*). These offer one suggestion regarding the operation of the two mouths placed in relation to the larger torus which they ingest or eject -- although clearly the larger torus tube would then be of minimal diameter in the animations shown (effectively of zero diameter there). If it was of larger diameter, the mouths would obviously not take the form of horn-type tori, but could have a similar dynamic.

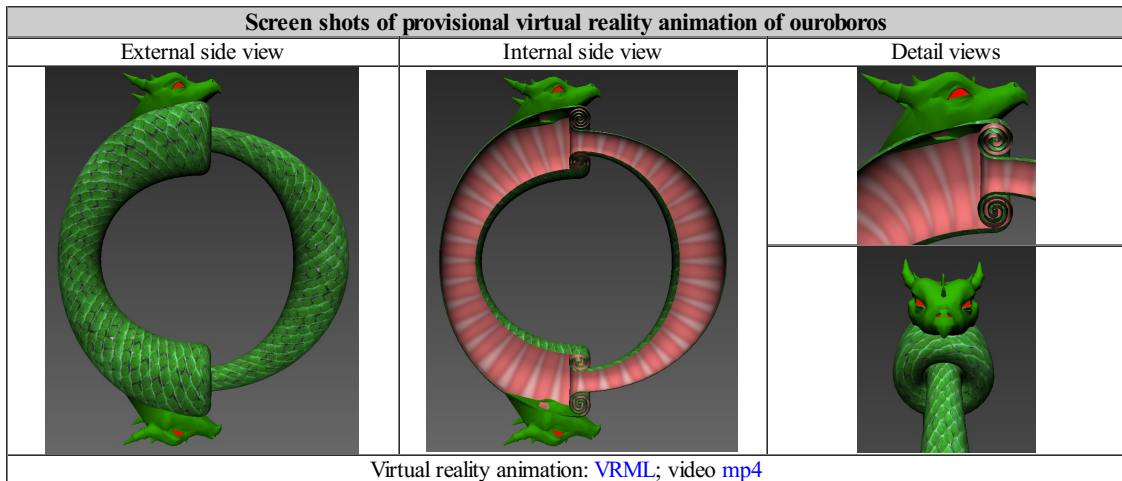
The dynamic shown below raises the further question as to whether the ring of Archimedean spiral rings forming and framing the mouth could also usefully rotate -- functioning as a vortex -- or whether the motion of the spirals within the mouth could be limited to those of scroll compressor/expander indicated above.

<p>Dynamics of "Head-Out"?</p> 	<p>Dynamics of "Head-in"?</p> 	<p>Discussed with respect to:</p> <ul style="list-style-type: none"> • <i>Cognitive heart dynamics framed by two tori in 3D</i> (In: <i>Visualization in 3D of Dynamics of Toroidal Helical Coils: in quest of optimum designs for a Concordian Mandala</i>, 2016) • <i>Framing the Interplay of Leadership and Misleadership - in the light of the coaction cardioid and the Mandelbrot set</i> (2007) <p>Illustrative animations in virtual reality enabled in the above by Sergey Bederov of Cortona3D</p>
		

*** helixtor/heart_alone.x3d

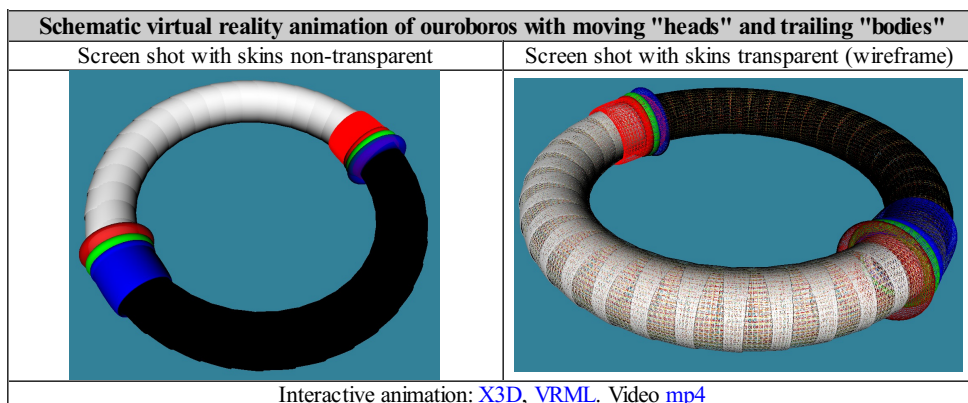
Experimental animations in 3D of the ouroboros pattern

The following animation was produced as an exercise by Sergey Bederov of [Cortona3D](#) using the virtual reality modelling language ([VRML](#)). As indicated below, it may be explored with appropriate browser facilities or viewed as a video. It is based on the preliminary indications outlined above. Notable is the interactive facility to view the inside of the ouroboros by simply clicking on it. Especially remarkable (from the detail on the right) is how the transition between "outside" and "inside" is accomplished dynamically through a motion based on the Archimedean spiral "lip" design around the "mouth" (as suggested above).

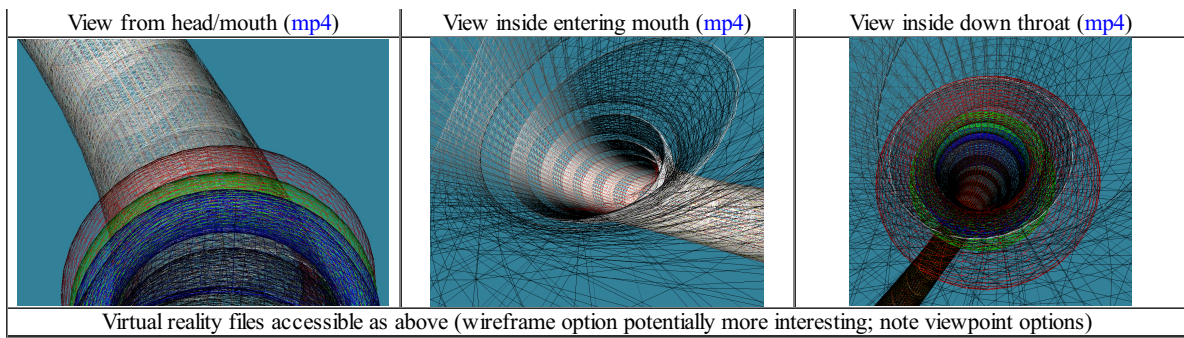


As implemented above the experiment usefully highlights both various design issues and the nature of the "story" they might carry. Should the "heads" be pointing in the same direction or in opposite directions? What kind of movement of the bodies would then be appropriate? Are there other techniques for suggesting the nature of the osmosis between inside and outside?

The following exercise is based on a more schematic approach (with notably less efficient coding and the more limited aesthetics). In this case the "heads" -- pointing in the same direction -- move around the toroidal ring in such a way as to suggest that the "body" pulled behind each is of a distinctive colour. Each "mouth" then consumes what has been "embodied" by the other. It is then the "scales" on the body (better viewed in the right hand image) which change from one colour to the other as they are injected by the "mouth" which consumes them.



Screen shots of schematic ouroboros animation in 3D (wireframe renderings)

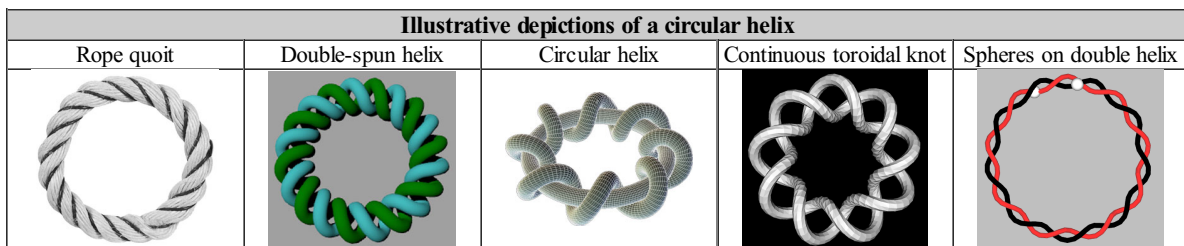


In this exercise, the torus contains a second torus within it. Various experiments can be made to render transparent either the "scales" around the outer torus or that torus itself -- in order to render visible the changing pattern of variously coloured scales around the inner torus. The question is how best to highlight the transition between "inside" and "outside" which is the intended purpose of the animation. The design can be readily adapted with respect to colour of the "skin", rate of movement and design of the "head".

In its current simple form the animation is a clear illustration of an ideal recycling process in the environment. One "head" processes products enhanced by the other, degrading and egesting them into a condition requiring reprocessing. The design of both animations can be usefully challenged by comparison with the Klein bottle as exemplifying the paradoxical "nondual duality" required by the arguments of Steven Rosen. Do the animations adequately imply the need for the 4-dimensional insight required to comprehend the Klein bottle -- through the dynamics of the animations? How might their respective animations of cognitive osmosis be challenged and improved?

Future design options for interactive 3D animations of cognitive osmosis

Given the intertwining of the "serpents" in some varieties of the ouroboros, further inspiration for designs could be derived from helical coils, reproduced from a n earlier exercise (*Visualization in 3D of Dynamics of Toroidal Helical Coils -- in quest of optimum designs for a Concordian Mandala*, 2016). Interactive versions for the two on the right are accessible (X3D or VRML; with sphere movement, X3D or VRML). The sphere movement could be used as a design basis for "serpent head" movement, for example.



As suggested above, the ouroboros may well be understood as potentially made up of multiple serpent-like strands between which "cognitive osmosis" of some kind is required. This may have been an intuition leading to the emergence of current interest in a [Triple Helix concept](#) in sustaining innovation, recently extended to advocacy of Quadruple Helix and Quintuple Helix models (*Systemic closure: fourth helix -- and beyond?* 2017). The implications have been variously discussed separately (*Cognitive Implications in 3D of Triadic Symbols Valued in 2D*, 2017; *Psychosocial Learnings from the Spiral Form of Hurricanes: implications of the triple helix and the 3-fold triskelion as "cognitive cyclones"?* 2017).

The above-mentioned interest in toroidal helical coils included presentation 5-coil configurations with multiple windings (*Dynamic possibilities of 3D visualizations of a helical toroid with multiple windings*, 2017). Various formats are available (interactive X3D or VRML; videos: MP4; MOV)..

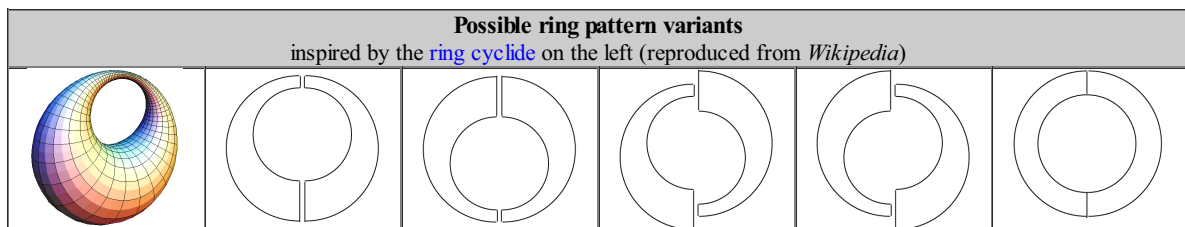
From a design perspective, no particular model should necessarily be produced, but rather **the focus could be more usefully placed on the development of a software template or platform inviting multiple design variations** -- a template for the imagination with possibilities such as the following:

- distinctive motions (possibly at contrasting rates)
 - ripple/wave along skin, perhaps in the form of [peristaltic waves](#)
 - spiral twisting of patterns on the skin (rope-like "writhings")
 - rotation of mouth
 - movement into mouths
 - colour (and transparency) phased variations of portions of ring and heads/mouths
 - relative size of ring and heads/mouths
 - blinking eyes (if relevant to the head design)
- multiplicity:
 - number of heads on toroidal ring (as with Club Med plastic tokens of exchange, snapped together to form a bracelet or necklace)
 - forms of ring (simple, figure-of-eight, intertwined, etc)
 - rings (for example several linked in [Borromean style](#))
 - segments to ring (fragmented, disjointed, unjoined-up), systemically incomplete, associated with multiple heads (possibly to be associated with the cycle of four seasons)

- "skins" and "bodies":
 - skin colour fading from head to tail, especially with a single-headed symbol (as is the case with many images of the ouroboros, potentially indicative of ideal transcendent of duality)
 - relative transparency of body(s) and head(s)
 - phasing processes in the alchemical *magnum opus* in relation to a toroidal ring ([nigredo](#), [albedo](#), [citrinitas](#), [rubedo](#)), as has been traditional with the ouroboros
 - body texture (banding, spiral, scales, etc)
 - dragon themes: flames from head? (in/out), skin shedding?
- "heads", "mouths" and "anal" forms (with and without eyes, in the light of their evolutionary emergence)
 - simple geometry (vortex)
 - basic biological head (possibly as an anus)
 - insect siphoning [mouth parts](#) ([haustellate](#))
 - sucking mouth parts of leeches
 - dragon framing as in the classical ouroboros
 - human caricature (as in political cartoons, Medusa-style archetypes, etc)
- viewpoints from which the user can interactively choose to perceive the animation:
 - from "head":
 - as with the dashboard/windscreen of car / aircraft / spacecraft -- of the route followed (or the stars flashing by in the classic depiction of travel in a spaceship)
 - as from a conference podium -- of an audience
 - as from a tactical situation room
 - as from the afterdeck of a ship
 - zoom:
 - onto skin detail (as with Google Earth -- people, waste, etc)
 - down to osmosis ("gas exchange")
- sound files, possibly relevant to different parts of the symbol

Of particular interest from a systemic perspective is the general form of the ouroboros as a variant of the toroidal ring, with variants inspired by

- paired "horns", as with the [cornucopia](#) ("horn of plenty"), a curved [Gabriel's horn](#), an [ear trumpet](#), or the variety of [animal horns](#)
- portions of spirals, as with the Fibonacci spiral or the Harriss spiral
- ring cyclides, potentially especially appropriate as inversins of the torus, with alternatives illustrated by the following



The systemic and cognitive significance of the four ring patterns would of course depend on whether the upper or lower interface between the halves was associated with the the injecting or egesting locus of the head/mouth -- with the pattern on the right as possibly a hypothetical ideal. Which way is the other head pointing?

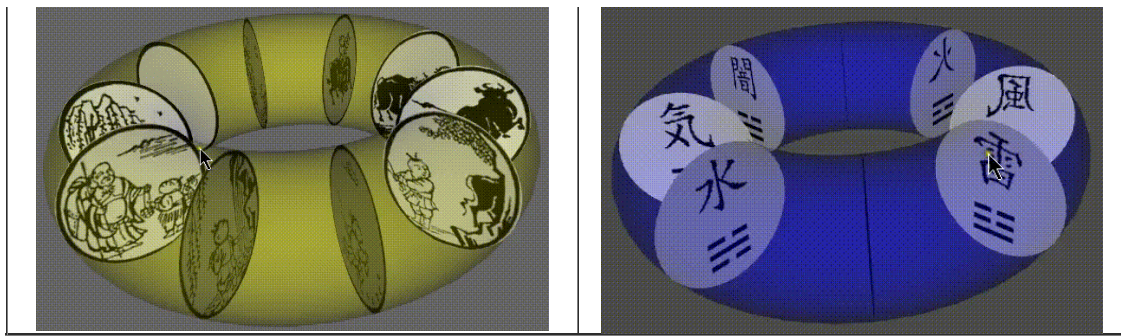
The variants offer the possibility for exploration of contrasting systemic "stories". The patterns raise valuable issues with respect to how significance is then associated with highly controversial symbolic issues of [chirality](#) and [handedness](#). Especially problematic from symbolic, systemic and psychosocial perspectives is the controversial function of the "head/mouth" as an overtly recognized primary attractor in contrast with the powerful covert attraction exerted by the "other end" with which reproduction is associated -- and fundamental to so much psychoanalysis.

Also to be noted is that as symbols in virtual reality, these can be reoriented in a variety of ways. Clearly an animation could permit alternation between such alternative depictions.

Circular configuration of cognitive phases framing toroidal experience?

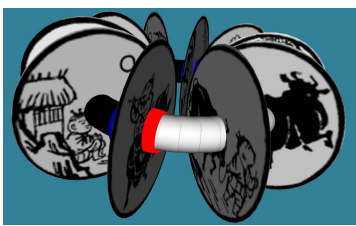
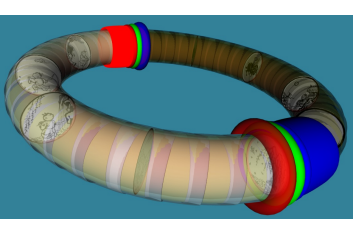

The schematic animation above was adapted from a previous exercise in configuring the set of [10 Zen ox-herding pictures](#) into toroidal form (*Circular configuration of cognitive phases framing toroidal experience?* 2017). This gave rise to the following animations in the context of a more general argument which included specific references to the ouroboros (*Zen of Facticity: Bull, Ox or Otherwise? Herding facts and their alternatives in a post-truth-era*, 2017).

Animation of simplest torus as container for dynamic cognitive relations	
<i>10-fold pattern of Zen bulls</i> (also .mp4 , .wrl and .x3d versions)	<i>8-fold BaGua pattern of trigrams</i> (also .mp4 , .wrl and .x3d versions)



Reproduction of the above animations here is justified in that they suggest an adaptation of the schematic animation of the ouroboros with respect to what is "encountered" cognitively when the "head" travels around the toroidal form. This is particularly appropriate to the extent that the animations above are specifically concerned with subtle cognitive processes.

A version of the schematic animation can therefore be produced to include a succession of scenes "through which" the head passes -- suggesting a succession of such processes. Similarly such use of scenes would allow the imagery associated with the [cosmological depiction of the ouroboros](#) (mentioned above) to be presented in another adaptation, most notably to highlight that scaled argument in relation to powers of 10 -- in 12 phases from 10^{-25} to 10^{30} , variously depicted otherwise (*Scale of the Universe: powers of ten*, 1977).

Experimental combination of ouroboros schematic animation with 10 Zen ox-herding images		
Ouroboros through images	Images within ouroboros	View of image within ouroboros
		
Adapted from <i>Zen of Facticity: Bull, Ox or Otherwise? Herding facts and their alternatives in a post-truth-era</i> , (2017)		

Rather than the option of increasing the diameter of the scenes around the torus (left above), a different approach is possible. The scenes can be positioned within the torus as shown in the earlier animations (above centre), namely to be traversed through movement along the torus -- but within it. Further options are to vary the diameter dynamically between being visible only within and enlarged as shown above.

Cognitive osmosis through topological eversion and interlocking tori -- framing outside-inside otherwise

Strange loops: This argument derives its inspiration from the improbable processes of sphere eversion, the eversion of the torus, and from the topological transformation between sphere and torus (as illustrated in an animation above). The challenge to the imagination and to cognitive significance can be variously envisaged (*Transforming vehicles of identity between global and toroidal forms*, 2016).

As prominent symbols of wholeness, it is this improbability which recalls the argument of Steven Rosen (*Wholeness as the Body of Paradox. Journal of Mind and Behavior*, 18, 1997). The point is made otherwise with respect to "strange loops", described by *Wikipedia* as a cyclic structure that goes through several levels in a hierarchical system: *It arises when, by moving only upwards or downwards through the system, one finds oneself back where one started*. Strange loops typically involve [self-reference](#) and paradox, as proposed and extensively discussed by [Douglas Hofstadter](#) (*Gödel, Escher, Bach: an eternal golden braid*, 1979; *I Am a Strange Loop*, 2007).

With respect to such strangeness, the animation possibilities discussed suggest that consideration should also be given to the symbol as a whole -- with any serpents as being indicative of strange loops. One clue is offered by the pursuit of a pearl in the Chinese dragon dance. As a pearl of wisdom, this accords with the integrity implied by the ouroboros. However this can also be seen as implied by the hole which it frames and around which one or more serpents are entwined.

Potentially of great relevance to this argument are the international hopes associated with [nuclear fusion](#), currently the focus of the [International Thermonuclear Experimental Reactor](#) (ITER). The toroidal form of the reactor is designed to contain plasma with the potential to destroy it if not managed appropriately. The "snake" metaphor has long been used in the description of instabilities in the circulating plasma in the reactor -- including "runaway snakes". The project -- including the [snake metaphor](#) -- offers a remarkable range of metaphors of relevance to cognitive osmosis, as discussed separately (*Enactivating a Cognitive Fusion Reactor: Imaginal Transformation of Energy Resourcing (ITER-8)*, 2006)

Holes: Such a symbolic hole merits the attention recently accorded to the mysterious nature of holes as explored by [Roberto Casati](#) and [Achille C. Varzi](#) (*Holes and Other Superficialities*, 1994) -- with respect to the borderlines of metaphysics, everyday geometry, and the theory of perception (reviewed by Steven A. Gross, *What's in a Hole? The Harvard Review of Philosophy*, 1994). Their unexpected implications are indicated in an extensive [entry on holes](#) in the *Stanford Encyclopedia of Philosophy*.

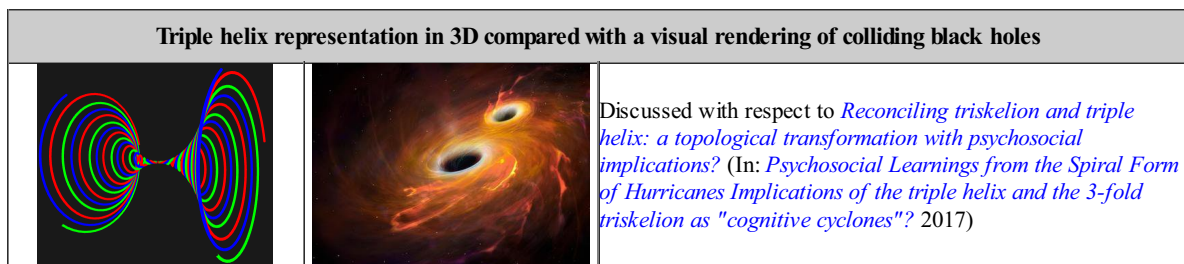
Such implications may be explored otherwise, as argued by [Terrence Deacon](#) as a cognitive anthropologist with respect to the role of what is missing (*What's Missing from Theories of Information?* 2010; *Incomplete Nature: how mind emerged from matter*, 2011; *The importance of what is missing*, *New Scientist*, 26 November 2011). He explores the paradoxical incompleteness of semiotic and teleological phenomena in terms of information to demonstrate how specific absences (or constraints) play the critical causal role in the organization of physical processes that generates these properties. For Deacon:

Basically, it means that our best science -- that collection of theories that presumably comes closest to explaining everything -- does not include this one most defining characteristic of being you and me. In effect, our current "Theory of Everything" implies that we don't exist, except as collections of atoms. So what's missing? **Ironically and enigmatically, something missing is missing.** (p. 1, *emphasis added*)

A sense of the missing can be specifically related to the ouroboros through the significance attached to a ring (*Engaging with the missing -- however encircled or encycled*, 2017). With the ring as symbolic of coherence, what is encircled by it? How is forming a circle or a ring understood as a container -- especially one with symbolic or magical implications? Formation of a **circle of trust**? What of defensively **circling the wagons**? The strategic implication has been extended to configuring problems in cyclic terms (*Encycling, Enwholing and Wholth*, 2014; *Encycling Problematic Wickedness for Potential Humanity*, 2014).

Directionality and wholeness: There is a curious but relatively obvious sense in which the serpents or dragons imply directionality and a quest. It is the manner in which their dynamic defines a (toroidal) ring which is intriguing -- given the relationship between torus and sphere, to the extent that the sphere is held to be more symbolic of wholeness. In conventional terms however, a sphere is essentially static rather than dynamic. What might be assumed to be the dynamics of sustainable globalization? Arguably the imagery of sphere eversion topology should inform reflection on the nature of such globalization ([John M. Sullivan](#), *Topological Stages in the Eversion*; video of *The Optiverse*, 1998).

In their strange pursuit of wisdom, it is the serpents which embody that dynamic to a degree. Hence the potential significance of the helical, serpent-like nature of a triple, quadruple or quintuple models -- inspired by that of DNA, as noted above. As separately argued, these can be understood as engendering the symbolic stars which are so fundamental to representation of national identity on flags and otherwise (*Symbolic stars vs Strategic pillars; Polyhedra vs Helices; Logic vs Comprehension?*, 2017).



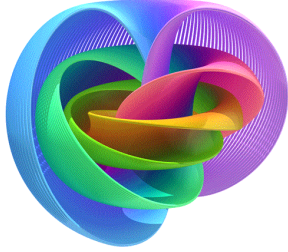
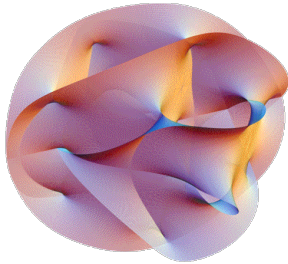
Such an argument would seem to suggest a strange relationship between symbolic use of serpents, helices, stars and pillars. Are strategic stars and pillars to be usefully recognized as "frozen categories" -- "petrified" serpents, namely an "entombed" dynamic to which strategic helices are now conceived as providing a degree of remedy?

Especially intriguing in symbolic terms is the manner in which the dragon-serpents are intuitively understood to both intertwine and plunge into the hole which they thereby frame. This is strangely reminiscent of the process of intercourse and the fundamental significance attributed to it -- with a hole being the primordial attractor. It is therefore curious that the role of the double helix with respect to reproduction should now be "extended" to what is envisaged in relation to the triple, quadruple and quintuple helices -- if not more. Ironically this would seem to anticipate the speculations of science fiction with regard to alien biologies requiring multiple sexual partners for viable fertilization. A quintuple helix model must indeed envisage 5-way cognitive osmosis. Globalization may indeed be more complex than conveniently assumed (*Engendering Invagination and Gastrulation of Globalization: reconstructive insights from the sciences and the humanities*, 2010).

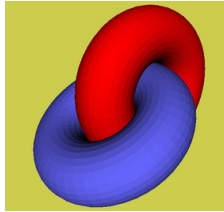
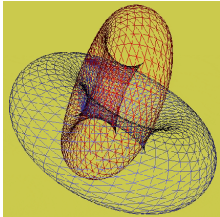
Given the preoccupation of fundamental physics with the necessity for **extra dimensions** for any adequate **theory of everything**, any multiplication of helices could be explored in terms of intuitive recognition of the **compactification** of dimensions -- understood by physics to be "curled up" in some manner, as argued separately (*Framing Cyclic Revolutionary Emergence of Opposing Symbols of Identity*, 2017). With serpents indicative of distinctive knowledge dynamics, the compactification of multiple modes of knowing becomes more comprehensible.

For cosmology, it is then understandable that a theory of everything would be associated with compactification into a singular serpent -- hence the ouroboros. However, should a triple helix model be understood as a "3-serpent model" -- or a quintuple helix model as a "5-dragon model", as Chinese culture might well find appropriate in the light of *Wu Xing* dynamics?

Given the insights from physics, the serpents and dragons might be better understood as features of visual renderings of the **Calab-Yau manifold** of string theory, as shown below -- or of **Hopf fibration**, namely a **hypersphere** in **four-dimensional space**. In their animated form, these featured as indications of *Animations variously suggestive of "being a waveform"* in an argument exploring the possibility that people could -- in the light of the understandings of physics -- experience themselves as waveforms (*Being a Waveform of Potential as an Experiential Choice: emergent dynamic qualities of identity and integrity*, 2013). Both featured in a discussion of *Transforming vehicles of identity between global and toroidal forms* (2016).

Animations of visual renderings suggestive of higher-dimensional cognitive osmosis		
Hypersphere (Hopf fibration)		Calabi-Yau manifold
	<p>The image on the right from <i>Wikipedia</i>, which originally appeared on the cover of <i>Scientific American</i>, Nov. 2007). Such manifolds are higher-dimensional analogues of K3 surfaces of significance in superstring theory. The extra dimensions of spacetime are sometimes conjectured to take the form of a 6-dimensional Calabi-Yau manifold.</p> <p>The image was previously used in a separate speculative discussion of <i>Global Brane Comprehension Enabling a Higher Dimensional Big Tent? Strategic implication in encompassing nothing and coming to naught</i> (2011).</p> <p>The animation of the original image made use of selected aesthetic possibilities of Photoshop -- of which many others might be employed to improve the suggestive quality of the animation.</p>	

Interlocking tori: There is however also the possibility of inviting imaginative reflection on the toroidal ouroboros as a whole rather than solely on the zone of osmosis. The following animation suggests how a single head/mouth/anus might be depicted in a rendering of the more common symbol of a single serpent-dragon biting its tail. Whether the serpent is one torus or the other, the mouth/anus orifice is interlocked with it and of the same dimension -- the interlocked tori rotating with respect to one another. Such an animation offers usefully provocative and controversial connotations.

Interlocking tori -- modelling a single-serpent ouroboros		
		<p>Discussed with respect to the <i>Fearful attraction of a hole</i> (In: <i>Visualization in 3D of Dynamics of Toroidal Helical Coils: in quest of optimum designs for a Concordian Mandala</i>, 2016)</p> <p>Red torus has a vortex (smoke ring) dynamic in the model; Blue torus has a wheel-like dynamic in the model</p> <p>VRML animation produced by Bob Burkhardt. X3D and VRML variants produced by Sergey Bederov of Cortona3D</p> <p>Consideration can be given to using the dynamics of the blue torus as the basis for the head/anus design in the schematic animation above</p>
Mandelbrot set		<p>Discussed in:</p> <ul style="list-style-type: none"> • <i>Psycho-social Significance of the Mandelbrot Set a sustainable boundary between chaos and order</i> (2005) • <i>Sustainability through the Dynamics of Strategic Dilemmas -- in the light of the coherence and visual form of the Mandelbrot set</i> (2005)
Fibonacci spiral		<p>Discussed in:</p> <ul style="list-style-type: none"> • <i>Construction of Fibonacci spiral as providing an open-ended integrative framework</i> (In: <i>Tao of Engagement -- Weaponised Interactions and Beyond</i>. 2010) • <i>Designing Global Self-governance for the Future: patterns of dynamic integration of the netherworld</i> (2010) • *** in relation to the clothoid

Especially intriguing is how such imagery enables anyone to identify with the "dragon" -- riding around the torus with a view from the dragon's head, as the "questing beast". How is the consumption and injection of "otherness" ("outsiderness") to be imagined -- as well as its embodiment, following transformation, into "insiderness"?

Transformation? Arguments enabled by animation are no guarantee of the integrative transformation purportedly implied by the ouroboros -- Jung's *Mysterium Coniunctionis* (1970). The distinction may be made in the light of the imagery of the pearl of wisdom pursued in the Chinese dragon dance, assuming the dragons in the ouroboros are engaged in a dance. The pearl is then mysteriously associated with the space they surround -- the hole in the centre.

This hole is not accessible by conventional means, however skillful the animation. Its nature could even be implied by "pointlessness" and

"nescience" (*¿ Embodying a Way Round Pointlessness ?* 2012; *Happiness and Unhappiness through Naysign and Nescience: comprehending the essence of sustainability?* 2008). Missing is the sense of surprise associated with transformation -- and the cognitive risks associated with morphogenesis. Arguably the dynamics of the ouroboros could be explored as a **cognitive black swan** -- as with any revelation -- in the light of the arguments of Nassim Nicholas Taleb (*The Black Swan: the impact of the highly improbable*, 2010). Yet to be clarified is the distinction between such transformative experience and that offered by the psychoactive drugs so important to many, or those of being born again, so important to others (*Varieties of Rebirth: distinguishing ways of being "born again"*, 2004).

To proprioceive or not to proprioceive -- is that the question?

Whilst the noun *proprioception* is itself not commonly used, the verbal form (*proprioceive, to propriocept?*) is even more rarely used. The brain is indeed understood to dynamically integrate information from proprioceptive process and from the vestibular system into its overall sense of body position, movement, and acceleration. The word *kinesthesia* or *kinaesthesia* (*kinesthetic sense*) strictly means movement sense, but has been used inconsistently to refer either to proprioception alone or to the brain's integration of proprioceptive and vestibular inputs. Proprioception is often synonymous with balance. When thrown "off balance", the brain is especially challenged to propriocept.

Understandably, academics -- as academics -- have no need "to proprioceive", irrespective of the extent to which they may explain the nature of proprioception. Indicative search results at the time of writing offer: **proprioception**, 2,280,000; **proprioceive**, 1,380; **to proprioceive**, 349; **propriocept**, 39,000; **to propriocept**, 3,500. This is strikingly indicative of the conventional attitude to such a process, most notably in the explanatory descriptions offered by natural science and some schools of philosophy. As argued on one website: *Don't Neglect to Propriocept!* (*Ego Performance Training*, 5 March 2012).

Provocatively, a contrast may be made between widespread enthusiasm for *explanation* and the nature of the *explaining* process -- which curiously results in *explanation*. The latter implies a successful cognitive dissociation from the plane of reality in topological terms -- whether or not this is a complex plane. It reinforces dubious assumptions regarding global *plans* emerging from any *planning* process, speculative explored separately (*Is the World View of a Holy Father Necessarily Full of Holes?* 2014). Explaining could be understood as a successful cognitive dissociation from the "plain" -- as the latter is promoted in arguments for simple living.

Proprioception has the meaning to make "one's own", to take or grasp, in the sense of recognizing the relative position of one's own parts of the body and strength of effort being employed in movement. It bears an interesting relation to property, its acquisition and its possession. It is distinguished from **exteroception**, by the outside world is perceived, and **interoception**, by which pain, hunger, etc., and the movement of internal organs are perceived.

In humans, a distinction is made between *conscious* proprioception and *non-conscious* proprioception:

- Conscious proprioception is communicated by the **posterior column-medial lemniscus pathway** to the **cerebrum**.
- Non-conscious proprioception is communicated primarily via the **dorsal spinocerebellar tract** and **ventral spinocerebellar tract** to the **cerebellum**. as recognized with respect to the human proprioceptive reflex, or **righting reflex**

Examples of description of the process include Wendy S. Scholz (*The phenomenology of movement: action, proprioception, and embodied knowledge*, Iowa Research Online, 2010) and Andy Hamilton (*Proprioception and Self-Consciousness: proprioception as direct, immediate knowledge of the body*, 2013). As summarized by Schulz:

The intent of this thesis is to provide an account of the phenomenology of movement that collapses the distinction between mental and physical without the elimination of the mental. There are two main ways in which mental and physical converge in this account. First of all, the type of knowledge involved in learning movement skills is a type of nonpropositional knowledge that is literally embodied in the neuromuscular system of the body. Thus the mental phenomena of knowing-how and thinking how to do movement skills are body-wide phenomena. Furthermore, this type of knowledge is genuinely self-referential, since the knower and known are identical. Second, the phenomenology of self-actuated movement reveals that the self is experienced as a psychophysical unity through the experience of the coherence of action and the proprioception of that action. This is due to the sense of effort provided by sensorimotor integration of the peripheral nervous system. This sense of effort is the direct awareness of physical properties of muscle lengths, tensions, and speeds of contraction, and is thus a genuine psychophysical phenomenon. It is also argued that we enjoy a high degree of epistemic security regarding experiences of this type.

Sometimes referred to as the "sixth sense," proprioception includes the sense of position and movement of our limbs, the senses of muscle force and effort, and the sense of balance (Uwe Proske and Simon Gandevia, *Proprioception: the sense within*, *The Scientist*, September 2016). For Elise Walker:

Proprioception is a sense that we often overlook because it is only subtly distinguished from movement. And, unlike sight or hearing or taste, we rarely experience the absence of proprioception (dead arm being a rare exception). Yet, a total loss of proprioception might be even more devastating than going blind or deaf. Without sensory information coming in from our muscles, we would be unable to monitor and correct our paths of motion. Imagine trying to walk, gesture, or eat if you had no sense of where your limbs were without looking at them. Few people can understand the burden of proprioceptive loss better than an amputee. When a limb is lost, the ability to move and sense are both gone. (*Proprioception: Your Sixth Sense: why movement and sensation are inextricably linked*, *Helix*, 27 October 2014):

Informing his concern with cognitive topology, as noted above, Steven Rosen has argued extensively for a more appropriate

understanding of conscious proprioception in contrast with the better known symbolic operations of perception and conception prevalent in conventional science:

Etymologically, to perceive is to "take hold of" or "take through" (from the Latin, per, through, and capere, to take), and to conceive is to "gather or take in." These activities are carried out in the "forward gear,"... The term *proprioceive* is from the Latin, *proprius*, meaning "one's own." Literally, then, proprioception means "taking one's own," which can be read as a taking of self or "selftaking." It is true that the term's conventional meaning derives from physiology, where it signifies an organism's sensitivity to activity in its own muscles, joints, and tendons. But [David Bohm (*Thought as a System*, 1994)] spoke of the need for "proprioceptive thought" (p. 229), which he viewed as a meditative act wherein "*consciousness ... [becomes] aware of its own implicate activity, in which its content originates*" (p. 232). Years earlier, the social psychiatrist Trigant Burrow spoke similarly of the need for human beings to gain a proprioceptive awareness of the organismic basis of their divisive symbolic activity (see Galt 1995). What I propose here is that a proprioceptive move is required if the dimensional organism is to gain the awareness of itself that is necessary for entering the climactic stage of its Individuation. Whereas the forward orientation of stage two maintains the trichotomy of object, space, and subject, the proprioceptive unearthing of the lifeworld carried out in stage three would disclose through its "backward" action the intimate transpermeation of these three terms. (*The Self-evolving Cosmos: a phenomenological approach to nature's unity-in-diversity*, 2008) pp. 126-127 [emphasis added]

Rosen continues (pp. 245-246):

It is a commonplace of neuroscience that cognitive activity is linked to the cortical region of the brain. In *Topologies of the Flesh*, I drew on the work of psychiatrist Trigant Burrow to demonstrate that it is possible to *proprioceive* the workings of the brain. Supplementing his laboratory research with systematic self-observation, Burrow kinesthetically detected a unique pattern of tensions around the eyes and forehead that he found to be correlated with the symbolic operations of the cerebral cortex. In this experiential self-probing of the brain's "symbolic segment" (*Science and Man's Behavior: the contribution of phylobiology*, 1953, p. 316), the area that constitutes the site of thinking and language, Burrow was exploring the seat of his own identity as an individual governed by the thinking function.

Or, in Merleau-Ponty's terms, Burrow was investigating the "*I think that must be able to accompany all our experiences*" (Merleau-Ponty, 1968/1970, p. 145). Burrow himself came to refer to this cortical center of identity as the "I"-persona. This thinking subject that presides over every facet of human experience and behavior should not be confused with the ego of the allegedly isolated individual.... Therefore, when Burrow became attentive to the "I"-persona rather than continuing to be unwittingly governed by it, he experienced this palpable pattern of tension around the eyes and forehead against the "*tensional pattern of the organism as a whole*" (Galt 1995, p. 31). He was thus presumably able to apprehend in an immediate way what he called the "phyloorganism" (p. 445), i.e., the organism of humanity at large. Burrow coined the term "cotention" (1932) for his practice of proprioceiving the generic organism. He described the procedure as one of setting aside daily experimental periods in which he "*adhered consistently to relaxing the eyes and to getting the kinesthetic 'feel' of the tensions in and about the eyes and in the cephalic area generally*" (1953, p. 95). [emphasis added]

Such arguments call for greater recognition of the contrasting perspectives of proprioception, [exteroception](#), and [interoception](#) (namely any sense that is normally stimulated from within the body). In their absence it can be readily argued that there are cognitive implications to the current environmental consequences of [concreting the environment](#), [canalizing river banks](#) and lining tunnels.

An interesting contrast is offered by the design challenges of ensuring the circulation of plasma to enable nuclear fusion (*Enactivating a Cognitive Fusion Reactor: Imaginal Transformation of Energy Resourcing (ITER-8)*, 2006). More fundamentally it may be asked what should be understood as circulating through the ouroboros (*Circulation of the Light: essential metaphor of global sustainability?* 2010)

Unproprioception: demining, mine-sweeping and waste management

As might be expected, *unproprioception* is not recognized as a cognitive process -- or as a valid term. Would *deproprioception* be a more appropriate given the increasing significance of [desensitization](#) and [psychic numbing](#)? Arguably however, with *proprioception* understood as a cognitive process of making externalities "one's own", the common effort to "grasp" through possessive attachment calls for recognition of the complementary process of detachment and "letting go" as may be speculatively argued (*Beyond Harassment of Reality and Grasping Future Possibilities*, 1996).

The process of *appropriation* is clearly usefully associated with *proprioception* -- if only etymologically through their association with property. Curiously that process is widely understood as "appropriate" -- despite the ambiguity from a sociopolitical perspective (*Comprehension of Appropriateness*, 1986).

The issue is how to recognize (appropriately) the nature of *unproprioception*. If proprioception can be fruitfully associated with ingestion, then unproprioception should be intimately related to understandings of egestion. As the final process in [digestion](#), it is through [defecation](#) that organisms eliminate solid, semi-solid, or liquid waste material from the digestive tract via the anus. Again, as might be expected, both the process of [infecation](#) and that term are seldom mentioned -- despite their potential significance as metaphors for social experience, and many anecdotal comparisons of their equivalence in that respect (through questionable jargon).

Curiously again, mention of any such processes in conventional discourse tend to be framed as *inappropriate* -- despite being a daily feature of human biology, and however the process is then consciously experienced. Understood more generally, the process of *disappropriation* (as with *dispossession*) is readily applied to taking something away from another, but not from oneself. Whereas the

verb *to appropriate* is widely used, no use is made of *to inappropriate*. The associated cognitive challenge of detachment is recognized otherwise through expressions such as "letting go" and arguments of intentional communities for [simple living](#) and [voluntary poverty](#) (as in monastic vows).

Any animation of the ouroboros therefore offers an integrative cognitive approach to the system dynamics of the alternation between attachment and detachment. Conscious engagement with this process is cultivated through schools of meditation making use of breathing exercises focusing on the cycle of inspiration and expiration. How are these insights applied to collectives?

Given the obvious relation of proprioception to the acquisition and possession of property -- with all the psychosocial controversies with which this is associated -- proprioception as a cognitive process merits exploration in relation to "letting go", whether with respect to possessions, relationships, patterns of consumption, ideological positions, or cognitive biases (Antonio de Nicolas, *Habits of Mind: an introduction to clinical philosophy*, 2000; George Monbiot, *Everything Must Go*, *The Guardian*, 22 November 2017).

As noted above, this challenging cognitive process can be usefully explored through a form of word play, using "mine" as a metaphor -- given its intimate association with possession. Used as a metaphor, "mining" could then be understood as a synonym for proprioception. The complementary process could then be explored through:

- **mines** sought possessively as a source of resources for which claims can be legally registered, often overriding other property rights. Obsession with acquisition of intellectual property could be then be understood in such terms
- **landmines** as explosive devices positioned to damage others endeavouring to lay claim to one's possessions and territory -- rendered of particular significance by [improvised explosive devices](#). Sting operations to challenge claims to one's cognitive or cultural property are an obvious consequence
- **demining** as the extremely challenging process of removing landmines from territory which has been acquired from another.
- **mine-sweeping** as the maritime variant of demining. How indeed is the sense of "mine" to be "swept" from consciousness -- as favoured by some schools of thought?

As a process consequent on ingestion, unproprioception brings into focus what is to be done with whatever is claimed as "mine". It can indeed be stored for future use -- as with the proverbial storage of nuts by a squirrel. However there is also a sense in which it involves a form of incarceration, with its particular associations to the embodiment resulting from ingestion. The extent to which intellectual property is stored behind firewalls and paywalls can be usefully described as knowledge incarceration in relatively inaccessible locations. Much is made of the eventual release of classified materials.

Paradoxically, and ironically, most of the knowledge of relevance to remedial response to global challenges is subject, actually or potentially, to intellectual property constraints -- including research cited in this document. ***

Understood as especially symbolic of identity and heritage, more intriguing is the sense in which intellectual or cultural property is systematically entombed and enstoned -- and associated with complex understandings of memory, remembering and a possible afterlife ([Enstoning in memorials and monuments](#), 2012; [Enstoning through petrification and entombment](#), 2012).

However, further consideration of "cognitive waste management" merits exploration in the light of the major challenge of waste management on a planet of limited disposal capacity. This is exemplified by the issues of [radioactive waste disposal](#) and the accumulation of [marine debris](#), most obviously in the [Great Pacific Garbage Patch](#) -- and equally symbolically through the accumulation of [space debris](#) orbiting the globe. Arguably the current global civilization, like it or not, faces a major environmental problem of "managing its shit".

Paradoxically it could be argued that global civilization has a heavy investment in the inappropriateness of having failed to "get its shit together" -- again using the common jargon phrase for emphasis. Far less evident is the management of "cognitive waste" ("cognitive shit") -- so evidently undermining any possibility of fruitful global governance. An animation of the ouroboros serves in some measure to highlight an appropriate degree of cognitive integration.

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