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Pricking the Bubble of Global Complacent Complicity

Hyperdimensional insights from the physics of bubble blowing, bursting and collapse ?

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Introduction

Readily admired by children, the beauty of bubbles exercises a peculiar fascination. There have been many uses of the bubble metaphor in relation to recent financial and economic crises (financial bubble, the housing bubble, etc). An extensive definition of a [financial bubble](#) is offered by the *Financial Times Lexicon*, and of [bubble \(economics\)](#) by *Revolvy*. Related terms include asset bubble, speculative bubble, [stock market bubble](#), [liquidity bubble](#), price bubble, and [real estate bubble](#). There are also many references to collapsing bubbles and bursting bubbles -- also part of the fascination for children. Controversial references may be made to the commodities bubble and to the [population bubble](#).

Less evident are the references to the manner in which collapsing and bursting is achieved using the pricking metaphor in that connection (John Cassidy, *Pricking the Bubble*, *The New Yorker*, 17 August 1998; Tim Iacono, *Pricking Bubbles*, *Financial Times*, 5 November 2009; Kevin Drum, *Pricking Bubbles*, *Mother Jones*, 7 July 2009; Carol Iannone, *Pricking the Bubble*, *Research Gate*, December 2011; Howard Davies, *The Trouble with Financial Bubbles*, *The Guardian*, 19 October 2015). Beyond description though the metaphor, the question of how has also been addressed (Wolfgang Munchau, *How to Prick Bubbles*, *Financial Times*, 26 October 2009; Dina Medland, *Pricking The 'Bubble' Of Banking By Calling The Sector To Account*, *Forbes*, 24 February 2014). Arguably however, this understanding of a "prick" is totally inadequate, if not naive, given the nature of such bubbles and how they are sustained.

There is even concern that maybe such bubbles should not be pricked, arguing for the appreciation of unpricked bubbles. Within mainstream economics, many believe that bubbles cannot be identified in advance, cannot be prevented from forming, that attempts to "prick" the bubble may cause financial crisis, and that instead authorities should wait for bubbles to burst of their own accord, dealing with the aftermath via monetary policy and fiscal policy (*The Perils of Pricking Bubbles*, *The Economist*, 14 May 1998; Howard Davies, *Should we Prick Financial Bubbles?* *World Economic Forum*, 20 Oct 2015; John Authers, *The Importance of Bubbles that Did not Burst*, *Financial Times*, 10 February 2017; John Galt, *Neel Kashkari Argues Against Pricking Financial Bubbles*, *TheoTrade*, 23 May 2017). Are bubbles "bad"? Despite any recognition of it being an illusion, is any process sustaining it to be so framed?

Although frequent reference is made to the importance of such bubbles and of their continuing emergence, it is less than clear that any effort is made to identify the set of bubbles which are currently evident or potentially emergent. Although it is recognized as a systemic phenomenon, the phenomenon is not explored systemically. In how many domains can socioeconomic and related bubbles be currently recognized? Whether bad or not, it is now foreseen that future bubble collapse will be even more catastrophic (Tyler Durden, *'The Everything Bubble': why the coming collapse will be even worse than the last*, *ZeroHedge*, 17 May 2017; Adam Taggart, *The Mother of All Financial Bubbles will be Unimaginably Destructive when it Bursts*, *The Market Oracle*, 15 February 2017).

More intriguing is the seeming dependence on a bubble-like process. Is globalization the process of "blowing a bubble" of immense proportions -- or fruitfully recognizable as such? The process of promoting credibility in collective agendas, most notably in the case of "talking up" currencies and economic prospects, readily lends itself to framing by the metaphor. The widespread quest for agreement and the need for consensus, can be understood in that light, despite its illusory quality as separately argued (*The Consensus Delusion*:

mysterious attractor undermining global civilization as currently imagined, 2011). There is some irony to the contrast between any bubble-like consensus and use of a seemingly distinct metaphor, namely solidarity. Is the solidarity -- for which appeals are so frequently made -- to be understood as equally bubble-like? **Should global civilization be explored as a bubble -- given the risk of its collapse** and the curious dependence on its growth? Should the quest for sustainability be explored in terms of ensuring the viability of a bubble?

The argument here is less concerned with the credibility accorded to the metaphor with respect to socioeconomic phenomena but rather to its relevance to any elusive sense of consensus. More especially the concern is with the manner in which it usefully characterizes questionable processes of complacent complicity. Are there illusions -- "myths" carefully created and sustained -- which merit recognition as bubbles of a kind (*Cultivating the Myth of Human Equality: ignoring complicity in the contradictions thereby engendered*, 2016).

What of the myth cultivated by so many that "we have never had it so good"? Is the complacent dependence on non-renewable resources to be usefully explored as a bubble? To what extent does humanity need bubbles and to enable more to be blown? The question can be explored otherwise in relation to the internet and assumptions regarding the desirability of [filter bubbles](#) to sustain confidence in particular world views ([Eli Pariser](#), *The Filter Bubble: what the internet is hiding from you*, 2011; Holly Green, *Breaking Out of Your Internet Filter Bubble*. *Forbes*, 29 August 2011; Engin Bozdag and Jeroen van den Hoven, *Breaking the Filter Bubble: democracy and design*. *Ethics and Information Technology*, 17, 2015, 4).

The marketing strategies encouraging the emergence of search engine filter bubbles have recently been dramatically extended in response to political pressure to filter out "fake news" and information considered threatening to a dominant worldview -- potentially framed as "evil" ([Andre Damon and Niles Niemuth](#), *New Google Algorithm Restricts Access to Left-Wing, Progressive Web Sites, Transcend Media Service*, 31 July 2017). This can be recognized as engendering a "bubble of recitude", or a "bubble of righteousness" -- ironically echoing historical forms of censorship, such as the Catholic *Index Librorum Prohibitorum* (abolished in 1966). This had been the responsibility of the Sacred Congregation of the Index, but was merged with the [Congregation for the Doctrine of the Faith](#) (previously the [Sacred Congregation of the Inquisition](#)).

Clearly the unquestionable rectitude of any such "bubble of faith" functions to inhibit any critical thinking by which it might be "pricked", whether from within or from without. With respect to questioning, the irony is all the greater in that the Inquisition had functions somewhat analogous to the search engines of today. Could filtering out misleading advertising and pornography be similarly justified, or the cultivation of violence for purposes of entertainment by the media?

More generally, and even more problematic, is the complacent complicity in the systematic depredation of the ecosystems of the environment. There is a bubble-like adaptability to any shocking news about the percentage of species forced into extinction, or the proportion of people suffering from various conditions of deprivation and injustice. Do such bubbles, as cocoons, offer a cushioning effect otherwise recognized in terms of [psychic numbing](#) and indifference (*Indifference to the Suffering of Others: occupying the moral and ethical high ground through doublespeak*, 2013)

If there is indeed a case for "pricking" some bubbles, missing from that metaphor is how a diminutive "prick" is so dramatically effective in ensuring the collapse of a relatively massive bubble -- and its evident global integrity. **What is a "prick" in a knowledge-based civilization overwhelmed by fake news?** Clearly it is not a new fact, nor is it the renewed promulgation of any inconvenient truth, as by [Al Gore](#) truth (*An Inconvenient Truth*, 2006; *An Inconvenient Sequel: Truth to Power*, 2017). Bubbles are bouncily resistant to such pressures, as climate change has so clearly demonstrated (*An Inconvenient Truth about any inconvenient truth*, 2008).

Given such questions, is there anything of psycho-social relevance to be learned from the extensive research on the physics of bubbles regarding the particular nature and efficacy of a "prick" as it might relate to complacent complicity? Could new insight be derived into what is intuitively recognized as a "bubble of hope", a "bubble of meaning", a "bubble of joy", or a "bubble of pleasure"? Is there any possibility that this might be relevant to new understanding of widespread recourse to psychotropic drugs or to the extremes of radicalism?

Requisite philosophical reframing of bubbles, globes and foams?

The quest for an effective "prick" can be fruitfully informed by the philosophical perspective on spheres offered in a 3-volume, 2,500-page trilogy by [Peter Sloterdijk](#) and Wieland Hoban. These volumes are most succinctly described in the following publisher summaries:

Bubbles: Microspherology (2011):

An epic project in both size and purview ... is the late-twentieth-century bookend to Heidegger's *Being and Time*. Rejecting the century's predominant philosophical focus on temporality, Sloterdijk, a self-described "student of the air", reinterprets the history of Western metaphysics as an inherently spatial and immunological project, from the discovery of self (bubble) to the exploration of world (globe) to the poetics of plurality (foam). Exploring macro- and micro-space from the Greek agora to the contemporary urban apartment, Sloterdijk is able to synthesize, with immense erudition, the spatial theories of Aristotle, René Descartes, Gaston Bachelard, Walter Benjamin, and Georges Bataille into a morphology of shared, or multipolar, dwelling --identifying the question of being as one bound up with the aerial technology of architectonics and anthropogenesis. Sloterdijk describes *Bubbles*, the first volume of Spheres, as a general theory of the structures that allow couplings -- or as the book's original intended subtitle put it, an "archeology of the intimate". *Bubbles* includes a wide array of images, not to illustrate Sloterdijk's discourse, but to offer a spatial and visual "parallel narrative" to his exploration of bubbles.

Globes: Macrospherology (2014):

All history is the history of struggles for spheric expansion. In *Globes* -- the second, and longest, volume -- the author attempts nothing less than to uncover the philosophical foundations of the political history -- the history of humanity -- of the last two thousand years. The first... volume of the author's Spheres trilogy, *Bubbles*, dealt with microspheres: the fact that individuals, from the fetal stage to childhood, are never alone, because they always incorporate the Other into themselves and align themselves with it. With *Globes*, Sloterdijk opens up a history of the political world using the morphological models of the orb and the globe, and argues that all previous statements about globalization have suffered from shortsightedness. For him, globalization begins with the ancient Greeks, who represented the whole world through the shape of the orb. With the discovery of America and the first circumnavigations of the earth, the orb was replaced by the globe. This second globalization is currently giving way to the third, which we are living through today, as the general virtuality of all conditions leads to a growing spatial crisis. Peter Sloterdijk tells here the true story of globalization: from the geometrization of the sky in Plato and Aristotle to the circumnavigation of the last orb -- the earth -- by ships, capital, and signals.

Foams: Plural Spherology (2016).

"So the One Orb has imploded -- now the foams are alive". *Foams* completes the Spheres trilogy: his 2,500-page "grand narrative" retelling of the history of humanity, as related through the anthropological concept of the "Sphere." For Sloterdijk, life is a matter of form and, in life, sphere formation and thought are two different labels for the same thing. The trilogy also offers his corrective answer to Martin Heidegger's *Being and Time*, reformulating it into a lengthy meditation on *Being and Space* -- a shifting of the question of who we are to a more fundamental question of where we are. In this final volume, Sloterdijk's "plural spherology" moves from the historical perspective on humanity of the preceding two volumes to a philosophical theory of our contemporary era, offering a view of life through a multifocal lens. If *Bubbles* was Sloterdijk's phenomenology of intimacy, and *Globes* his phenomenology of globalization, *Foams* could be described as his phenomenology of spatial plurality: how the bubbles that we form in our duality bind together to form what sociological tradition calls "society". *Foams* is an exploration of capsules, islands, and hothouses that leads to the discovery of the foam city. The Spheres trilogy ultimately presents a theology without a God -- a spatial theology that requires no God, whose death therefore need not be of concern. As with the two preceding volumes, *Foams* can be read on its own or in relation to the rest of the trilogy.

As argued by [Robert Mugerauer](#) (*Anthropotechnology: Sloterdijk on environmental design and the foam worlds of co-isolation, Architecture and Culture*, 4, 2016, 2):

... a reinterpretation of space, architecture, and culture could help us to learn to design better and act by way of an "anthropotechnology" (Sloterdijk's word) that is simultaneously developmental and threatening -- that might enable us to find an orientation in a world of complexity, and thus more positively shape our lives and future world. Sloterdijk's intriguing concepts -- spheres of immunization (bubbles, globes, foams), co-isolation, dyads, tensegrity -- hold great promise for the next pulse of architectural, planning, and construction theory.

Such an agenda could be understood as consistent with the argument of such as [Michael Wheeler](#) (*Reconstructing the Cognitive World: the next step*, 2005)

Bubbles, balloons and cocoons

Metaphorical bubbles: In the quest for better understanding of a "prick", various bubble-like forms merit exploration:

- **Worldviews:** Clearly academic models -- philosophical, methodological or otherwise -- merit exploration as a bubble. It provides a coherent context -- however this may be challenged as unrelated to reality, as perceived from within other bubbles. The challenges may well be framed as "pricks" -- however readily they can be treated with indifference and set aside. The relations between religions, disciplines and ideologies suggests that, even when merely irritating, they may well give rise to very active responses -- most obviously of violent form
- **Institutional systems:** Notably when they reflect worldviews, these offer instances in which the efficacy of a "prick" merits careful reflection. An obvious example is provided by the multiple cases worldwide of sexual abuse by the Catholic clergy. As recognized by the United Nations, as an institution the Catholic Church has been deviously skilled in denying the phenomenon and covering it up whenever recognition of it cannot be denied (*Second UN panel criticizes Vatican on sex abuse, The Boston Globe*, 22 May 2014). Thereafter various costly processes of damage management have been undertaken. The point to be stressed however is the inefficacy of any singular prick in that regard. The bubble of belief remains intact even when those at the highest level are recognized to have been complicit. Framed in terms of credibility, it can merely be argued that the bubble is leaking -- but not to a degree which could be described in terms of bursting or collapse, whatever the alienation of many of its adherents.

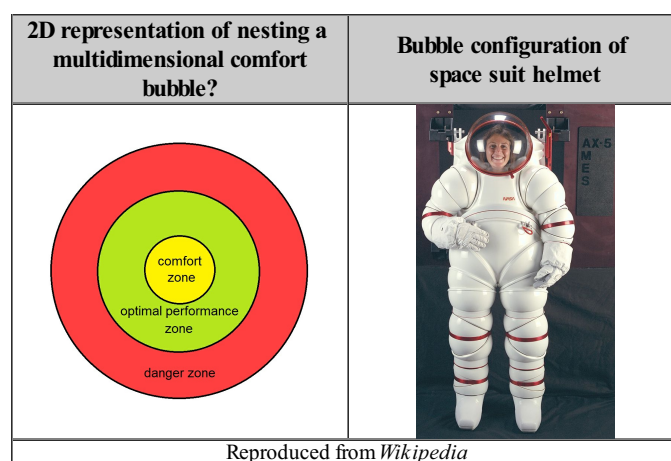
Similar points could be made with regard to complex institutions such as the United Nations and the European Union, as evidenced by the multiple scandals of recent years (Eursostat, ***). Although variously claimed to be in a state of imminent collapse, this has not proved to be the case. However the collapse may be one of credibility rather than institutional rituals cultivating a much-desired sense of sustained coherence.

- **"Imperial systems":** Empires of any kind can be usefully explored as civilizational bubbles. Given the relatively recent collapses

of the British, French, and Spanish colonial empires, these frame the question of the "prick" which triggered their dramatic decline. Potentially more insightful are the "pricks" which ensured the collapse of the Nazi empire and that of the Soviet Union. However the quest is even more relevant in the case of the USA and its partially achieved ambitions for global hegemony under the doctrine of [full-spectrum dominance](#). Within that perspective, there is some irony to the fact that significant "pricking" is framed in terms of defence against missiles, and their use to "prick" any opposing systems perceived as a threat. Unprecedented efforts are made in this period to prevent disastrous "pricking" and to out-manoeuvre the defensive systems of others to ensure their collapse.

The quest for hegemony may itself be used as a metaphor, as discussed separately (*Embodying Global Hegemony through a Sustaining Pattern of Discourse: cognitive challenge of dominion over all one surveys*, 2015).

- **Projects, programmes and collective initiatives:** It is striking to note the resemblance between "bubble" (as noted above) and "balloon". It is common for institutional systems to engender initiatives, readily framed or excused by those concerned (and by commentators) as "[trial balloons](#)". This is clearly a switch of metaphor -- effectively with the bubble engendering a balloon. However the intriguing contrast is the manner in which the bubble-like balloon offers a means of transportation for whatever is suspended from it. Beyond any understanding of globalization as the progressive inflation of a balloon this suggests the speculative exploration of the multiplicity of balloons variously floating within the psycho-social system -- at different levels and in response to the winds to which they are variously responsive (*Globallooning -- Strategic Inflation of Expectations and Inconsequential Drift: global, glo-bull, glow-ball, glow-bawl*, 2009). **Could policy formulation and presentation be usefully compared with "blowing bubbles" -- especially with their propensity to collapse?**
- **Cocooning and personal bubbles:** Originally framed in 1981 by [Faith Popcorn](#), [cocooning](#) is the process of staying inside one's home, insulated from perceived danger, instead of going out. Echoing the implications of a filter bubble, the psycho-social implications of bubble may be emphasized beyond the physical implications of cocoon, notably as the container provided by a [comfort zone](#) -- a "comfort bubble" (*Burst your comfort bubble -- if only for the thrill*, *The Globe and Mail*, 20 February 2016; *Living in a Comfort Bubble*, *OneCry*, 2015)



As the interface with a potentially hostile environment, the form of a bubble is evident in the design of [helmets](#) for protective suits, as in the case of [space suits](#), [diving suits](#) and those required for radioactive and biochemical hazards. It is however any cognitive analogue which is of particular relevance, as separately discussed (*Challenge of psychosocially hazardous encounters with otherness*, 2009).

The question of what might then constitute a "prick" to collapse the bubble -- if that is understood as beneficial -- is variously and widely discussed through generalities. Many have the ambition to collapse the illusions of others -- for their own good. French offers further insight through use of *bulle* (meaning bubble) in common expressions: *être dans sa bulle* and *la vie est nulle sans bulles* (life is nothing without bubbles). The "bubbling of ideas" is commonly associated with creativity and environments inducing it. The jargon phrase *having a ball* is presumably an extension of such recognition.

Understood as a defensive mechanism offering coherence, any collapse of a bubble can be explored in the light of the resulting "hole", of the nothingness that then becomes only too evident -- the *nulle* of the French phrase (G. G. Cole and A. J. Wilkins, *Fear of Holes. Psychological Science*, 2013, and separately reviewed *Common phobia you have never heard of: Fear of holes may stem from evolutionary survival response. ScienceDaily*. 3 September 2013). The non-trivial nature of this concern is remarkably addressed 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 (as they summarize in the [entry on holes](#) in the *Stanford Encyclopedia of Philosophy*).

Of relevance are the widespread references to the "pricking of conscience". Again, however, the capacity to override any such prick is a common experience. Of interest is the questionable distinction from "compunction" (*Conscience vs Compunction - What's the difference? WikiDiff*). In religious terms the consequence of the prick -- implying the collapse of an erroneous bubble -- may then be framed in terms of repentance (Spencer W. Kimball, *What Is True Repentance? New Era*, May 1974).

Insights from blowing bubbles? Bubble-blowing is a common feature of party entertainment, most especially for children. Many commercial products are made to enable the process. Simple procedures are detailed for personal experimentation (*wikiHow to Blow Bubbles*). The process has evoked a wide variety of reflections on its metaphorical implications (Ray Ash, *A Life Metaphor -- Blowing Bubbles, Facebook*; *Bubbles for Metaphors of Society, StudyMode*; *Practicing Mindfulness with Kids: Blowing Bubbles, WannabeCalmMom*; Melanie King, *Metaphors in Art and Science: the bubble representing the brevity of life*). *I'm Forever Blowing Bubbles* is a popular American song, widely recorded.

Bubbles are a central feature of the movie of *The Tree of Life* (2011) by Terrence Malick, rated on of the 10 best movies by Roger Ebert who provides an insightful review of them and of *homo bulla*. He notes that that Roman saying -- *man is a bubble* -- had a great iconographic fortune in the West from the 16th century on (*Reviewing Tree of Life*, June 2013). *Homo bulla* is the focus of a website regarding its role in art (*History of Bubble Performers, Tools and Original Effects*).

Reflection is evoked by the simplicity of being able to blow at a ring covered by a soapy solution to create a single bubble (or a stream of bubbles). As a symbol, the process combines the solidity of the frame provided by a 2D ring, with liquidity and the intentional investment of a breath of air, to produce a surprising 3D form of remarkable symmetry -- with the capacity to float independently and variously to catch and reflect the light. Its life is typically terminated by finally encountering solid reality again.

The creation of the bubble via a 2D framework readily echoes the thinking process of an individual, those in a think tank, or the expression of opinions through the social media. It is therefore curious to note how this is commonly echoed in depiction of **speech bubbles** and thought bubbles in comic strips.

Typical bubbles in comic strips			
Speech bubble	Thought bubble	Whisper bubble	Scream
Reproduced from Wikipedia			

Bubbles in virtual reality:

- **Adaptation of bubble blowing to querying databases:** A bubble metaphor has been proposed in a new approach to data mining (Chiemi Watanabe, et al., *Queryball: A New Model for Querying in Immersive VR Systems*, 2003):

For query interaction by Queryball, we propose "Blowing bubble" metaphor interaction. Operating a Queryball, users handle just two input devices, which are a stylus pencil as a "straw" and a virtual board as a "soap water palette". In this example, there are thirty kinds of soap water on the virtual board. A user selects a drop of soap water and creates a Queryball by "blowing" straw (in reality, the user pushes a button on the stylus). Using the stylus "straw" to drag or blow balls, the user can change the search condition of the Queryball on the "soap water palette" board. Queryballs and blowing bubbles metaphor, which provide intuitive and laid-back interaction for querying, promote positive interaction for analysis.

- **Arraying a set of images on the faces of a spherically symmetrical polyhedra:** Such polyhedra are approximations to the spherical form of a bubble -- especially when the number of faces is increased as in the geodesic variants (as below). With readily available software, it is a simple matter to place images onto such faces. This can be done face-by-face or by using distinctive images for all faces of the same type. Especially with virtual reality facilities, the resulting image-covered polyhedron can be viewed in 3D **from without** by rotation or by navigating to its centre to view the array of facets **from within**. This then offers many distinct **opportunities to decorate one's own cognitive cocoon as a personal bubble**. According to preference, the sides of the polyhedron could be covered with: images of friends (Instagram or Facebook style); icons of a religion (apostles, deities, etc); icons of a discipline (science, philosophy, etc); media celebrities (music, sport, etc.); slogans, mathematical formula, aphorisms, endangered species, etc. Clearly a mix of these images could be used. With more sophisticated software, the images could be replaced by multiple videos.

Animations of experimental simulation of "cognitive bubbles" in 3D		
12 Olympian deities on 2-frequency geodesic truncated octahedron of 288 faces (external view of bubble)	12 Olympian deities on 2-frequency geodesic truncated octahedron of 288 faces (view of bubble from within)	64 face types distinctively coloured on 8-frequency dodecahedron (bubble of 1536 faces)



The images used in the left and central animations were selected from the entry on the [12 Olympian deities](#) in *Wikipedia* -- without any effort to improve the quality of the final result in an exercise for purely illustrative purposes. Given that there are 288 facets, each of the 12 deity images appears multiple times. Although the choice of a set of deities for this exercise is arbitrary, those of the Greek and Roman civilizations constitute appropriate "bubbles" which remain of significance -- given the manner in which such deities (or their names) are widely used in the iconography of intergovernmental organizations as well as for fashion product trademarks.

The animation on the right indicates the possibility of using many more polyhedral facets and types -- and resembles the iridescent quality of a bubble to a higher degree. An earlier experiment used the faces of polyhedra of requisite complexity to hold the text of the individual articles of several declarations of human rights (*Dynamic Exploration of Value Configurations: polyhedral animation of conventional value frameworks*, 2008). Clearly the Universal Declaration of Human Rights merits consideration as a "bubble" as explored in this argument.

Clues to effective bubble pricking from the physics of bubbles?

Despite its ubiquity, use of bubble as a metaphor seemingly avoids any detailed consideration of what processes ensure the integrity of the bubble and how it is sustained. Emphasis is placed on its fascinating coherence as a comprehensible whole -- if not its beauty to behold. It can be appreciated as superficiality *par excellence* -- in the very best and subtlest of senses. It is a veritable marvel of maximum globality with the use of improbably minimal resources.

An insightful appreciation of their significance, with a range of psycho-social implications, is offered from the perspective of a physicist [Andrea Prosperetti](#) (*Bubbles, Physics of Fluids*, 2004):

Vanitas vanitatum et omnia vanitas: bubbles are emptiness, non-liquid, a tiny cloud shielding a mathematical singularity. Born from chance, a violent and brief life ending in the union with the (nearly) infinite. But a wealth of phenomena spring forth from this nothingness: underwater noise, sonoluminescence, boiling, and many others.

Although extremely vulnerable to any "prick", a bubble remains viable for a period under a variety of forces, enabling imaginative reflection and engagement. It is an inspiration to poets.

Curiously the experience of bubble collapse is much studied with respect to its influence on the taste of carbonated drinks -- and specifically champagne (Monell Chemical Senses Center, *Pop! Bursting the bubble on carbonation*, *ScienceDaily*, 22 August 2013; Paul M. Wise, et al, *The Influence of Bubbles on the Perception Carbonation Bite*. *PLoS ONE*, 2013, 8)

Formation and collapse of bubbles in liquids is of significance in many technical applications such as [sonochemistry](#), [lithotripsy](#), [ultrasonic cleaning](#), [bubble chambers](#), and [laser surgery](#). Bubble dynamics has been the subject of intensive theoretical and experimental studies, notably because of its importance to the destructive effects of [cavitation](#) during bubble collapse (Vladislav A. Bogoyavlenskiy, *Differential Criterion of a Bubble Collapse in Viscous Liquids*. *Physical Review E*, 60, 1999; M. A. Margulis, *Sonochemistry and Cavitation*, 1995; Leenvan Wijngaarden, *Mechanics of Collapsing Cavitation Bubbles*, *Ultrasonics Sonochemistry*, 29, 2016). One useful summary is offered by the *Physics Stock Exchange* (*What is the physics behind a soap bubble?*, 2013)

Beyond the common use of bubble as a metaphor, clearly some of the above-mentioned physical phenomena associated with bubbles offer a more extended set of metaphors with which richer insights could be associated. The "sound and fury" commonly associated with a collapsing economic bubble could then be enriched by research on the sounds made by collapsing bubbles. More surprising are the insights potentially offered by the light effects which are a focus of some research, and their combination with sound in [sonoluminescence](#) -- understood as the emission of short bursts of light from imploding bubbles in a liquid when excited by sound. Could this be recognized in the light of the title of [Thomas Homer-Dixon](#) (*The Upside of Down: catastrophe, creativity, and the renewal of civilization*, 2006)?

Subsequent to a discussion of bubble growth and [spherical bubble dynamics](#), an extensive commentary on both [cavitation bubble collapse](#) and on [bubble growth and collapse](#) is provided by Christopher Earls Brennen (*Cavitation and Bubble Dynamics*, 1995). Bubble collapse is considered to be of particular importance because of the noise and cavitation damage that can be caused by the high velocities, pressures, and temperatures that may result from that collapse. These high temperatures and pressures that can occur in the noncondensable gas during collapse, although highly localized both temporally and spatially, are believed to be responsible for the phenomenon known as sonoluminescence -- the emission of light that is observed during cavitation bubble collapse.

Particular interest is accorded to the [Rayleigh-Plesset equation](#) which governs the dynamics of a spherical bubble in an infinite body of

liquid. This can be used to solve for the time-varying bubble radius. This is a basis for consideration of bubble growth and collapse, as well as the viable equilibrium conditions. These are naturally subject to thermal influence -- leading to consideration of thermally controlled growth. Importance is also attached to bubble oscillation. Seemingly of potential significance to this argument is consideration of the Kirchhoff-Plateau problem (Giulio G. Giusteri, Luca Lussardi and Eliot Fried, *Solution of the Kirchhoff-Plateau Problem. Journal of Nonlinear Science*, 2017, and reviewed separately *Bursting the bubble: Solution to the Kirchhoff-Plateau problem: researchers solve a mathematical problem illustrated by soap films spanning flexible loops, ScienceDaily*, 31 March 2017).

Curiously the literature on bubble dynamics tends to frame bubble collapse in ways other than through anything that could be described as "pricking" or "puncturing". One exception is offered by the work of G. Debrègas, et al, (*The Life and Death of "Bare" Viscous Bubbles, Science*, 279, 1998). This was developed further by R. da Silveira, et al. (*Rippling Instability of a Collapsing Bubble. Science* 287, 2000). With regard to the "pricking" of a bubble rising to the surface of a liquid to form a hemisphere, the authors note:

If the latter is punctured at its apex by a needle, surface tension drives the rapid expansion of a circular opening. The retraction velocity soon (after about 10-30 ms) saturates to a constant, owing to the high viscous resistance. In the meantime, the air flow through the hole equilibrates the pressure difference, allowing the bubble to collapse under its own weight. As it deflates, an instability appears: the fluid sheet folds into a wavy structure, with radial ripples that break the original axisymmetry.... The rippling results from the competition between compression, bending, and gravity. Each fluid element tends to fall under its own weight, but experiences a viscous resistance from its neighborhood. If the bubble were to collapse in a uniform, symmetric way, it would occupy a progressively reduced area, leading to an in-plane compression which would require forces that far exceed the scale set by gravity. Instead, the film deforms in a nearly inextensional fashion by undergoing pure bending. Equivalently, for a given (gravitational) force, the relative time scale associated with stretching is much larger than that for bending, and the surface therefore corrugates over short times, before eventually relaxing into a uniform, thicker membrane

Clues to bubble pricking from geometry and structural design?

Beyond the particular focus of the physics literature, bubble dynamics and collapse -- and vulnerability to "pricking" -- could be understood in terms of a global configuration of molecular bonds. The missing insight is presumably associated with the manner in which that configuration is locally disrupted such as to undermine the global integrity -- which effectively unravels rapidly in a domino process, as intimated above with respect to a hemispherical bubble (Ross Douthat, *Are We Unraveling? The New York Times*, 9 July 2016). In the economic context, "pricking" appears to be understood metaphorically through the use of monetary policy. However this has the implication of corresponding only to the contextual preoccupations analyzed in such detail by bubble physics, rather than to "pricking" as understood mechanically and locally.

Tensegrity structure of bubbles: An understanding of bubbles in terms of tensional integrity ("tensegrity") has been offered by Buckminster Fuller (*Synergetics: explorations in the geometry of thinking*, 1975/1979). However, despite multiple references to both, their relationship is not explicitly addressed by him, despite their implied association in the interpretations of others (Diana Wehrell-Grabowski, *Buckminster Fuller, Soap Bubbles, and Geometry, YouTube*, 2008). In this light, the spherical geometry of a geodesic dome can be understood as a simplified understanding of a soap bubble. The issue of bubble collapse can then be explored in terms of the potential collapse of a tensegrity structure (Behzad Shekastehband and K. Abedi, *Dynamic propagation of snap-through buckling in tensegrity structures. ResearchGate*, December 2013; *Collapse behavior of tensegrity systems due to cable rupture, International Journal of Structural Stability and Dynamics*, 13, 2013).

The relationship between bubbles and tensegrity features in the work of Donald Ingber (*The Architecture of Life, Scientific American*, 278, 1998; *Tensegrity I: cell structure and hierarchical systems biology, Journal of Cell Science*, 116, 2003; *Tensegrity II: how structural networks influence cellular information processing networks, Journal of Cell Science*, 116, 2003). As he indicates:

While we can predict fundamental rules that will guide the behaviour of living mammalian cells a priori (starting from first principles), we cannot predict the specific three dimensional form of that particular tensegrity array *de novo*. However, this is a classic feature of fundamental design principles in Nature. A good analogy can be found in the rules by which soap bubbles coalesce to form a 'foam'. There are fundamental design principles that govern that, in any three dimensional foam, the bubbles will on average have 14 sides; this is well accepted and confirmed experimentally. Yet, some bubbles have 13, others 15, other 12, etc.; the shape of any particular bubble is impossible to determine. Nevertheless, on average, they always come out to 14. Thus, one can deduce fundamental design principles that are certain in an 'uncertain' world. (*Interview with Donald E. Ingber, Culture Machine, InterZone*, July 2002)

The focus on a biological cell raises the interesting questions as to the degree to which a cell can be understood as a bubble. However the argument also raises questions about any social "cell" and the existence of psycho-social tensegrities, as previously argued (*From Networking to Tensegrity Organization*, 1984). The argument has been developed from the perspective of management cybernetics by Stafford Beer (*Beyond Dispute: the invention of team syntegrity*, 1994).

With any bubble understood as having a structure with the characteristics of a geodesic dome, how many tensegrity struts need to be removed to ensure its collapse? Can a domino effect be achieved, or is the structure self-stabilizing due to tensegrity effects? The question is similar to that of detecting a key log which would disrupt a **log jam** in a river, For the purpose of this argument, are the subtlest of cognitive bubbles fundamental to collective coherence then better understood as spherical tensegrities -- notably those discussed in relation to the **icosahedron** and **biotensegrity**?

An interplay between the spherical metaphor of globalization and the explosion of interest in networks has been noted by Bruno Latour

(*Spheres and Networks: two ways to reinterpret globalization*, Harvard Design Magazine, 30, 2009). Both can be seen as closely related to comprehension of any psycho-social bubble -- if the network is understood as the network of bonds on the surface of the sphere.

Hyperdimensional bubbles: Seemingly missing from the approach of physics is the sense better understood in terms of the strategic response to a complex (global) network -- as might be depicted by a geodesic dome, or imagined as such. There the challenge is to locate key points which are targeted as a potential threat -- to be "taken out" by security services, or exploited for marketing purposes. The assumption is that by appropriately understanding the global configuration of the network, removal of such nodes or links will cause it to unravel -- well imagined in terms of the collapse of a bubble or a balloon.

There is however an unfortunate constraint implicit in conventional understanding of a geodesic dome -- and conventional use of the bubble metaphor. Both are readily framed in three dimensions. Missing is the sense in which what is intuited as any psycho-social bubble is more appropriately explored in the geometry of dimensions beyond three. The bubbles of psycho-social reality may well be hyperdimensional, especially given their obvious invisibility. They can only be "felt" intuitively, perhaps as fruitfully described in mathematical terms by Ronald Atkin (*Multi-Dimensional Man: can man live in 3 dimensional space?* 1981).

There is an extensive literature on [hyperspheres](#), otherwise known as [n-spheres](#) (Rebecca Frankel, *The HyperSphere, from an Artistic point of View*). It is therefore surprising to discover that there are seemingly few references to a "hyperbubble" -- presumably problematic or controversial for various reasons. As might be expected the term has already been appropriate by an electro/pop/synth musical group -- [Hyperbubble](#). It has also been noted that in the new release of the popular *Big Bang Theory* there is discussion of a hypothetical spherical multidimensional superfluid showing the same negative-energy density as space-time (*N-dimensional superfluid bubble* (*Kerbal Space Program*, 2015). Aesthetic insights of psycho-social reality anticipating science?

Without further clarification, and perhaps merely as [hyperbole](#), the term has been used to describe the state of the financial system by the renowned financial commentator [Doug Casey](#):

All I can say about the stock market is, by any traditional parameters of value -- price-earnings ratio, price-to-book ratio, dividend yields -- it's now very overpriced. And bonds aren't just in a bubble. They're in a hyperbubble. (Tyler Durden, *Doug Casey Has "Never Seen Anything Like This"*, ZeroHedge, 22 March 2017)

It is therefore intriguing to note the use of hyperbubble by a physicist in providing a very readable anecdotal description of his exploration of n-dimensional bubbles, or bubbles in n-dimensions (Alexander R. Klotz, *My Journey into the Hyperbubble. Post-Doc Ergo Propter Hoc*, 12 September 2015). When finally published, Klotz entitled his paper *Bubble Dynamics in N dimensions* (*Physics of Fluids*, 2013). There he notes:

Cavitation and bubble dynamics are central concepts in engineering, the natural sciences, and the mathematics of fluid mechanics. Due to the nonlinear nature of their dynamics, the governing equations are not fully solvable. Here, the dynamics of a spherical bubble in an N-dimensional fluid are discussed in the hope that examining bubble behavior in N dimensions will add insight to their behavior in three dimensions.... Overall, the dynamics of bubbles are faster at higher dimensions, with nonlinear behavior occurring at lower amplitudes. Several features are found to be unique to three dimensions, including the trend of nonlinear behaviour and apparent coincidences in timescales.

Distinction between 3D bubbles and hyperbubbles as summarized by Alexander Klotz (<i>My Journey into the Hyperbubble</i> , 2015)		
	3D Bubbles	Hyperbubbles
Bubble collapse time	$0.91468 \cdot R_0 \sqrt{\frac{\rho}{P}}$	$\sqrt{\frac{\pi}{2N(N-2)} \frac{\Gamma(\frac{1}{2} + \frac{1}{N})}{\Gamma(1 + \frac{1}{N})} R_0 \sqrt{\frac{\rho}{P}}}$
Rayleigh-Plesset equation	$R\ddot{R} + \frac{3}{2}\dot{R}^2 = \frac{1}{\rho} \left[P_0 \left(\frac{R_0}{R} \right)^{3\gamma} - P_{ext} \right]$	$\frac{R\ddot{R}}{N-2} + \frac{N\dot{R}^2}{2(N-2)} = \frac{P_0}{\rho} \left[\left(\frac{R_0}{R} \right)^{N\gamma} - 1 \right]$
Minnaert resonance frequency	$\sqrt{\frac{3\gamma P}{\rho R_0^2}}$	$\sqrt{\frac{N(N-2)\gamma P_0}{\rho R_0^2}}$

A more extensive discussion of hyperbubbles, and the connectivity between them, is provided by [Thomas A. Manz](#) (*A Theory of the Connectivity Dimensionality Field in Edge- Vertex Graphs and Discrete-Continuous Dual Spaces*, *Journal of Space Mixing*, 3, 2008, pp. 1-91):

Hyperbubbles are higher-dimension analogs of holes. A simple closed curve is topologically equivalent to a circle, and a circle is a 1-dimensional hypersphere. A hole is called a hyperbubble of order 1, because a simple closed curve drawn around the hole in the space cannot be contracted to a point without leaving the space. If a 2-dimensional hypersphere (or topologically equivalent surface) can be drawn in the continuous space but not contracted to a point without leaving the space, the space is said to contain a hyperbubble of order 2. More generally, if an n-dimensional hypersphere (or topologically equivalent surface) can be drawn in the space but not contracted to a point without leaving the space, the space is said to contain a hyperbubble of order n. A discrete-continuous dual space is said to contain a hyperbubble of order n if the continuous representation contains a hyperbubble of order n; in such case, the discrete representation is also said to contain a hyperbubble of order n. The number of hyperbubbles in a continuous space \mathcal{S} is equal to the number of hyperspheres that satisfy all three of the following conditions: (i) the dimension of each hypersphere is a nonnegative integer (but not necessarily the same nonnegative integer for different hyperspheres), (ii) each hypersphere (or topologically equivalent surface) can be drawn in the space \mathcal{S} but not contracted to a

single point without leaving the space \mathcal{S} , and (iii) the drawn hyperspheres form a set such that each drawn hypersphere (or topologically equivalent surface) in the set cannot be deformed into any other without leaving the space \mathcal{S} .

A **hard boundary** abruptly terminates a direction of motion within the space while a **soft boundary** does not. Hyperbubbles with a hard boundary are called **intrusive hyperbubbles**, while hyperbubbles with a soft boundary are called **latent hyperbubbles**. It is useful to think of the hyperspheres as being composed of rubber which may be deformed and contracted at will... A porous material like a foam contains numerous intrusive hyperbubbles. (pp. 84-85)

In a generalization of [Bohmian mechanics](#), space has been discussed as divided into n-dimensional bubbles (Ross Hyman, et al., *Bohmian mechanics with discrete operators*, *Journal of Physics A: Mathematical and General*, 37, 2004). A notion of "bubbling metrics" in relation to n-dimensional bubbles has been explored (Angela Pistoia and Carlos Román, *Large conformal metrics with prescribed scalar curvature*, *Journal of Differential Equations*, 2017), A framing of the n-dimensional bubble problem (with resources) is offered in a commentary by [Michael Hutchings](#) (*Soap Bubbles and Isoperimetric Problems*), introduced as follows:

Because of surface tension, soap bubbles or clusters thereof naturally try to minimize area for the volume(s) they enclose. This suggests the following mathematical questions. The isoperimetric problem, in an n-dimensional Riemannian manifold, is to enclose a region of a given (n-dimensional) volume v using a hypersurface of the smallest possible "area" (n-1 dimensional volume). For example, in Euclidean space, a classical theorem asserts that the unique area-minimizer is a sphere. The "soap bubble problem" is a generalization in which the problem is to enclose and separate m regions of prescribed volumes... using a (singular) hypersurface of minimal area.

The focus on minimal surfaces in relation to tensegrities and design is usefully explored by [Vlad Tenu](#) (*Minimal Surfaces as Self-organizing Systems: a particle-spring system simulation for generating triply periodic minimal surface tensegrity structures*, 2009).

Strategic implications of engaging with psycho-social bubbles?

Social bubbles: The metaphor has been used as the theme of a special issue on higher education and academia in general, as introduced by [Carol Iannone](#) (*Pricking the Bubble*, *Academic Questions*, 24, 2011). Ironically the bubble metaphor has been recently used in a critical description of the processes of physics research itself by [Peter Woit](#) (*The Social Bubble of Physics*, *Not Even Wrong*, 7 April 2017). As a physicist himself, Woit is the author of a critical description of the quest for the hypothetical [Theory of Everything](#) by physics (*Not Even Wrong: the failure of string theory and the search for unity in physical law*, 2006).

Woit uses the metaphor to frame an extensively cited criticism by [Sabine Hossenfelder](#) (*Science Needs Reason to be Trusted*, *Nature Physics*, 13, April 2017). Hossenfelder's argument is: *That we now live in the grip of post-factualism would seem naturally repellent to most physicists. But in championing theory without demanding empirical evidence, we're guilty of ignoring the facts ourselves.*

It could be further argued that in their quest for ultimate unifying insights, physics has as yet had little to offer of relevance to the coherence of the global psycho-social system. Intuitive metaphorical reference to bubbles as being central to socioeconomic crises therefore merits far greater attention in this critical period -- when various much-valued bubbles are highlighted as being in danger of imminent collapse. Again there is irony to the fact that physics has proven most effective in developing ever greater means to ensure physical destruction of what could be variously understood as "bubbles" -- and receives a high proportion of its funding for that purpose.

Given recognition that the coalescence of bubbles in a three dimensional foam, results in them having on average 14 sides (as noted above), this raises useful questions as to the number of "sides" characteristic of psycho-social bubbles in a psycho-social foam, whether in three dimensions or more. Given the understanding of bubbles in a universe of n-dimensions, provocatively it might be asked whether the faculties of a university (as cognitive bubbles in their own right) could be understood as coalescing to form an "academic foam".

Potentially of greatest relevance is whether the language of socio-economic growth -- with its particular bubbles (noted above) -- could be "translated" into the language of blowing viable bubbles, as it might be described by physics in systemic terms. How does the pattern of surface bonding stretch and reconfigure to maintain coherence? It is somewhat ironic that soap is used metaphorically in relation to enabling social bubbles but is of course very significant in the production of physical bubbles (*Soap bubbles and detergents...* *Introduction to SurfaceTension*, MIT).

Curiously a social bubble lending itself to such exploration is that engendered in the [stadia](#) built for games, concerts and large assemblies -- exemplified by the Roman [Colosseum](#). They may now be designed as geodesic domes using the tensegrity principles discussed above. The collective dynamics enabled therein can be recognized as engendering an otherwise elusive "bubble of consensus" or a "bubble of togetherness". The latter term is occasionally used to describe romantic and family relationships.

Identity bubbles: The collapse of any global bubble can be usefully seen as matched to varying degrees by that of personal bubbles -- to the extent that it is felt to be meaningful to consider that one lives inside a bubble and that the sense of the coherence of identity can itself be associated metaphorically with a bubble. Curiously this can be caricatured metaphorically as living within a goldfish bowl (Jonathan Dawson, *Life in the Goldfish Bowl*, *New Statesman*, 20 August 2008; Steven Paglierani, *The Fish Tank Metaphor: how the conscious, subconscious, unconscious come into being*, *The Emergence Alliance*, 2002). This is curiously complemented by the crystal ball metaphor through which personal future is foreseen.

The multitude of personalities of history, recorded or not, would seem to lend themselves to representations as bubbles -- emerging later to collapse. Extensive use is made of "ego bubble" (*Wall Street's Ego Bubble*, *Newsweek*, 17 November 2009; *The Ego Bubble: 10 things you need to know about startups, super-angels and desks*, *Forbes*, 24 September 2010).

Such use of metaphor can be readily deprecated, although the argument of [Kenneth Boulding](#) remains teasingly relevant:

Our consciousness of the unity of self in the middle of a vast complexity of images or material structures is at least a suitable metaphor for the unity of group, organization, department, discipline or science. If personification is a metaphor, let us not despise metaphors -- we might be one ourselves (*Ecodynamics: a new theory of social evolution*, 1978).

This would appear to accord with the argument of the much-cited research by Shelley Taylor and Jonathon Brown (*Illusion and Well-Being: a social psychological perspective on mental health*, *Psychological Bulletin*, 103, 1988, 2, pp. 193-210) concluding that:

Yet considerable research evidence suggests that overly positive self-evaluations, exaggerated perceptions of control or mastery, and unrealistic optimism are characteristic of normal human thought.... These positive illusions may be especially useful when an individual receives negative feedback or is otherwise threatened and may be especially adaptive under these circumstances.

That argument suggests that "illusion" could be usefully explored through the metaphorical language of [optical lens curvature](#). A bubble, as a lens offering a sense of assumed personal well-being, is then characteristic of the convex nature of positive curvature (of spheres), in contrast with the opposite illusion resulting from the concave nature of negative curvature. The metaphor highlights the merit of exploring the nature of illusion in higher dimensional spaces through the implications for the design of an n-dimensional "lens" -- as suggested by some research on so-called [lens space](#) (E. A. Lauret, et al., *Spectra of Lens Spacs from 1-norm spectra of congruence lattices*, *arxiv.org*, 7 May 2015; Alexander N Dranishnikov, *The LS category of the product of lens spaces*, *Algebraic and Geometric Topology*, 15, 2015, pp. 2983-3008).

Embodiment of a bubble, or within one, can also be a focus of criticism, illustrated by [Christopher Hitchens](#), as described by [Anthony Lock](#) (*Prick the Bubbles, Pass the Mantle: Hitchens as Orwell's Successor*, *The Humanist*, 29 June 2012). For Lock, the problem Hitchens wished to address was the same as that of [George Orwell](#), namely the enshrining of people or ideas -- in "bubble reputations" so detrimental to clear thinking:

Try as best as you can, he challenged us, to not allow one belief to squander clear thinking about another, especially in regards to those so-called bubble personalities that become protected from criticism. It's a kind of worship whereby anything deemed negative against the topic or person, even the act of criticizing, is illicit. This is totalitarian, he warned: a control over one's head and what can be said, creating corrosive preconceptions.

There are many who have employed the blueprints Orwell gave us, but the simple practicality of Hitchens' "pricking bubbles" principle, whether it be applied by voters, politicians, academics, or bon mot-spilling essayists, is one everyone, everywhere needs to know dearly. Everyone should be aware of what controls exist over their thoughts and opinions, both external and internal. It is an essential part of developing a critical mind. And in an age of increasing information, it becomes more critical by the day.

Following the reference by Woit to the physics community constituting a social bubble -- offering an example of "bubble reputations" -- this could be considered one instance of an argument of Peter Sloterdijk (*Talking to Myself about the Poetics of Space*, *Harvard Design Magazine*, 30, 2009):

There are hundreds if not thousands of milieus in the current social terrain that all have the tendency from their own viewpoint to form the center of the world and yet are as good as nonexistent for the others. I term them "inter-ignorant systems." And, among other things, they exist by virtue of a blindness rule. They may not know of one another, since otherwise their members would be robbed of the enjoyment of being specialized members of a select few.

It is also curious that what is esteemed as the best of physics, and of other research, is published in journals explicitly ranked as having a high [Impact Factor](#) (as potentially to be contrasted with an "Attraction Factor"). In a world of psycho-social bubbles, this implies a conscious militarization of communications which could be considered highly questionable -- perhaps a measure of the degree to which the worldview of others is forcibly transformed by that research, whether those identified with other bubbles wish it or not. The point can be made otherwise (*Enhancing Sustainable Development Strategies through Avoidance of Military Metaphors*, 1998; *"Tank-thoughts" from "Think-tanks" metaphors constraining development of global governance*, 2003).

Hyperidentity? As discussed separately ("[Hyperidentity](#)"? 2006), this is a topic of research in mathematics (cf W. Taylor, *Hyperidentities and Hypervarieties*, *Aequationes Mathematicae*, 23, 1981; S. L. Wismath, *On finite hyperidentity bases for varieties of semigroups*, *Algebra Universalis*, 1993). An identity is called a hyperidentity if, whenever the operational symbols defining it are replaced by any terms of the appropriate order, the identity which results holds for that order. Hyperidentities can be defined more precisely using the concept of [hypersubstitution](#).

In the psycho-social domain, Marisa Zavalloni (*Identity and Hyperidentities: the representational foundation of self and culture*, *First International Conference on Social Representations*, Ravello, 1992) clarifies the interplay between words and representations in the creation of identity and culture. She uses the term "hyperidentity" to characterize groups as the sum of all the representations produced about them; the term "figure" is used to describe a unique group representation. What is intuited in the widespread appreciation of a "bubbly personality"?

It is therefore a useful provocation to infer that there is hope for new understanding of the hyperdimensional bubbles of psycho-social space through the standard mathematical representation of n-dimensional bubbles (as indicated above and below). Is it to be assumed that human identity is less complex than is implied by that formula -- especially in the case of [multiple personalities](#) or those possessed of [multiple intelligences](#)?

Identity as a hyperbubble -- Hyperdimensional identity? Mathematical representation of standard n-dimensional bubble
$U_{\mu,y}(x) = \mu^{-\frac{n-2}{2}} U\left(\frac{x-y}{\mu}\right), \mu > 0, y \in \mathbb{R}^n,$ <p>where $U(x) = \alpha_n \frac{1}{(1+ x ^2)^{\frac{n-2}{2}}}, \alpha_n = [n(n-2)]^{\frac{n-2}{4}}$.</p>
Reproduced from Angela Pistoia and Carlos Román (<i>Large conformal metrics with prescribed scalar curvature, Journal of Differential Equations</i> , 2017)

Psycho-social multiverse? As the nexus of the thinking capacity from which more appropriate forms of global governance might emerge, the engagement of physicists with the challenging frontier of [string theory](#) merits continuing attention -- notably any [multiverse hypothesis](#) capable of encompassing Sloterdijk's "thousands of milieus". With respect to reframing insights into bubbles of a higher and subtler order, it is therefore intriguing to note a degree of conflation in the language of the physics of string theory between "dimensions", "universes" and "bubbles".

Dimensions are then understood by physics as membranes (or "[branes](#)"). However within the 11 dimensions envisaged by one flavour of string theory, there can be "bubbles" of 3-, 4-, and 5-dimensions (if not more). The branes can exist in different dimensions. Conventionally, with each bubble's dimensionality represented by "p" -- these are distinguished as "[p-branes](#)" (not to be confused with "pea-brains"). A p-brane can then be considered as a universe floating like a bubble in a "[hyperspace](#)" of greater dimensionality. If they collide, they may form a single bubble -- a universe. When such a single bubble separates, it forms two universes. It is curious that the social and policy sciences have resisted engaging with such higher dimensional possibilities -- whilst so obviously and disastrously stumbling at every stage to engender more appropriate forms of global governance.

Could the so-called "[clash of civilizations](#)" then be more fruitfully explored as a "clash of bubbles" -- hyperdimensional bubbles? The continuing clash between the Abrahamic religions would seem to merit exploration as a clash between hyperdimensional "bubbles of belief" of the greatest subtlety. Could metaphorical arguments for a "bigger tent" be reframed in terms of a bigger bubble of greater dimensionality (*Global Brane Comprehension Enabling a Higher Dimensional Big Tent?* 2011).

Potentially more intriguing is the choice of "string" as a metaphor, given the contrasting importance attached to "knot" as a metaphor by psychoanalysis (R. D. Laing, *Knots*, 1972; Jean Michel Vappereau, *Knot: the theory of the knot outlined by Jacques Lacan, Lacanian Works*, July 1996). From the latter perspective, the implications of "prick" and "pricking" (in relation to any bubble) provocatively recall the most fundamental preoccupations of that discipline, as can be speculatively explored (*Engendering Invagination and Gastrulation of Globalization: reconstructive insights from the sciences and the humanities*, 2010). Whether consciously or unconsciously, does everyone aspire to being a "prick" -- and to pricking the bubbles of others?

Neuroscience and cognitive psychology: Such language merits comparison with the results of recent neuroscience research which indicates the remarkable possibility of cognitive processes taking up even up to 11-dimensional form in the light of emergent neuronal connectivity in the human brain. As summarized:

Using mathematics in a novel way in neuroscience, the [Blue Brain Project](#) shows that the brain operates on many dimensions, not just the three dimensions that we are accustomed to. For most people, it is a stretch of the imagination to understand the world in four dimensions but a new study has discovered structures in the brain with up to eleven dimensions - ground-breaking work that is beginning to reveal the brain's deepest architectural secrets..... these structures arise when a group of neurons forms a clique: each neuron connects to every other neuron in the group in a very specific way that generates a precise geometric object. The more neurons there are in a clique, the higher the dimension of the geometric object. ...

The appearance of high-dimensional cavities when the brain is processing information means that the neurons in the network react to stimuli in an extremely organized manner. It is as if the brain reacts to a stimulus by building then razing a tower of multi-dimensional blocks, starting with rods (1D), then planks (2D), then cubes (3D), and then more complex geometries with 4D, 5D, etc. The progression of activity through the brain resembles a multi-dimensional sandcastle that materializes out of the sand and then disintegrates. (*Blue Brain Team Discovers a Multi-Dimensional Universe in Brain Networks* *Frontiers Communications in Neuroscience* 12 June 2017)

In their published paper the researchers suggest that these cavities open the way to new understanding between structure and function (Michael W. Reimann, et al, *Cliques of Neurons Bound into Cavities Provide a Missing Link between Structure and Function*, *Frontiers in Computational Neuroscience*, 12 June 2017).

However, with respect to such dimensionality, there is a strange alienation between the preoccupations of physicists and that of neuroscientists. Arguably the "cavities" formed by neuronal connectivity could be compared to the tensegrity cell structure of Ingber and to bubbles of higher dimensionality. There is however a striking contrast between the higher dimensional hypotheses of physics and the higher dimensionality now demonstrated by neuroscience research. Arguably it is the capacity of the brain to function in that manner

which enables physicists to recognize the credibility of higher dimensionality, as would follow from the arguments of [George Lakoff](#) and [Rafael E. Nunez](#) (*Where Mathematics Comes From: how the embodied mind brings mathematics into being*, 2000).

The central challenge is how physicists can engage so remarkably with such dimensionality from "within" their own brains in contrast to their preference for articulation of higher dimensionality "elsewhere" and "elsewhen" in the cosmos -- effectively denying the psycho-social implications. Ironically it might be said that, from the perspective of a physicist (characterized by the highest impact factor), the distinction between a physicist and an AI is that the physicist has the capacity to be "[not even wrong](#)" (and may be as likely to be so as not). However this capacity is significantly different from the [negative capability](#) famously praised by the poet John Keats.

Is a subtler preoccupation with bubbles all about a sense of identity and how identity is embodied? This is presumably consistent with the arguments of George Lakoff and Mark Johnson (*Philosophy in the Flesh: the embodied mind and its challenge to Western thought*, 1999). In the absence of any understanding of the potential multidimensionality of bubbles, it is then understandable how reactive is the response to any threat of individual or collective identity being "pricked" or "punctured".

Consensus and coherence? Any sense of consensus, however illusory, can be fruitfully recognized through relatively frequent use of the phrase "bubble of hope" -- however this may be associated with sustaining the illusion, notably in relation to the viability of the current global financial and economic systems -- variously held to be close to collapse.

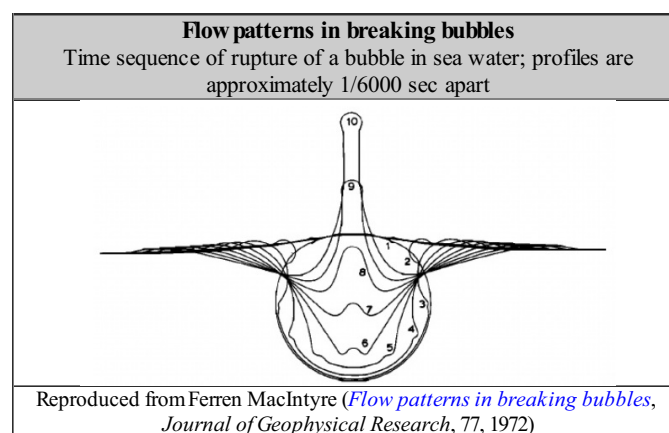
As noted above, also intriguing is the possibility of new insight into any "bubble of joy" or "bubble of pleasure", whether enabled by psychotropic drugs or otherwise. Appropriate to this argument, the *New Scientist* reviewed a centennial reprint of a book by [C. V. Boys](#) (*Soap Bubbles: their colours and the forces which mould them*, 1891) under the title *A Bubble of Joy* (1783, 24 August 1991). Such phrases are readily associated with choral singing, especially by the religious. In imagining the nature of "hyperbubbling", a valuable clue is offered by the experience of humour and its remarkable capacity to transcend conventional boundaries and barriers, as can be variously argued (*Humour and Play-Fullness: essential integrative processes in governance, religion and transdisciplinarity*, 2005).

With respect to meaning, as argued by [Barbara Czarniawska-Joergs](#): *Culture can be viewed as a bubble of meaning covering the world, a bubble we both create and live within* (*Culture is the Medium of Life*, 1991). Clearly more problematic is the attraction of psychotropic drugs in engendering such bubbles -- framed as a more effective substitute for other processes, especially when unrealizable. Even more problematic are the attractions of the "reality bubble" associated with the radicalism of any belief system or cult. Is a radical worldview to be recognized as of higher or lower dimensionality?

Citing the [reality distortion field](#) engendered by charismatic leaders, David Voelker argues:

The term "reality bubble" has generalized beyond its original market-based meaning. The principle really applies to any situation where a person or group of people succeed in sustaining (for a time) a belief inconsistent with objective facts. The reality inside the bubble is what I call beta reality -- beliefs are the "facts" of this reality, and their effects (the actions taken by people based upon them) are the equivalent of the effects of objective facts as enforced by the laws of physics in objective (alpha) reality, which is outside the bubble. (*Two Realities*, 12 October 2009).

In a world inundated to ever higher degrees by "fake news", can insights from the natural sciences into the nature of bubble dynamics clarify these conditions? What can be learned about the process of bursting bubbles? Why has "blowing bubbles" of universal consensus become an unrealistic pious hope? Should Donald Trump, Emmanuel Macron and [Nigel Farage](#) be considered examples of "pricks" causing the rapid and unforeseen collapse of political configurations and world views -- as bubbles of the past -- much to the surprise of many? What kind of question constitutes a "prick" capable of bursting a bubble -- calling it into question? Can this be explored as a "deadly question" (*World Futures Conference as Catastrophic Question: from performance to morphogenesis and transformation*, 2013).



Psycho-social hyperbubbling: beyond one-bubble credibility and despair?

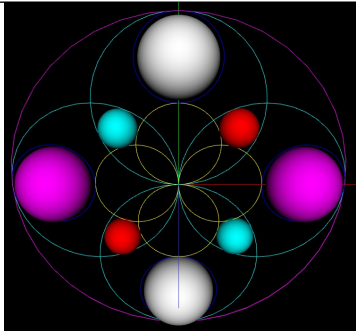
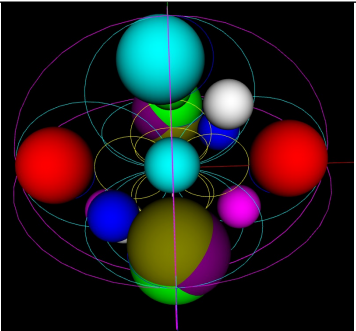
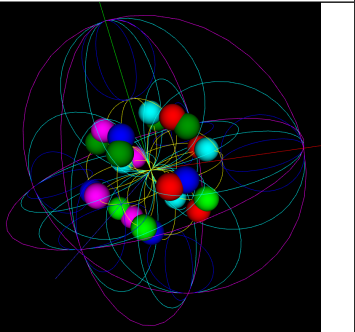
Emergence/Reabsorption: In the socioeconomic domain the concern is with the catastrophic consequences of bursting bubbles -- however much enthusiasm and benefit is derived from the [dot-com bubble](#) and others of that ilk. The joyful appreciation of chaotic bubbling in sparkling drinks and brooks derives from the surprising aesthetics, tinged by recognition of the momentary existence and imminent decline of any bubble. This appreciation is similar to that accorded by the annual [cherry blossom](#), especially in Japan (known there as *sakura*). The latter is potentially indicative of the limitations and inappropriateness of any metaphorical focus on the "bursting", "pricking" or "puncturing" of bubbles -- whether desirable or not.

A metaphor of greater coherence would encompass both rise and fall, rather than focusing on the violently catastrophic disappearance of a bubble. There is a need for imaginative frameworks to encompass emergence and decline, so appreciated in the poetry evoked by the cherry blossom. Presumably collective initiatives, from groups to civilizations, lend themselves to such appreciation from a historical perspective -- especially the poignant nostalgia evoked by the many theories and deities which have faded into irrelevance following a golden era (see *Lists of Deities*; *Civilizations of the past*). Fascination with their implication is now surprisingly evident in the role of mythology in games such as *Dungeons and Dragons*. In the socioeconomic field such a framework is offered only to a very limited degree by cycles of inflation and deflation -- the unequivocal language especially associated with bubbles and balloons (as noted above). By contrast, the mythology of [eternal return](#) is a more powerful catalyst for imagination.

Fractal patterning of higher order: The argument above highlighted the possibility of n-dimensional bubbles, necessarily of greater complexity and subtlety -- bubbling of a higher order. Of potential relevance is the possibility that the seeming violence of bubble emergence and reabsorption -- bubbling of a lower order -- might be framed otherwise through patterns of a higher order. Such patterns may well lend themselves to intuitive recognition. One indication is offered by the much-admired aesthetics of [fractals](#), most notably the visual renderings of the [Mandelbrot set](#). This might be understood as the static representation of a form of "bubbling dynamic" in the [complex plane](#) (*Psycho-social Significance of the Mandelbrot Set: a sustainable boundary between chaos and order*, 2005).

Beyond the provocative depiction (above) of the mathematical representation of n-dimensional bubbles, the question is whether suggestive visual renderings of "hyperbubbling" could be developed to trigger imaginative reflection on patterns of rising and falling, emergence and reabsorption, as variously recognized. These are of course echoed by the patterns of birth, ageing and death gracefully, as so intimately recognized by all.

Indicative visual renderings: The following experiments in 3D depiction are suggestive of further possibilities. They derive from the challenge of depicting [polyphonic singing](#) combining a variety of partially independent voices in such a way as to suggest patterns of a higher order. This exploration was especially inspired by the process of improvised singing of the [bertsolaritza](#) central to the Basque culture. The complex circular geometry of the [lauburu](#), symbolic of that culture, is used in the animations below to explore the interplay between voices -- variously rising and falling, only to rise again (*Improvisation in Multivocal Poetic Discourse: Basque lauburu and bertsolaritza as catalysts of global significance*, 2016). The patterns of emergence and reabsorption are variously reminiscent of the dynamics implied by the Tao symbol. The animation of the 8-bubble pattern in a single plane best clarifies the movements in the 16- and 24- bubble patterns.

Suggestive images and 3D animations of "hyperbubbling" using the geometry of mutually orthogonal lauburu to frame pathways of bubble emergence and reabsorption		
Single-plane lauburu framework 8-bubble "bubbling"	Double-plane lauburu framework 16-bubble "bubbling"	Triple-plane lauburu framework 24-bubble "bubbling"
		
Video (mp4). Virtual reality (x3d, wrl)	Video (mp4). Virtual reality (x3d, wrl)	Video (mp4). Virtual reality (x3d, wrl)

The complex subtlety of hyperbubbling is usefully implied by the sphere (not indicated) of which the 3 lauburu planes are great circles. Framing the bubble dynamics nested within it (as indicated), that circumsphere sphere can also be understood as itself nested within a similar pattern of dynamics -- effectively a fractal organization of hyperspheres. Each bubble indicated above can thus also be understood as encompassing a similar pattern.

As suggested by the rendering of [hyperbubbles in the hyperbolic plane](#) by Paul Nylander, the argument may be further developed through mathematical consideration of the [Poincaré disk](#) and the [tessellation of the hyperbolic plane](#) with which it is so closely associated, as separately illustrated by animations (*Global communication patterns in a hyperbolic space of negative curvature*, 2016). Such a hyperbolic mapping was an inspiration for the widely appreciated drawings of [M. C. Escher](#).

The animations suggest a fruitful psycho-social relationship between Sloterdijk's bubbles, globes and foams (as mentioned above). Sloterdijk commonly describes himself, and the way he presents his ideas, as "hyperbolic" (*hyperbolisch*). He has argued that in the age of the "wired hyperbubble" (Sloterdijk, 1997, p. 57), with the tendency to define ourselves in terms of access to networks, a spatial approach to globalization is required. He also argues that all ethics are hyperbolic, that is, they radicalize motives such as purity, holiness, love and justice, and turn to an elite that does not yet exist (*"Die Menschheit sucht das Perpetuum mobile"*, *Focus Magazin*, 16, 2009).

Beyond catastrophic bursting: The animations are useful in offering insight into orderly deflation of a bubble in contrast with the focus on the catastrophe of bursting. The bubbles shown could also be usefully imagined to be spinning as they travel along helicoidal pathways -- conic vortices framed by the lauburu -- whether during emergence or reabsorption.

In a culture obsessed with growth, there is currently little interest in the nonviolent phasing out of any worldview -- or of those who subscribe to it -- however much this may be a matter of experience in any ageing process, or the progressive obsolescence of a fashion.

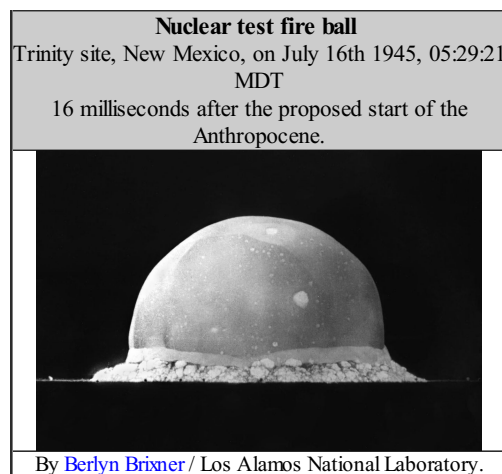
As the exemplification of a bubble, the structure of geodesic domes also offers the possibility of using telescopic struts which could enable a dome to both expand and contract in an orderly manner, as required by circumstances. This design possibility could reinforce understanding of the challenge in relation to psycho-social bubbles, especially if telescoping was controlled by hydraulic pressure.

Missing from the dynamics, as symmetrically rendered above, is any seemingly asymmetric interplay of phases of movement. These are more readily comprehended and appreciated in the melodies of polyphony, where the "symmetry" is of a higher order as the interplay of "voices" rising and falling. Hence the argument for a *A Singable Earth Charter, EU Constitution or Global Ethic?* (2006) and *Clues to patterns of dialogue from song (Enabling a 12-fold Pattern of Systemic Dialogue for Governance, 2011)*.

As cognitive containers, and as an alternative to 2D depiction, bubbles offer a suggestive means of imagining the higher dimensional nesting and interplay of the pattern of energy centres (**chakras**) variously "voicing" the psychic energy associated with the **kundalini** metaphor of a number of Eastern spiritual traditions (**Karlfried Graf Durckheim, Hara: the vital centre of man, 1988**). The dynamics of the nested interplay of such bubbles is also suggestively indicated by the "pumping" relationships of spherically symmetrical polyhedra, as presented by animations separately (*Psychosocial Implication in Polyhedral Animations in 3D: patterns of change suggested by nesting, packing, and transforming symmetrical polyhedra, 2015; Nesting polyhedra to enable comparison of patterns of discourse, 2015*).

If the bubble is described and experienced as a cocoon, such orderly deflation can be usefully contrasted with the "orderly" bursting of a **pupal cocoon** or an egg -- a process described as **eclosion** in the lifecycle of some animals. Recognized as a cyclic phase, this metaphor of emergence has been used to frame anticipation of the fundamental psycho-social transformation to a form which could "fly" (**John Elkington, The Chrysalis Economy, 2001**). A bubble can then be fruitfully understood as a container for morphogenesis (*Enabling morphogenesis and transformation through catastrophic questioning, 2013*).

Anthropocene or Chthulucene? Much is currently made of the epochal emergence of the **Anthropocene** as a successor to the **Holocene** -- notably heralded and characterized by the sixth **mass extinction of species**. The following image is reproduced from the *Wikipedia* entry on the Anthropocene -- perhaps to be recognized as successful "bubble blowing" by physicists.



Rather than the catastrophic effect illustrated above, the fundamental question highlighted by the this argument is how physics might inform new understanding of the global bubble of complacent complicity which is so characteristic of human endeavour. The familiar bubbles of physics are sustained by the complex dynamics of **surface tension** in relation to the viscosity of the fluid from which they emerge -- as a balance of surface tension forces against internal pneumatic pressure. The complacent complicity of psycho-social bubbles would appear to ensure an equivalent balance -- with social networking and bonding processes performing an analogous function in ensuring the integrity of the surface of a "globular" worldview for a time -- a community.

Can these processes be understood more fruitfully otherwise -- especially in the hyperbubbling of n-dimensional bubbles in a seemingly chaotic environment? How might the insights of physics be "translated" to that end, as can be variously argued speculatively (*Quantum Wampum Essential to Navigating Ragnarok Thrival in crisis through embodying turbulent flow, 2014; Enabling Governance through the Dynamics of Nature: exemplified by cognitive implication of vortices and helicoidal flow, 2010*).

Potentially more appropriate than the "Anthropocene" bubble currently proposed, are the imaginative implications of a "Chthulucene" bubble, as provocatively proposed by **Donna Haraway (Staying with the Trouble: making kin in the Chthulucene, 2016; Tentacular Thinking: Anthropocene, Capitalocene, Chthulucene, e-flux, September 2016)**. This recognizes dimensions of complexity neglected by the increasingly obsolete framings of the Anthropocene -- ineffectual in the face of the **surreality** of the times -- suggesting new ways to reconfigure relations with a damaged earth and all its inhabitants. As with the **Kraken**, evocation of the imagined monstrosity of Lovecraft's **Cthulhu** fruitfully informs the proposal with neglected dimensions of the unconscious, echoed in other myths of relevance to the "awakening" monstrosity of the times (**John Wyndham, The Kraken Wakes, 1953**).

These considerations highlight the role of the imagination and inference with respect to the "existence" of any psycho-social bubble, including those of an economic nature. To what extent is any purported hyperdimensionality (as understood by some sciences) to be understood as being as ill-founded as what is deprecated as **"pseudoscience"** (even by those same sciences)? There is an ironic contrast between the speculative "bubbling up" of hypotheses by cosmologists, as reviewed by **Ross Andersen (In the Beginning: will we ever understand the beginning of the universe, Aeon)**, and the reality attributed to bubbles by cosmology (**Caleb Scharf, Gravity's Engines: how bubble-blowing black holes rule galaxies, stars, and life in the cosmos, Scientific American, 2012**).

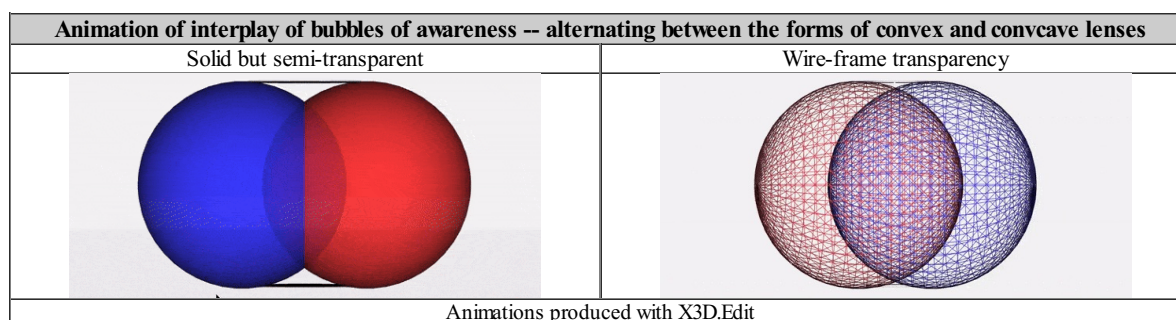
As contrasting forms of bubble, the issue is given particular focus by the distinction made by *Wikipedia* between [aura as a perceptual disturbance](#) and the unrelated reference to a [paranormal aura](#) as an energy field variously claimed to be perceived or hypothesized. Curiously these may be understood as related through a bubble-like [reality distortion field](#) -- a term now applied to charismatic managers and leaders who succeed in convincing others to become passionately committed to projects without regard to constraining circumstances.

Bubbles objectively "outside" vs Bubbles subjectively "inside"

The subtlety of bubbles, and the inspiration they offer, suggests a distinction between those "without" and those "within" -- and the manner of their confusion (*World Introversion through Paracycling: global potential for living sustainably "outside-inside"*, 2013). This is in contrast to a distinction made in economics (Sergi Basco, *Switching Bubbles: from outside to inside bubbles*, *European Economic Review*, 87, August 2016, pp. 236-255). It is especially significant that humans interact with externalities through the bubble-like form of eyes -- via which images are formed within. How the correspondences between the externalities of globalization relate to their cognitive significance merit continuing exploration (*Personal Globalization*, 2001). Is "globalization" an externality or a bubble of collective "recognition"?

The distinction is then more fruitfully recognized in optical terms between a [convex lens](#) and a [concave lens](#), and the contrasting manner in which each processes an image. It is of course the case that focus is achieved through flexible [accommodation by the lens of the eye](#) -- possibly aided by spectacles, or enhanced by lenses in a telescope or microscope. These all focus on externalities and many benefit from stereoscopic effects. More intriguing is the manner in which the brain processes images and any sense of an inner eye through which matters are brought into focus to form a significant conceptual image of some kind (*Oliver Sacks, The Mind's Eye*, 2010). Much is made of the complementarity of function of the two hemispheres of the brain in this respect.

It is therefore interesting to reflect on the manner in which any so-called inner eye(s) adjust between convex and concave forms -- as might be suggested by phases in the interplay between two bubble-like forms in the animations below. Each bubble can be understood as "pricking" the other in a process reminiscent of insemination.



There are many accessible images and animations of the manner in which light is focused through concave and convex lenses. A valuable indication of the transformation between the two extremes is provided in an interactive animation using GeoGebra (*Concave and Convex Lenses*). Such features could be added to the above animations. The flow of significance over either surface is echoed by the characteristic iridescence of bubbles and the manner in which they capture and reflect the light.

The animations frame a possible exploration, using an optical metaphor, of both relations between the two hemispheres of the human brain and the implications for the integration of any [global brain](#), as explored separately (*Engendering Viable Global Futures through Hemispheric Integration: a radical challenge to individual imagination*, 2014; *Corpus Callosum of the Global Brain? Locating the integrative function within the world wide web*, 2014). Given the potential dysfunctionality of eyes in achieving focus ([myopia](#), [far-sightedness](#), [astigmatism](#), [presbyopia](#), etc), there would appear to be urgent need to correct for corresponding dysfunctionality in governance, as previously suggested (*Developing a Metaphorical Language for the Future*, 1994).

The colouring used for the "bubbles" above recalls widespread discussion about the metaphorical implications of the "red pill" and the "blue pill" (*Psychosocial Transformation by "Pill Pushing"? Model-making, strategic advocacy and the myth of the "red pill"*, 2017). There is indeed a case for recognizing life as being lived within a cognitive bubble. Identifying with that bubble exemplifies the Roman recognition of *homo bulla est*. However the dancing flexible adaptability of the bubble in the moment also recalls the recognition of *homo undulans* in the concluding chapter of the study by Daniel Dervin (*Creativity and Culture: a psychoanalytic study of the creative process in the arts, sciences, and culture*, 1990), as separately reviewed (*Emergence of Homo undulans -- through a "grokking" dynamic?* 2013).

<i>To See a World...</i>
To see a World in a Bubble, And a Heaven in a Wild Flower, Hold Infinity in the palm of your hand, And Eternity in an hour.
fragment adapted from <i>Auguries of Innocence</i> (1863), with apologies to William Blake

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