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In recent years there has been a growing interest and reporting in the popular press and scientific literature on the topics of *dark energy* and *dark matter*. The mysterious, unknown nature of these entities has captured the cultural imagination. However, very little psychological reflection has been offered on the attention given to these phenomena. A brief overview of the human fascination with (and fear of) the dark is presented as a backdrop to the current interest being given to realms of darkness in modern cosmology. Beginning with the hypothesis of dark matter in the 1930s based on astronomical observations of galaxies, this fascination has grown. More recently the even more mysterious dark energy, a repulsive force opposite of gravity that creates regions of void, has come to the forefront of cosmological studies. This dark energy is purported to be one of the shaping elements in the evolution of the large scale structure of the universe. The psychological significance of the scientific imagery generated by these studies is heightened when a comparison with neural patterns in mammalian brains is made. Furthermore, the model of the universe emerging from these studies has striking parallels with certain schools of Buddhism, especially those that value *nothingness* as the key to reality. Jungian psychology is shown to be well positioned to appreciate the paradigm shift represented by the confluence of these visions.

Keywords: ***dark energy, dark matter, cosmic web, nothingness, Hua-Yen Buddhism, Jungian psychology***

The mysterious, unknown aspects of the world have been a source of fascination and fear to humans probably since our emergence as a species, if not earlier. Knowledge that penetrates into such mysteries tends to come with the feeling of the archetypal, that is, a numinous aura seems to surround the knower as well as what is revealed. Prior to the birth of the modern era, knowledge of the mysteries of nature were comingled with those of the spirit and usually watched over by religious authorities. With the separation of mind and matter as first formulated by René Descartes in the 17th century, a division of forms of knowledge emerged (Audi, 1999, pp. 226-227). Spiritual knowing became increasingly distinct from knowing about the physical universe. Since the very onset of this division there have been countercurrents longing to reunite what was torn asunder.

Even in the 17th century there were major philosophical responses to Descartes, most notably by Leibniz and Spinoza. Leibniz imagined a pre-established harmony among monads to avoid the Cartesian split, while Spinoza postulated that god and nature were actually two aspects of one fundamental reality (Audi, 1999). However valuable these reflections were and continue to be, as in contemporary philosophy of mind and neuroscience (e. g., Damasio, 2003), the wound remains and the lure of the unknown in its many expressions beckons toward the fantasy of complete understanding. To better understand the current fascination with *dark energy* and *dark matter* I will start with the inability of the forms of mainstream science springing from the physical, mechanistic elements in the origins of the scientific approach to deliver on the promise of a total understanding of the universe.[1]

Since Newton's articulation of the three laws of motion bearing his name, codified in his 1687 *Principia: Mathematical Principles of Natural Philosophy*, the desiderata of the modern mind has been a complete mathematical description with numerical solutions for all of reality. This situates humans in a mechanistic, clockwork world. Nevertheless, even within Newton's lifetime, the problematic nature of such an endeavor emerged. The algorithms of Newtonian mechanics are

only fully soluble for systems of two interacting particles, since the introduction of a third particle requires approximations such as perturbation theory to approach results, but never with full accuracy.

After several centuries of trying, by 1887 Bruns, followed by Poincare opened new ground by demonstrating mathematically that there could be no general solution, only solutions under special circumstances, otherwise the best hope was approximations using a series of differential equations (Vallado, 2001, p. 37). This was not a rejection of the scientific method, but a recognition of the need for refinement and expansion. Nevertheless, the universe had eluded a full unveiling; the project of mechanistic science, which had been taken over by enlightenment and positivistic philosophies to render all mathematically visible, was thus thwarted.

In contradistinction to the impetus to reveal all, the romantic traditions of the late 18th and early 19th centuries, sought to reunite fragmented reality by including the force of the irrational in their descriptions of the world. Dark and light were felt to be in dialectical tension. From these traditions arose the notion of unconscious processes essential to any full description of mind, while implicitly hinting that this might also be true for matter. As the 19th century unfolded, elaborations of the unknown took on an increasing descriptive force. In medicine, for example, Charcot began this movement with his differentiation of organic, neurological injuries and illnesses from functional or psychological problems (Ellenberger, 1970). These trends came to their greatest flower in the emergence of the depth psychologies as the nineteenth century drew to a close.

In the physical sciences of the 19th century, major breaks with the mechanistic vision of the cosmos began to gain strength. Stemming from the romantic traditions in Germany, the mystery of a possible link between the then newly discovered phenomenon of electricity and magnetism, known since the ancient world as a property of materials such as lodestones, was of great interest and concern. Thus, in 1820, Danish physicist Hans Christian Hans Christian Ørsted serendipitously observed during a classroom demonstration of the passage of an electric current through a wire the influence this exerted on a compass in close proximity (Dusek, 1999). However, he could penetrate no further into the mystery and it took about 15 years until Michael Faraday conducted a set of experiments to show the rich, complex interdependence of these two forces, and another 45 years before these ideas could be codified mathematically by James Clerk Maxwell (as detailed in my book on synchronicity, Cambray, 2009; see also Pearce, 1980). The description of the interactions required a new way of thinking, in terms of extended fields of interaction, which had non-local properties. The Newtonian formulation was shown to be wholly inadequate to describe these forces. The reconsideration of gravity implicit in this lead directly to Einstein's theories of relativity (special and general, that is, a new formulation of the laws of motion and later gravity itself). Through the writings of William James these ideas were imported into psychology. James read Maxwell in the later 1870s, incorporating these ideas into his 1902 book *The Varieties of Religious Experience*, which C. G. Jung (1947/1969, para. 356, n. 23) read and quoted at length.

The other main area of physics to inform depth psychology was quantum mechanics. This too began with the attempt to solve a curious mystery, that of black-body radiation. This refers to the electromagnetic radiation given off by an object held at a constant temperature; it is characterized by its frequency spectrum which depends solely on the temperature of the radiating body. The spectrum is in the infrared at room temperature; with temperatures from about 500°C black-bodies begin to emit visible light (starting at dull red, then glowing yellow, and finally a brilliant bluish-white as temperatures rise—increasing amounts of ultraviolet radiation are also present as temperatures rise). The sun approximates a black-body radiating at about 5530°C at its surface (by contrast its core can reach 15,000,000°C; see Hathaway, 2015). The attempts of classical physics to describe black-body radiation completely broke down in what was called the *ultraviolet catastrophe* and the only way out of this was to adopt a quantized view of light, which was the stunning discovery of Max Planck (1900), curiously coincident with the publication of Freud's (1900) *Dream Book*.

Gradually the quantum revolution was brought to bear on the realm of matter, especially the Copenhagen school of Niels Bohr, which included Wolfgang Pauli among others (Faye, 2002/2014). Bohr led much of the effort to work out the quantum mechanics of matter, which again, coincidentally, was in process from about 1913 to 1927, approximately paralleling the time Jung (2009) was actively working on his *Red Book*. There is no suggestion here of any direct link between Jung's activities

and those of the physicists, though Einstein had been an informative dinner guest of Jung's several times at the end of the first decade of the 20th century; Jung (1953/1975) claimed to have learned about *psychic relativity* from Einstein. Jung's connection to and correspondence with Wolfgang Pauli only begins after this, in 1932. The point of drawing the parallels here is to indicate the way ideas in the Zeitgeist draw upon what may have been framed as activations in the collective unconscious. These in turn often manifest through an intense interest in the unknown, a fascination with what might be in the dark, and this of course alters with each age. In this way the scientist and the analyst share a fascination with unknown forces (in nature and in mind).

Pursuing the Dark

Medieval alchemy, the primary metaphoric system in Jung's writings on psychological transformation from the 1930s on, maintained a fascination with the dark. This was formulated in terms such as the *Nigredo*, a darkness of mind that was also the first stage of the alchemical work of transmutation imaged as the *black sun*, the *raven's head* and so on (Jung, 1944/1968). Jung (1958/1969) saw this as compensation for Christianity's culturally dominant pursuit of the good, often framed in terms of embracing the light. Seen in this vein, there have been countermovements that have found revelatory mysteries in pursuit of what is in the dark. Darkness tends to be initially and naively experienced as frightening, since humans are diurnal creatures. But through the study of unconscious process, themselves functioning in what is often identified metaphorically as the dark, the tendency to automatically moralize against the dark has been suggested to be based on projective dynamics (e.g., Neumann, 1969). There is another side to the imagination of darkness and the night, a kind of fecundity and richness of the psyche, which comes alive more fully in the dark, outside direct quantitative scrutiny. Given that light and dark as attributes of the world are archetypal at core, it is not surprising that they exert a fascination on everyone, despite formal education and training (Jung, 1958/1969). Hence in approaching the concept of dark energy and dark matter, before even engaging their current status in science, one can perhaps sense the psychological activations inherent in their names, offering a point from which to start.

In 1933 the astrophysicist Fritz Zwicky (1898-1974), who trained at the ETH in Zurich where Jung, Pauli, and Einstein held positions, moved to Cal Tech to work with famed physicist Robert Millikan. He quickly proposed that the recently discovered island universes, or galaxies, contained enormous amounts of unseen matter (Panek, 2008). Zwicky, a remarkable visionary maverick scientist, had together with Walter Baade predicted, that same year, the existence of *neutron stars* as the remnants of *supernova* explosions—another term he had just coined (Burrows, 2015). This was an especially rapid extrapolation as the subatomic particle known as the *neutron* had only been discovered the previous year. Now these two scientists were proposing an incredibly compact stellar body composed of these neutrons; a neutron star containing about 1.4 times the mass of Earth's sun would only be about 15 km in diameter. These predictions became fact with the first observational evidence of a neutron star in 1967. Baade and Zwicky (1934) also predicted these supernova explosions would generate *galactic cosmic rays*, high energy subatomic particles traveling at nearly the speed of light. Zwicky had been studying properties of galaxies, especially how they move relative to one another, and realized that they themselves tended to come in clusters. He had focused on the Coma cluster of about 1000 galaxies moving together in a shared gravitational field;.by measuring the total amount of light being given off by the cluster and comparing this to the mass of the cluster, based on gravitational measurements, he realized the cluster appeared to be deficient in matter by a very sizable amount, as there should have been more than 100 times as much matter than could be ascertained by the light measurements. Thus the cluster had to contain a very large amount of material that was not visible, and which Zwicky termed dark matter (Panek, 2008). As a part of these arguments he also correctly envisioned that galaxies would act as gravitational lenses, a fact confirmed by observations in 1979.

By the early 1970s advances in several branches of science, especially astrophysics and particle physics, along with computer technology, made questions about the nature of this dark matter compelling. By this time general relativity was well established, and together with the advances in nuclear physics, the Big Bang theory of the origins of universe was on increasingly solid scientific ground. Residue of this singular, originary event found in the cosmic microwave background permeating the entire universe served as strong evidence in support of the theory (Tate, 2013). Subsequently, as scientists began to

model the nature and behavior of galaxies, the theoretical calculations again required massive amounts of unseen matter if results were to be anywhere close to observed reality. Direct observations also produced surprises. For example, Vera Cooper Rubin and Kent Ford (1971) at the Carnegie Institution made an in depth study of the motion of hydrogen clouds in the Andromeda galaxies, one of Earth's nearest galactic neighbors. The anticipated differential orbital speed of gas clouds out at the edge of the galaxy versus clouds near the center was not borne out as gravitational theory would have predicted. Strikingly, the velocity of the various clouds remained constant, and the same proved true for stars orbiting the *galactic center*. One of the best ways to account for this was the inclusion of significant amounts of unseen or dark matter beyond the visible edge of the galaxy, in fact, the amount of dark matter increased as one moved away from the center of the galaxy.

Mapping the Dark and the Cosmic Web

By the later 1970s astronomers were beginning to pursue and map areas of darkness. There were at least two components to this. Earlier in the 1960s, detailed surveys of the red shifts of galaxies produced the first three dimensional portraits of regions of the sky (see Cofield, 2015). From these it became apparent that galaxies tended to cluster and even form *superclusters*. By 1978 distinct regions of voids, with significantly less than the usual amount of mass/volume than regions with clusters, were identified by several groups, such as Gregory and Thompson (1978) exploring the Coma cluster, while Joeveer and Einasto (1978) discussed the large scale structure of the universe as a whole. As this progressed, these regions of relative void were being mapped in relation to the clusters. Taken together these structures formed what is known as the *cosmic web* (see Université de Genève, 2015), which itself is currently being mapped with greater precision—the images tend to be quite dramatic and are regularly on display in both the scientific and popular press. The cosmic web is noted for its bubbles of nothingness, the voids, together with clusters of galaxies, which on very large scales form so-called walls with what are called filaments that protrude out from the walls.

The basic structural components of this architecture are thought to stem from quantum fluctuations in the pre-inflationary period of the universe, an extremely short time frame after the Big Bang, $<10^{-32}$ second (Jackson & Schalm, 2012). The more dense regions in the fluctuations resulted in the galaxies with their penumbra of dark matter holding them into walls and filaments. What is incredible about this is the relative percentages: dark matter far outweighs so-called ordinary galactic material, making up about 24% of the total mass of the universe, with matter forms familiar to us supplying only about 4.6% of the total (i.e., there is more than five times as much dark matter of an unknown nature as there is matter composed of materials that are known and understood; NASA, 2014). The remaining 71.4% is due to dark energy; void spaces occupy most of the volume of the universe. Dark energy is the repulsive force that is creating the cosmic voids, originating in the regions of less density from the quantum fluctuations discussed above. At galactic distances gravity's attractive force tends to overshadow dark energy, which has a very low density but is uniformly distributed throughout the universe, so that at larger scales the repulsive force gradually comes to dominate (Jackson & Schalm, 2012).[2] As the universe expands beyond a size threshold, the power of dark energy gains the upper hand and the expansion begins to accelerate—the cusp of the increasing acceleration occurred around 7.5 billion years ago. As voids expand, the density between galactic clusters continuously decreases, with matter migrating outward towards the boundaries of the void, where it merges into walls and filaments. The matter density in the interior of the voids thus asymptotically approaches zero, or pure emptiness. In an ever-expanding universe this becomes the ultimate fate of everything, a disappearance into non-existence. The psychological implications of these observations and imaginings will be considered later in the discussion.

In mapping the cosmic web, scientists have discovered that not only are galaxies not distributed randomly, but their groupings in clusters and superclusters are interconnected via networks of filaments (Cautun, van de Weygaert, Jones, & Frenk, 2014). The superclusters tend to form at the intersections of filaments. According to the University of Hawaii Institute for Astronomy (UHIA; 2014), the Milky Way, the galaxy in which we live, is a part of such a supercluster. This gigantic cluster is made up of around 100,000 galaxies, and is more than 500 million light years in diameter. The enormous dimensions of these collective objects confounds ordinary capacities of conception and evokes the mythopoetic imagination, reflected in part by the fact that this supercluster was

dubbed Laniakea by astronomer Brian Tulley from the University of Hawaii, borrowing from the Hawaiian for *immense, or immeasurable heaven.*

> The name Laniakea was suggested by Nawaʻa Napoleon, an associate professor of Hawaiian Language and chair of the Department of Languages, Linguistics, and Literature at Kapiolani Community College, a part of the University of Hawaii system. The name honors Polynesian navigators who used knowledge of the heavens to voyage across the immensity of the Pacific Ocean. (UHIA, 2014, para. 6-7)

Hawaiian scholar Lilikalā Kame'eleihiwa (2009) provided some mythic background:

> Today our Hawaiian navigators can use their knowledge of the stars to travel across 2500 miles of open ocean between Hawaiʻi and Tahiti and Raʻiatea, without any western instruments to guide them, simply using the teachings of the ancestors. Today the name Raʻiatea, or Laniakea in Hawaiian, means in both islands, the Sky of Atea, that ancient Sky father, who is in turn the constellation Orion. Because Atea straddles the equator, with his feet planted in the southern hemisphere, and his arms reaching upward in the northern hemisphere, he isn't really needed as a guiding star until one sails between hemispheres. (p. 47)

It is no small task to reflect on these fantastical realms, so far beyond ordinary human scale.

The New Imagination of Enormous Realms of Darkness

Cosmologists have established that much of the "stuff" of the universe is made of dark matter, a mysterious, unknown and invisible substance that cannot be directly detected by any known means. It does not interact with light as other forms of matter do, but its existence is inferred solely by the gravitational pull it exerts on surrounding objects. This dark matter is envisioned as existing in a vast network of filaments throughout the universe, pulling luminous galaxies into an interconnected web of clusters, interspersed with seemingly empty voids containing an even more mysterious force of repulsion, the opposite of gravity, dark energy. Once again, human ideas about the essence of nature have proven to be woefully inadequate. Even the best science has returned to a vision of nature filled with mysteries that reveals the profound limitations of a conventional understanding of the world; the level of structure and complexity that is emerging at the grandest scales can easily bring a sense of incredulity and awe if one attempts to engage it with the imagination.

No sooner than the immensity of this galaxy as an island universe is grasped—now estimated to contain 100 to 400 billion stars (Howell, 2014)—it is relativized by the realization that it is one galaxy among a vast number, currently estimated at roughly 10 x (200 billion)^2 others (space.com, 2016), and it is a rather ordinary one at that. More recently it has been calculated that this behemoth of roughly 2 trillion solar masses, a quantity our ancestors would have struggled with mightily to even represent, accounts for just 4.6% of the known universe. It is as if scientific truth seeking has brought the realization that truth is not so simply composed of objective descriptive facts; the pursuit of such facts can lead to information that does not fit within the previous bounds of imagination. The invisible, ungraspable aspects of reality weigh in with staggering bulk. Visions of and about nature reflect back unknown and unacknowledged needs for radical new imaginings of the world, ones that cannot so easily be integrated into to current understanding, but reintroduce awe and confusion—perhaps recalling the power of psychoanalysis when first unveiled. At a feeling level it is reminiscent of trickster legends, in that just as humans (in the naïve objectivist ego position) are about to victoriously claim a full description of the world, it becomes almost magically more complex.

These trickster-like qualities of the new dark explorations are captured by one of the prominent theories of dark energy in which it is seen to be "chameleon-like" (McKee, 2015, p. 6). The dark energy field is thought to change depending on the surrounding environment. When in the presence of large amounts of ordinary, dense matter it essentially disappears, hidden by the stronger forces of gravity, only to manifest most fully as conditions approach nothingness. The less matter present, the more dark energy exerts itself. One cannot see it by looking for its effects on things, for only in the absence of things does it show up. As may be becoming evident, a new relationship to the concept of nothingness is emerging from these studies, bringing science and some aspect of Buddhist philosophy into juxtaposition, as will be discussed later.

The most recent pathway into the dark began with the contemporary scientific creation myth, the Big Bang, and in logically following out the implication of

this originary event, the tale now becomes enshrouded again at the edges of reality in a Hades-like realm of dark invisibles that ultimately hold the fate of our world—whether it ultimately disappears into nothingness, or collapses back in on itself, disappearing to possibly reemerge phoenix-like in another Big Bang, or of being just one of many universes in a *multiverse* (see Kuhn, 2015). From the perspective of Jung's (1958/1969)psychology, when cultures lose touch with their mythic roots, these tend to reappear in external forms as beliefs about reality. Pursuing the fullest picture of the natural world has in this fashion returned, in a non-linear dynamical manner, to views that curiously reflect the awesome magnitude of the unconscious realm especially in its collective dimensions relative to consciousness. Those elements of consciousness adhering solely to localized, mechanistic principles subsequently suffers narcissistic injury when what is relegated to the known, however valuable it may be, proves to be such a small portion of what actually is. Despite the pain of this, the psyche may be freed from its imprisonment in the underworld by this limited view of consciousness and come to reanimate the world in a new as yet unrealized form. Regaining a sense of awe is key in this paradigm shift.

Re-sizing the imagination of the cosmos can be understood psychologically as a kind of modern alchemy of the world. Saving the *Anima Mundi* (soul of the world) from an entrapping descent into the concrete, literal realm of ordinary matter, the new darkness forces attention onto the invisible mysterious presences that give form to our universe—this is likely part of the excitement these reports generate in scientists and the lay public. Among its many activities, medieval alchemy projected the psyche onto objects of the world, and then tried to recover and redeem these so-called objects by turning them golden. However, as Jung (1944/1968) pointed out, some of the alchemists did understand the activities they were, so to speak, observing in their retorts were ultimately about the nature of their own psychic processes, as imaged through alterations in the appearance of material substances. The transformation of base metals into gold was, through a Jungian lens, metaphorically linked to attempts to purify and ennoble one's own character. In a parallel fashion, contemporary cosmologists describe their findings as ways to more profoundly understand the physical nature of the universe. At the same time, the discoveries offer evocative visions of darkness that may hold the potential for transforming views of the psyche, returning it to the cosmos. Again there have been (initial) attempts to present the new understanding in concrete, quantitative terms, as if the subjective levels of the experience are not relevant, only to prove to be essential as deeper truths unfold.

Consider the similarities between a partial picture of the large scale structure of the cosmos, showing clusters of galaxies wrapped in dark matter with filaments or tendrils into regions of greater darkness (the realm where dark energy holds sway), with the juxtaposed image of a thin section of a mouse's brain, displaying neuronal fibers forming an interconnected network—the biological foundations of the mammalian mind. This comparison was made almost immediately after the pictures of the universe's large scale structures were first made public (Pickover, n.d.). The remarkable similarity in morphology of brain neurology, an important part of the somatic basis of mind, with the structure of the universe, may be wholly coincidental, but the very nature of these parallels invite one to at least re-imagine and entertain possible significances, such as fractal processes in complex systems that generate similar emergent forms, even though at vastly different scales. There may be meaning in these similarities even if the objects are not overtly, causally linked. The coincidence would in this sense be more synchronistic, with meaning supplied by human imagination, which might be on the cusp of realizing its objective aspects through such imagery. There is movement, at least in imagination, from a clockwork, mechanistic universe to one that much more closely resembles a network capable engendering mind. It is a picture that comes close to resembling the dual-aspect monism of Spinoza (Cambray, 2014), especially as reconsidered in the Pauli-Jung hypothesis of synchronicity with a psychoid level of the archetype at the core of a psychophysical universe (Atmanspacher & Fuchs, 2014, in passim).

Recognition of the stunning new dimensions of reality previously hidden in the dark is not only to be found in the vastness of large scale structures of the universe. Far closer to home, on Earth, scientists have begun to discover signs of life in regions of the planet previously believed wholly barren of organisms. This began with the exploration of thermal vents in the ocean floor. Rather than life built on photosynthetic food chains, the possibility of organisms using thermal and chemical sources of energy to sustain life were considered and subsequently found in the late 1970s

(Deep Carbon Observatory, 2012). More recently, seas under Antarctic ice have been found to be teaming with life, mostly microbial (Deep Carbon Observatory, n.d., and references therein). Perhaps most stunning is the very recent discovery of ecosystems deep below Earth's crust and well below the ocean floor (Deep Carbon Observatory, n.d.). While these dark environments are not yet well understood, they appear to contain enormous amounts of previously unknown, unimagined life—the largest microbiological habitat on the planet. As Edwards, Becker, and Colwell (2012) stated:

> The dark biosphere represents the largest collection of habitats for biological ecosystems on Earth—two orders of magnitude by volume larger than the ocean basins and extending kilometers below the ocean floor and below the continental surface. … On a global basis, up to 95% of prokaryotes (bacteria and archaea) reside in the deep subsurface of our planet… the microbes harbored in the marine subsurface alone may account for up to one-third of Earth's total biomass carbon! (p. x)

(For more scientific detail, see Center for Dark Energy Biosphere Investigations, n.d.; Dark Energy Biosphere Institute [DEBI], 2014).

It is as if the implicit solar worship of the Enlightenment left Western societies blind to any other possibilities for life to sustain itself. Now it seems there are incredible amounts of animation in what was formerly deemed uninhabitable, nether regions consigned to dead souls in various hells by some Western ancestors

These forays into contemporary areas of darkness are just some of the more obvious and striking examples. One could also explore what some scientists such as Buckner, Andrews-Hanna, and Schacter (2008) have termed as dark energy in the brain, now associated with the *default mode network* (DMN). This brain network was discovered in the aftermath of the observation that the brain consumed as much energy in states of seeming quietude as when a person is engaged in difficult cognitive tasks, such as solving complicated mathematical problems. PET scans measuring glucose consumption revealed that the subjective experience of being at rest, letting the mind wander seemingly in aimless fashion, supposedly a low energy resting state, is in fact as energy expensive as intense acts of concentration. The DMN was subsequently mapped by Raischle and colleagues (2001) and found to involve multiple brain loci working in synchrony. The significance of this network for mental life and pathologies associated with its malfunction have been intensively explored in the last decade (Buckner et al., 2008). This has been part of a larger project to map interacting brain regions, revealing a series of functional networks. More recently an even more ambitious project to map the entire *connectome* of the human brain has been undertaken (Seung, 2012). Yet rather than extending the catalogue of contemporary exploration into areas that carry the literal or metaphorical quality of darkness, the discussion will turn to look more deeply at the possible psychological significance of this fascination and how it may reflect a need for respiritualization of the cosmos.

Spirituality in Darkness, Depth, and Nothingness

By peering into the dark, humans have sought to shed light on and gain knowledge of what is hidden to consciousness, a longing to enter and often to unveil the mysteries believed to reside there. This may represent an activation of epistemological instincts as well as a quest for scientific knowledge, given the way in which it constellates the mythopoetic imagination. The culture-generating functions of this archetypal propensity of the human psyche span the full measure of human achievements, from the scientific and philosophic to the artistic-aesthetic, religious and spiritual, engaging deep longings and fears.

What might lie behind some of this contemporary enthusiasm for (re)turning to and probing the dark? The lament for the loss of religious certainties has marked the last century and a half. From Nietzsche's (1887/1974) pronouncement of the death of God, to Jung's (1933/1955) *Modern Man in Search of a Soul*, leading thinkers have raised psychological concerns regarding the impact of this loss. In general, these authors did not seek a nostalgic return to earlier theological certainties, but highlighted the painful dilemmas that secular societies suffer as a consequence of this loss, largely due to the manner in which the findings of science have been embraced. Jung, his followers, and the transpersonal psychologists after him have sought ways to reengage the numinous aspects of experience formerly associated with religion and mystery cults, as these are acknowledged as potential sources of healing under the right conditions (e.g., Corbett, 1996; see also Cambray, 2011). In mythic terms, there has been much attention in the Jungian literature to a return of

the *dark feminine* associated with somatic knowing and experience, together with a deep valuing of intuitive processes (Woodman, 1985; see also Baker, 1996; Perera, 1981). Thus, for example, the number of publications on this topic has steadily grown into a solid body of work that deserves its own separate discussion; this short piece could be seen as complementary to that literature.

In the realm of contemporary science, over the last several decades the rise of *complexity theory* has offered an unanticipated bridge between realms of the unknown, linking science, aesthetics and spirituality in a new, holistic paradigm (Mainzer, 2007). Thus the propensity for complex adaptive systems to undergo spontaneous self-organization under conditions of environmental competition has been documented at an enormously wide range of scales, from the subatomic to the cosmic web, and includes numerous human activities, especially social and collective behaviors (from traffic jams, to stock markets, to social media, and much more). One of the more striking aspects of these studies has been the observation of emergent forms and processes (Johnson, 2001). These are holistic features that spontaneously arise out of the interactions of components in a complex adaptive system but that have properties in the aggregate that are not reducible to an understanding of the components. Emergence can be found throughout the world, for example, the liquidity of water at room temperature. Biological examples abound, especially when looking at social insects, herds, schools of fish, and others, in which the collective behaviors explored by *swarm logic* can often greatly transcend the activity of single individuals. Ecological systems are often best approached using complexity theory as a host of recent books and articles demonstrate (e.g., Dodds, 2011). The levels of complexity found in the brain is another topic of much current research and interest (Sporn, 2012). For numerous philosophers and neuroscientists, consciousness is an emergent property of the embodied brain in engagement with the environment (internal and external). Human social and cultural behaviors are also well described by applications of complexity theory, hence its increasing use in theories of art and in the social sciences.

Clinical explorations of complexity have led to some of the most important current ideas about therapeutic action, such as how and why psychotherapy can be impactful in transformations of the personality. Daniel Stern (2004) has discussed this in terms of the "moment of meeting" (p. 28), and Jungians have been applying this thinking to a host of theoretical and practical considerations (Cambray 2011; Cambray & Carter, 2004; Hogenson, 2009). In one paper Cambray (2006) explored the affective experience associated with the onset of emergence in the clinical setting and suggested that the primary emotion of surprise/startle/shock was central. This in turn may serve as a link in regaining access to the transformative potential of the numinous and may be the reason that a number of researchers in complexity have turned to questions of spiritual experience; for example, Stuart Kauffman's (2008) book *Reinventing the Sacred: A New View of Science, Reason and Religion* blends complexity science, especially that associated with life forms, with a new way into spirituality. Glimpsing the transcendent realm partially described by the study of emergence can serve as a powerful source of motivation. Practically, in my clinical work this has led to the study of synchronistic experiences, itself a form of exploration of the dark realms, as forms of emergence (e.g., Cambray, 2002).

An aspect of the numinous, awe, has received national press attention (Piff, & Keltner, 2015), based on recent social scientific research that has demonstrated rhe prosocial value of recovering a sense of awe, perhaps most readily accessed via experiences in nature and with art (Piff, Dietze, Feinberg, Stancato, & Keltner, 2015). Central to this response are encounters with something more than oneself (e.g., standing in a grove of large, ancient trees), and the genuine humility that may emerge from these experiences can enhance appreciation of a person's surroundings, tending to increase collaboration with and compassion towards others, as well as prosocial attitudes generally.

It may be that contemporary scientific explorations into what I have termed darkness, turning attention toward the enormity and the strangeness of what the human species live within, highlighting invisible elements in the heavens and in the Earth, may also mobilize profound awe. Within a larger sociocultural context, the engendering of awe toward the universe evokes language that holds archetypal resonances, which may serve to give transpersonal depth to new emergent forms of spirituality associated with the paradigm shift in culture. This may also be influenced in part by responses to the sociocultural factors of modern life, from alienation engendered by mass urbanization, and the physical isolation often associated with the digital age.

In tracking aspects of this potential re-emergence of spirituality as an integral part of what may be a broader paradigm change, a number of points of convergence between scientific discovery and wisdom traditions within various religions can be noted. Contemporary mathematics has serendipitously come upon patterns that reproduce religious representations, images, or metaphors (Cambray, 2009). For example, the elaborate geometric tiling of a 15th century mosque in Isfahan was shown to be part of design work in Islam that allowed these designers and artisans "to construct nearly perfect quasi-crystalline Penrose patterns, five centuries before their discovery in the West" (Lu & Steinhardt, 2007, p. 1106); mathematical cosmologist Sir Roger Penrose demonstrated such patterns in quasi-crystalline structures in the early 1970s (EEB, 2016). Likewise, in modeling some mathematical objects first elaborated by Felix Klein in the 19th century (EEB, 2001), using computer graphics, startling visual, fractal patterns were seen as bearing direct relationship to a metaphor from the Avatamsaka (Flower Garland) Sutra of Mahayana Buddhism, attributed to the Buddha in one of his first sermons, the Net of Indra:

> In the heaven of the great god Indra is said to be a vast and shimmering net, finer than a spider's web, stretching to the outermost reaches of space. Strung at each intersection of its diaphanous threads is a reflecting jewel. Since the net is infinite in extent, the jewels are infinite in number. In the glistening surface of each jewel is reflected all the other jewels, even those in the furthest corner of the heavens. In each reflection, again are reflected all the infinitely many other jewels, so that by this process, reflections of reflections continue without end. (Mumford, Series, & Wright, 2002, p. ii)

Such convergences seem to be an unexpected but meaningful outcome of what may be a paradigm shift. Western science, with its historical focus on the allegedly objective world of objects and forces, is yielding findings that have clear, resonant parallels with certain belief and practices found in various religions of the world that, in turn, metaphorically reflect the subjective, intuitive, mythopoetic realities they representationally embody. The first indications of the change in awareness associated with the new forms of spirituality emerging from this shift is the need to reintegrate diverse forms of knowing in a rigorous but holistic manner. The Pauli/Jung hypothesis regarding the psychoid archetype can be now identified as potentially prescient in this regard (Atmanspacher & Fuchs, 2014).

In the main subject of this paper, what might be understood as a new science of the dark may be one potentially fruitful area for bridge building between science and religion, in line with emerging forms of spirituality. In this vein, there might be value in a detailed examination and comparison of dark energy with Buddhist conceptions of *nothingness* or *emptiness*, especially as discussed in Hua Yen Buddhism (Cook, 1977). This school originated in China during the T'ang dynasty (618-907 CE) and its central text was an adaptation of the Avatamsaka Sutra that incorporated Daoist views with a more positive, less nihilistic conception of nothingness (Cook, 1977). Hua-yen doctrine became the theoretical foundation for the practices of Ch'an Buddhism, better known in the West by its Japanese name, Zen (Hershock, 2015). The essential feature of Buddhist emptiness, for present purposes, is the interdependent, co-origination of all aspects of reality. As has been recognized for more than 40 years, this portrayal of reality is profoundly ecological in its vision of the network of interdependence of all being (Cook, 1977). Since there is no independent origination of anything, the vision is emergence out of a fecund nothingness, a seeming paradox that sounds curiously like some discussions of the singularity envisioned as the point of origin in modern cosmology. A philosophical parallel between Hua Yen and Heiddeger's *place of nothingness* have already been made, along with a close comparison of these ideas with Alfred North Whitehead's *process theology* (Odin, 1982).

The current fascination with dark energy and the struggles to understand it extend the potential for comparison and exploration of the limits of overlap between these viewpoints. Science has now identified a previously unrecognized pervasive force permeating the entire universe, revealed by mapping regions of darkness and voidness, and their evolution in time. The results point to a new, unknown force: dark energy generating increasing regions of relative no-thing-ness and producing the intricate patterns of a cosmic web. Most curiously, this web shares gross morphological parallels with neuronal webs in brains, striking enough to be offered as a possible meaningful coincidence without obvious causal links—though of course the latter may be discovered in time. The current scientific picture seems to give a graphic confirmation of the lack of permanence of any particular

thing, which at its limit could suggest that what endures is the dark energy of nothingness. Even though details may reveal differences with the insights of Hua Yen's cosmology, one is left to ponder the remarkable capacity of the meditative methods of this school to create such a far reaching vision and more generally how the nature of mind seems to increasingly reflect the universe within which it has emerged.

Conclusion

Some aspects of the pathway used by science toward understanding nature may be currently in the midst of deep change as increasing complexity is necessitated. Previous divisions (e.g., the siloes of academic disciplines), useful for obtaining specific sorts of knowledge, are proving obstacles to grasping the more complex dimensions of our world. For the last two hundred years, science, with its methods of obtaining knowledge, has in Western cultures been carrying mythopoetic imagination in ways that are specific but often unconscious. In identifying numerous potential convergences between the discoveries of science and wisdom from ancient intuitive and meditative practices, it may be possible to encourage a conscious recovery of the imagination as an organ of intelligence; when carefully cultivated, this imagination may serve to contain and bridge approaches to knowing that begin with radically different assumptions and orientations. In such a narrative, the dark may serve as a field for transcending the apparent opposites of science and religion. By not collapsing into a partial truth of either position, the emergence of the mystery of no-thing-ness potentially complexifies matter and spirit into a shared creation myth of cosmos and psyche.

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Notes

1. The mechanistic model of the universe from classical science has proven inadequate to predict or even fully describe these phenomena. Dark matter is presumed to be a type of particle not yet known in high energy physics, dark energy has only been discovered at the largest scales of the universe, and its nature has only been described as producing the opposite effects from gravity.
2. Recent descriptions of the acceleration of expansion of the universe have suggest two categories of possible reasons for this. First is a reinstitution of the *cosmological constant* (an idea originally suggested by Einstein and then retracted by him in light of astronomical observations of galaxies moving away from one another). The second comes from studies on supernovae, the large scale structure of the universe, and the cosmic microwave background radiation which can be modeled using a scalar field, referred to by astrophysicists as the *quintessence* (Carroll, n.d.). The name quintessence refers to the fifth element, a reference back to the four element cosmologies of the ancient world, and also an important idea in alchemy.

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Joe Cambray, PhD, is Provost at Pacifica Graduate Institute; he is Past-President of the International Association for Analytical Psychology; has served as the U.S. Editor for The Journal of Analytical Psychology and is on various editorial boards. He was a faculty member at Harvard Medical School in the Department of Psychiatry at Massachusetts General Hospital, Center for Psychoanalytic Studies; and former President of the C. G. Jung Institute of Boston.

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