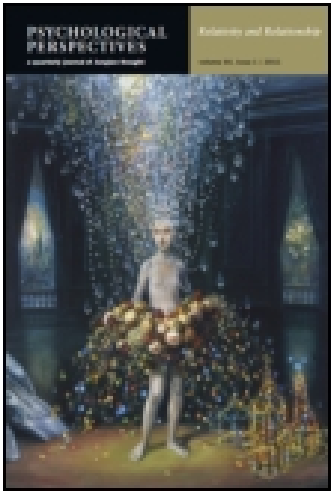

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The Certainty of Uncertainty

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The Certainty of Uncertainty

Terry Marks-Tarlow

> We are floating in a medium of vast extent, always drifting uncertainly, blown to and fro; whenever we think we have a fixed point to which we can cling and make fast, it shifts and leaves us behind; if we follow it, it eludes our grasp, slips away, and flees eternally before us. Nothing stands still for us. This is our natural state and yet the state most contrary to our inclinations. We burn with desire to find a firm footing, an ultimate, lasting base on which to build a tower rising up to infinity, but our whole foundation cracks and the earth opens . . .
>
> —Blaise Pascal, *Pensées*

Carl Jung believed that everyone, regardless of culture or historical era, needs a set of guiding myths by which to live. Jung feared for our times, as did Edward Edinger. When Nietzsche asserted, "God is dead," he was perceiving that Western civilization had lost its guiding mythology. When religion fell from the sky, science took its place as Western society's guiding principle. Many, including Edinger, decried this takeover as evidence of a Luciferian plunge into atheistic materialism. However, it is possible to view science itself as a creation mythology. Like other myths, this variety of mythology carries a strong potential to guide our culture, partly by marrying spiritual and material affairs. Although science is often pitted against mythology as an opposite, there is a significant projective pole that draws them together. Furthermore, the uncertainty out of which all myth and science are born is the same territory into which contemporary science returns. Their common ground intersects in the dark soil of the collective unconscious.

The Projection Process

Science and mythology seem so very different on the surface. Science addresses the "real" world; mythology addresses the imaginary. Yet both

spring from the same unconscious source. Both are creative acts that begin with projection: An idea or picture of the outside world is brought forth from the imagination and laid atop the world, like a set of clothes. The clothes either fit nature's contours well or do not. With science, concern with fit is high; the wardrobe is ever customized to nature's exact dimensions with great precision. With mythology, concern with fit is less significant than with style and freedom of movement. *Projection* is a psychological term by which interior reality is superimposed on people, things, or situations and then disowned as emanating from the self. We tend to pathologize projection as an undesirable process and to associate it with, for example, the paranoid's false perception of external danger or the abuser's irresponsible perception of external blame.

Science and mythology both spring from the same unconscious source. Both are creative acts that begin with projection: An idea or picture of the outside world is brought forth from the imagination and laid atop the world, like a set of clothes.

Yet, as Jung knew, projection is actually a very natural process. In fact, projection is so deeply rooted within everyday experience as to be a critical aspect of perception itself. Although we act as if sensations of brightness, color, shape, sound, and taste reflect the world outside us, they are actually the product of our own perceptual organs, which we then attribute to the world. What we see "out there" is truly "in here," of our own making. (See Robin Robertson's article, "The Mote in Your Eye.")

In science, projection is easy to spot in outdated theories that are so clearly wrong. Consider the idea, popular in the days preceding Galileo, that the sun revolves around the earth, which is the center of the universe. While based on direct experience—the sun does appear to rise as surely as it sets on a daily basis—this idea also was infused with religious ideology concerning God's perfect creation. Viewed through another lens, it reflected the projection of infantile narcissism: Young children experience their whole world as revolving around themselves.

It is more difficult to spot the projection in theories or beliefs we hold strongly as "true." Nonetheless science always involves the projection of central metaphors. Science advances only by recognizing when an outdated projection no longer fits. This recognition occurs either because anomalies (i.e., facts the theory cannot explain) take center stage or

because a new, more inclusive projection (i.e., theory) is proposed to replace the old one or place it in a new context. Marie-Louise von Franz states sardonically, "As long as we feel subjectively that we are not talking about projections but about the true quality of the object—a special aspect of our Western mentality—then we call it the scientific truth."

Where Inner and Outer Eyes Meet

Science is a story about outer processes told as if they have nothing to do with inner ones. Mythology is a story about inner processes told as if all were experienced in a never-never land. Both science and creation mythology shed light on the edges of what is known. Both allude to how conscious order evolves from chaotic, unconscious bases. Both chaos theory (science) and creation mythology produce a picture of the outside world—and both emerge from the fertile ground of the collective unconscious. Yet, in self-referential fashion, both are equally relevant to the inner world, and both illuminate sources of order and meaning inside and outside of us.

Creation myths describe not only origins of the outside world but also the origins of internal worlds, of human consciousness itself. The generative utterance "Let there be light" can constellate an image-meaning that symbolizes not just the light of day breaking through the darkness of night, but also the light of conscious awareness breaking through the darkness of the primitive unconscious, where each infant starts life. "In the beginning was the Word," the opening line of the Gospel of St. John, can refer not only to the Commandments of a God who would ordain physical creation, but also to the importance of human language as a springboard for symbolic creation and container for self-aware consciousness.

Creation mythology and much of contemporary science and mathematics address this seemingly seamless edge where inner and outer worlds collide as well as separate, where they are distinct yet continuous.

Creation myths operate simultaneously at multiple levels: They evoke the dawn of culture within collective human consciousness, and they suggest the dawn of individual consciousness in infancy. Finally, they describe the dawn of daily awareness following sleep. All night long

we are merged with the chaos of the unconscious, as it manifests in dreams. We bask completely in unpredictable and ever-so-vivid alternative or virtual realities. In the morning we douse one flame in order to reignite another, using the light of consciousness to put into perspective the previous night's reveries. To illuminate the mythological bases of chaos theory is to clarify as well as preserve this mysterious, luminous line between inner and outer worlds.

The notion of *self-reference*, by which assertions about the world are applied to the assertion-making act or to the assertion-maker, is a key feature of mythology, mathematics, and contemporary science. Because of self-reference, our conscious images of outer reality often reflect unconscious processes of inner reality, much like Narcissus's pond. Both science and mythology offer theories about an objective world that emerges from limited beings trying to cast off their subjectivity—but ultimately unable to do so.

Creation mythology and much of contemporary science and mathematics address this seemingly seamless edge where inner and outer worlds collide as well as separate, where they are distinct yet continuous. We begin life straddling inner and outer worlds, basking in the primitive unconscious, which makes no distinction between inside and outside, self and other, right and wrong. Herein lies nature's endless source of mystery, the place where seer and seen, observer and observed, subject and object merge. We begin as inner beings trying to understand an outer universe, only to wind up learning something about the subjective process of understanding itself.

In the Beginning

Despite all the diversity, one element is nearly universal in creation myths: The separation of opposites—good from evil, right from wrong, woman from man—the most primordial of which is order from chaos. In just about every creation myth around the world, Cosmos emerges in some way from the deep abyss of Chaos.

According to the *Oxford English Dictionary*, *chaos* comes from the Greek derivation, *Xáos*, meaning "gaping void" or "yawning gulf, chasm, or abyss." We in the West perceive this void as empty and threatening. Chaos is usually portrayed negatively, as something in need of conquest, in order for creation to occur or civilization to advance. From the ancient Babylonian epic "Enuma Elish" to Milton's *Paradise Lost*, chaos wears the garb of a monster, a dragon, or the devil.

Through the lens of this myth, chaos is portrayed as the primordial enemy who must be destroyed before creation can commence. The

nature of chaos is wild and aboriginal. Only when chaos is vanquished can evolution and civilization proceed. From this perspective "chaos theory" appears a misnomer. However, chaos theory is as much about order as it is about the appearance of disorder. Shortly we shall see that the technical meaning of the word *chaos* is more consistent with non-Western mythologies where chaos is contained (but not controlled) and works hand-in-hand with the forces of order. Indeed, in these cultures, chaos is the fertile ground from which creation, fate, or novelty pours. Order still emerges out of chaos, but in less combative, polarized fashion than in Western myths, where chaos is commonly portrayed as a female who is slaughtered by a male, and whose sacrifice engenders all of creation. Biblical scholars such as Aviva Zornberg speculate that this motif symbolizes the passage from matriarchy to patriarchy in ancient civilization. Author Leonard Shlain believes that patriarchy, even misogyny, necessarily accompanies the transition from image to alphabet and written word in human civilization.

As in Western cultures, many Eastern ones view the dragon as a harbinger of chaos. However, unlike Western cultures, the dragon is often seen as a symbol of luck or as a beneficent animal to be celebrated. A Chinese folktale tells of a winged dragon assisting a man named Yü to dig channels and contain floods. By dragging its tail on the ground, the dragon marks the placement of channels. After the waters are channeled to the sea and the excess drained from the marsh, the terrain is fit for cultivation. According to this myth, chaos is not to be conquered but merely channeled. The only successful solution is quite literally to "go with the flow." There is wisdom for us in this perception: Only when the forces of chaos and order coexist can they serve a beneficial purpose.

Fundamental Uncertainty

Whether from the East or the West, all creation mythology stems from the big questions in life. When comparing the foundations of mythology to those of science, perhaps the most significant feature common to both is *fundamental uncertainty*. Out of our basic state of not knowing comes both the personal and scientific search for meaning and pattern in the universe. From the passion and curiosity of not knowing flow all human creativity. To place our personal search into this larger context is to recognize the primal and universal hunger to understand origins and bring order to perceived chaos.

Both science and creation myths are responses to theoretical, theological, and imaginative blind spots as well as to the experience of unpredictability and novelty in the universe. Both spring from the same uncon-

scious processes that address the mysteries of nature, especially those related to origins. How do order, pattern, and complexity emerge out of chaos? Is there an invisible level of order beneath apparent randomness? Are discrete things (i.e., all animate and so-called inanimate entities) interconnected? Is there a master plan that pulls together all the pieces?

Spiritual and material questions about where we come from, where we are headed, and the meaning of everything in between sprout like flowers or weeds, both to brighten as well as darken our lives, depending upon our attitude toward them. These questions are rooted in the dark soil of fundamental uncertainty and blossom on the horizon of wonder, fear, and awe.

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Perhaps because the origins of nature and humankind are so shrouded in mystery, no universal answers exist. Even scientists who adhere to the Big Bang theory of the universe's beginnings are confused about the first few nanoseconds of existence. Those who subscribe to Darwinian evolution remain unsure how initial glimmers of life appeared. Despite ever increasing technological and theoretical sophistication, important questions inevitably remain. Dreams of a single theory to unify all forces of nature remain dreams.

In order to understand the role of uncertainty in science, it is necessary to trace the origins of Western science from its philosophical roots several millennia ago. A heated debate raged for more than a thousand years between followers of Aristotle and Plato regarding how forms in nature relate to eternal forms. Finally, in the seventeenth century, a new trend emerged with the Renaissance and the empirical process was born. As if a spell were broken, releasing our obsession with abstractions and ideas, an interest developed in the world itself. The importance of careful observation was recognized, and systems of observation became formalized into the scientific method. Ever since, scientific facts of all kinds have been gathered and new disciplines birthed: physics, chemistry, biology, and more recently psychology and sociology. All were spawned out of an insatiable curiosity connected to doubt and fundamental uncer-

tainty about nature's workings.

Science advanced on the foundations of three important assumptions: (1) The more we learn, the more certain we become about how nature works; (2) the more we learn about how nature's past is tied to her present, the more we can predict how her present will relate to the future; (3) ultimately, with enough understanding and information, we will not only understand but also gain power to control nature's workings.

For several centuries, these assumptions appeared to be supported by the empirical world. As our scientific knowledge about the world increased, certainty and control seemed to increase as well. Observation techniques embedded within the scientific method appeared infallible. Facts always appeared as either true or false. All hypotheses could be empirically tested, with true ones retained and false ones eliminated. Nature's mysterious ways seemed to be diminishing. Dreams flourished of a grand, unifying theory of Everything, as humankind slowly whittled its way toward the bedrock of truth.

Then during the twentieth century, something strange began to happen. After much of the visible world was well categorized, scientists began nosing into more exotic, elusive realms, moving the observable into invisible places. As this shift in research focus occurred, slowly but surely certainty began to degrade, starting with Einstein's theories which stretched the previously immutable framework of space and time into a rubber affair. Einstein's notions of relativity destroyed many of the absolutes to which scientists had clung.

From the theories of Einstein flowed those of quantum mechanics. Heisenberg's "uncertainty principle" revealed how certain "yoked" qualities in the subatomic realm, such as a particle's position and speed, cannot be calculated precisely at the same time. The more we know about one quality—say, a particle's position—the less we know about the other—say, its speed. This subatomic view of the universe dethroned the reigning principle of determinancy and replaced it with the notion of randomness and probabilistic statistics. As an example, scientists learned that no matter how much information they possessed, they could never know the precise moment when a radioactive nucleus would decay.

Even though this new science came directly out of his work, Einstein could not accept such quantum conclusions, lamenting, "God doesn't play dice with the universe." Apparently Neils Bohr, another famous physicist, reputedly was heard to respond, "Quit telling God what to do!" And Einstein the genius became Einstein the dinosaur, left in the dust by his own contemporaries.

Whereas Einstein's physics concerns the very large, quantum dynamics tackles the very small. Both levels appear far removed from

that of everyday life. Even after the advent of quantum mechanics, scientists still tenuously tried to hold uncertainty at bay. They drew lines in the sand between cosmic, microscopic, and macroscopic levels. But all changed with the advent of chaos theory in the 1960s, proposed by meteorologist Edward Lorenz. Now we are all hit with fundamental uncertainty squarely in the middle of the macroscopic world in which we live.

Chaos Theory and Unpredictability

As with quantum dynamics, the fundamental reality of uncertainty pervades chaos theory in the form of unpredictability. All examples of chaos, including the weather, the prototypical example, share a common signature. Their surface behavior appears random—that is, without defined pattern. Yet underneath, invisible order lurks. This order can only be revealed abstractly, through mathematical sleight of hand—which means that, even with full knowledge of a chaotic system, no one can predict where it will go next. The best we can do is to possess broad outlines of what is possible in the form of a phase-space map of all possibilities, which reveals exquisite patterns at the most global level.

Linear systems, like clocks and cogs, move on regular and predictable tracks. Chaotic ones, like smoke and wind, travel along irregular, nonlinear paths. *Nonlinearity* means that tiny changes in starting conditions can have huge outputs—large enough to cause the whole system to careen off into entirely unexpected directions. This notion is intuitively easy to recognize in everyday life. For example, it is easy to see how often the tiniest details—a failed alarm clock or decision to stop at the supermarket for butter—lead to the most unpredictable and life-altering events. Survivors of the recent New York City terrorist attacks are filled with stories of this sort. Conditions of extreme chaos can be likened to a herd of elephants stampeding at the drop of a pin.

Chaos is evident in the erratic flight of animals, the spread of wildfires, patterns of epidemics and rumors, in the dance of molecules batted around by Brownian motion, and in changing numbers of animal populations from year to year. Chaos rules the activity of the stock market. It choreographs the weather on Earth and directs that planetary storm known as the "red spot" on Jupiter. Chaos typifies nature's fury and comprises her glory. It also pervades our bodies—from the timing of electrical signals across ion channels in our nervous systems to the ever so slightly irregular ticking of our hearts. Chaos regulates renal blood flow and mass-action binding of hormones. Chaos suffuses our brains, providing a kind of background noise against which sensory perception organizes itself.

The presence of chaos (in this technical sense) throughout our bodies transforms our very conceptions of health. Previously we assumed that physical orderliness was a sign of well-being and chaos a sign of sickness. Yet evidence rapidly accumulates to the contrary. Many systems in our bodies depend on irregularity in the form of chaos for proper functioning. Chaos theory and nonlinear dynamics offer new models that suggest health does not thrive on static conditions of sameness. Instead most physiological systems continually produce irregularity.

Sex and the Politics of Science

Chaos theory pries apart previously inseparable processes of determinism and understanding from those of prediction and control. Never before has this differentiation happened in the history of science. Always we assumed that by understanding precisely how a system comes to emerge from its past to its present form (the essence of determinism), we would be able to predict and ultimately control its future behavior. Not so.

No matter how well we model the relevant variables and past events of a complex, nonlinear system (of which human life and the human brain are the crowning glory), chaos theory guarantees an open, unpredictable future. This absence of a future that can be predetermined sets the stage for nature's creativity and the exquisite emergence of novelty at all levels, including free will and human creativity. Thus the age-old philosophical question about whether our behavior is free *or* determined appears to translate down to free *and* determined.

On the one hand, chaos theory has revolutionized science, by helping us to detect hidden patterns in highly complex phenomena that have eluded precise analysis for millennia. On the other hand, along with new power to understand previously opaque phenomena comes greater awareness of our powerlessness. This irony is barely acknowledged among scientists themselves and has yet to seep broadly into public awareness.

While some mainstream scientists accept chaos theory implicitly, others treat it like a distasteful fad soon to pass. Seeds of this science lay dormant for many decades before coming to fruition. Cultural and sexual politics may help explain why the theory was a long time coming, and now that it is here, why it has not impacted the general public more profoundly.

Chaos theory is largely about our limits. We detect order but cannot predict it. It tells us a lot about what we do not, and never will, know. Chaos theory reveals more about what science cannot do than what it can. Fundamental uncertainty—the soil in which mythology

sprouts and whose existence the rational, scientific mind denies—is a hard reality for some to face, for it dashes expectations of a mechanistic, clockwork universe and deflates modern fantasies that someday science will explain everything.

Sexual politics is also part of the story. Some feminist scientists, such as Linda Shepherd, claim that Western science has been primarily a patriarchal affair. The goal of Father Science is to dominate, control, torture, and ravage Mother Nature rather than to understand and respect her mysterious ways. Misogynist images extend back at least to the sixteenth century, to Francis Bacon, the father of experimental science. Bacon, a supporter of witch burning, longed to make nature a slave, to conquer and subdue her, to "put her on the rack to wrest all secrets locked in her bosom."

In stunning contrast, chaos theory may represent the voice of the feminine, serenading science after a long, deep slumber. In *Lifting the Veil*, Shepherd indicates how heavily chaos theory borrows from the world of women and the home. Its cast of characters includes *dust, webs, cups, foam, fudge flakes, folded-towel diffeomorphisms, smooth noodle maps, curds and whey.*

Even as the feminine reemerges, contemporary science still seethes with an underbelly of sexual politics. Consider this story about Ralph Abraham, father of the mathematics of chaos theory. Abraham discovered ways to visualize many complex patterns of chaos. Simultaneously he thought about broad philosophical implications of his theories. In his book, *Chaos, Gaia, Eros*, Abraham examines patterns of ancient worship, from goddesses to gods, as they relate to tenets of modern science. Abraham's major premise dovetails with Shepherd's—that chaos theory involves the reemergence of the feminine into previously patriarchal culture and science.

For years Abraham quibbled philosophically with a promising student, who later excelled as a chaos researcher in the area of human physiology. Eventually this physiologist made an important discovery: Tiny random nudges to an already chaotic system, such as a heart in fibrillation, can help it to regain stability. This discovery gave medicine an important new weapon to fight heart disease. When published in a prestigious medical journal, the physiologist sent his mentor a copy. The paper, "Controlling Cardiac Chaos," included a half-joking note

Many systems in our bodies depend on irregularity in the form of chaos for proper functioning.

attached that read, in essence, "Nature, you bitch, on your knees!"

Although seduced by the sweet fragrances of the new sciences, this physiologist was still operating in the stench-filled shadows of Francis Bacon, adamantly refusing to surrender to the unpredictability that shrouds nature's mysterious ways. Yet only by surrendering to the mystery can order emerge out of chaos at every level of existence. And sometimes in the process, the most exquisite patterns are revealed.

The Magic of Mythology

In cultures of both the West and the East, surprising parallels exist between modern chaos theory and ancient creation myths. Such parallels confirm our intuition of their common source in the collective unconscious. At times the parallels are quite direct, as when both science and mythology account for the same phenomena in nature. Turbulence in water is one example.

In mythologies the world over, floods signify a cosmic conspiracy rendering utter devastation and loss, but hidden order is always present within a germ of life preserved in the hopes of new beginnings. Reminiscent of breaking the sac of amniotic fluid during birth, floods are the breaking of the cosmic waters of the great Mother-Destroyer, with the hero of new life born of her womb.

In the Mayan sacred book *Popul-Vuh*, God used the flood to destroy an early experimental form of humanity. At first God was all alone and surrounded only by His own light. He planned to make life, but the animals He made were unable to speak to each other or say His name. The men He made out of mud were soft and limp and could not see or make sense. So God tried again, this time making men out of wood, but they had no minds, nor souls, nor hearts. They beat their dogs and burned the bottoms of their cooking pots.

A great flood was sent by God to erase His mistake and destroy His early creations. Only a few of the wood men survived, their descendents now said to be monkeys. Eventually God made four stunning men out of liquor and dough from corn meal. But these men were too perfect and close to God. He blew mist in their eyes to cloud their vision, so they could see only what was close to them. Eerily, this final outcome of blurred vision metaphorically mirrors recent chaos theory that limits our perception of complex phenomena to short-range prediction.

Jung viewed flood myths as describing a universal, archetypal theme of productive sacrifice. They remind us that life depends upon death. The restoration of primordial chaos precedes the repetition of original creation. In the psyche as well, a germ of exquisite order lurks beneath the "flood" of even the most primitive, chaotic, or seemingly

crazy psychological state. For this reason, even the most bizarre psychotic states can be interpreted, at times, as symbolically meaningful, although certainly not desirable and no less destructive. In a dream image, turbulent water as a symbol for chaos often prefigures reclamation of mental health.

Sometimes parallels between mythology and science are indirect, as when stories provide elaborate tales of antics and dramas to account for the presence of apparent chaos in nature. For example, in Islamic mythology, the Shaitan, a dangerous breed of spirit, is the offspring of Satan or Iblis. A Shaitan is extremely ugly and has hooves instead of feet. It eats excrement, dirt, and other waste. Perhaps the most dreaded demons descended from Iblis are the Ahl-at-Tral, who live below the Sahara desert and appear as whirling sandstorms that dry up the wells before caravans arrive.

A second example of indirect parallels comes from Norse mythology. Loki, the evil fire-trickster god, is portrayed as the contriver of all fraud and mischief, the disgrace of gods and men. After trying to hide, Loki is caught and bound by cords. A serpent is suspended over him, so that venom falls on his face to torture him, drop by drop. Loki's wife Seguna stands by, faithfully holding a cup to catch the drops. But every time she empties the cup, venom falls upon Loki. He howls with horror and writhes so violently that the whole earth shakes, producing what we call earthquakes today.

In these myths, demons and tricksters are the bearers of chaos that account for chaotic forces of nature. The Ahl-at-Tral cause sandstorms. Loki looses earthquakes. Each phenomenon in nature displays unpredictable patterns of occurrence. Each is an example of chaos, as technically defined. Modern science circles around and embraces what creation mythology has already addressed. How amazing and mysterious that mythology possesses the power to tap the fundamental pulse of the universe, as scientifically conceived!

Mind and matter meet here at the level of meaning and symbolism, with products of the human imagination fitting into nature like lock and key. This fit hints at the deep and hidden interconnectedness of various forms of human thought processes with patterns in nature and it seems nothing less than evidence for Jung's *unus mundus*. In the interplay between chaos and order, parallels between contemporary science and long-standing mythology can seem magical; they attest to the power of intuitive, deeply unconscious wisdom.

Thus contemporary science and creation mythology come from the same origins, deep within projective processes of the collective unconscious. Ultimately, both science and myth return to the same fundamen-

tal uncertainty out of which they were born. Early science was fueled by all-powerful dreams of omniscience and control. Contemporary science, however, is confronted by newly perceived limits that ensure the impossibility of this endeavor. No matter how good our methods, no matter how much data we collect, and no matter how much we know, we will never transcend our humanness. Despite new order, chaos and unpredictability continue to abound. Nature still clings to her mystery, teasingly revealing some secrets while simultaneously reveiling others.

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