Science, Art, and Spirituality
The Crow's Three Stones

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My Macedonian grandmother told me Aesop's Fables more than forty years ago. She never felt obliged to tell them exactly the same way each time. To her, they were starting points for good stories. Add to grandma's gift for embellishment my less than perfect memory, and all bets are off as to the authenticity of what I may tell you of Aesop, but more important than rote perfection in the retelling, fables should impart wisdom for today.

I seem to remember a story that Aesop told of two birds, an Ibis and a Crow, both desperately thirsty and trying to drink water from the bottom of a long necked jar. The Ibis with its long, slender beak easily dipped into the water and drank to its heart's content before flying away. The Crow's short, stout beak could not reach the water. Without sustenance, the Crow would surely die. Inspired by harsh necessity, the black bird gathered up three stones, and then dropped one down the neck of the jar. The water rose but still remained out of reach. The Crow scooped a second stone into the neck of the jar, and again the water rose. (This Crow may have been familiar with Archimedes studies of displacement.) As the second stone settled, the water rose and beckoned tantalizingly beneath the straining beak. After the third stone splashed into the jar, the water rose high enough for the Crow to quench its thirst.

I think of art, science, and spirituality as three stones that we poor crows drop into the well of experience in order to draw sustenance. I see them, if you will, as three sides of the same coin, attempts to comprehend reality through the senses, through the intellect, and through transcendental intuition. I see them not as a hierarchy, but as a spectrum. I see them as interdeterminate. Without science, art becomes hollow. Without art, science remains hopeless. Without spiritually, neither can have lasting value. Together, they may become the basis for wisdom.

The boundaries of each of these fundamental enterprises remain exquisitely elastic, and we combine them in very different ways in different times and places. As they run parallel, interweave, intersect-- even collide-- and touch on the slightest tangents, they fashion and refashion the farthest frontiers of our collective imagination.

In February 1990, six Tibetan Buddhist monks from Gelugpa Monastery spent three days creating a sand mandala in the atrium of the University of Michigan Museum of Art. Mandalas-- floor plans of the cosmic mansion of Buddha-- serve as perfect examples of the closest kind of symbiosis between art and spirituality, because they bring into visible and tangible form the ineffable world that coexists in a higher dimension with our illusory world of the senses. Many kinds of mandala have been created to manifest various powers of the Buddha. The Gelupga monks created a Bhaisajyaguru mandala,

one dedicated to the Healing Buddha. It works on at least two levels. Not only does the finished image contain the focus of cosmic power of healing, but also the process of making the sand painting constitutes an act of healing prayer on the part of the monks. All Buddhist initiates make a required number of devotions to Buddha. Elder monks chose these six at a young age to create mandalas as their personal form of devotion.

Certain aspects of this task belong in the domain of science-- if we concede geometry as a branch of science. Buddha's cosmic mansion has prescribed arrangements and fixed proportions among its entrances, rooms, courts, and gardens that must be observed with strict precision. The monks painstakingly lay out the pattern of the sand painting form a pre-drawn plan using a divider and snap line. Furthermore, the entire image must be squared to the points of the compass. The four entrances to Buddha's home face north, south, east, and west. Cosmic healing depends on right alignment to the *axis mundi*, not merely the real axis of the earth, but the symbolic pole around which the eternal cycle of life itself revolves.

As the monks organized their materials prepatory to work, I noticed that their bowls of colored sand numbered seven-- red, orange, yellow, green, blue, indigo, and violet, the same seven hues that Isaac Newton had observed fixed in the spectrum and called "Primary Colours." I asked a Tibetan-speaking friend to ask one of the monks what idea occasioned that particular choice of hues, hoping for a reply affirming an affinity between healing power and the elemental physical energies of light itself. To my mingled delight and dismay, the monk casually answered, "Oh, those are the colors we always use."

They worked without speaking, accompanied only by the cricket chirping sound of the copper wands that they raked over the serrated backs of the copper cones that dispense the colored sand.

All in all, the sand mandala brings us a powerfully tantalizing touching of calculated space, measured color, and a transcendental ritual of healing energy acted out in the creation of a work of art. Science indistinguishable form art, art indistinguishable from spirituality.

(Incidentally, the elder monk ritually swept the completed sand mandala into a heap at its center, the throne room of Buddha, scooped it into a ritual container-- in this case a plastic bag from Ulrich's bookstore-- and then ritually poured it into the nearest body of water, the Huron River, through which it would invigorate the whole world with its power.)

The Ancient Greeks practically invented plane and solid geometry, as we know it. Or at least Pythagoras and Euclid wrote down what they and others before them had learned about it. We all know Pythagoras' theorem equating the square on the hypotenuses of a right isosceles triangle to the sum of the squares on the adjacent sides. We may be less aware of the mystical belief contained in his assertion that, "All of the Universe is numbers." From this flash of insight that all things might be commensurable, Greek philosophers like Plato built an ethos that made mankind the measure of all things.

Greek artisans gave that ethic a concrete form by applying ideal numerical proportions of the human body to the physique of their culture, their architecture. The height of a Doric column measures six times its base, the ideal that Greeks abstracted from observations of the ratio between the length of the male foot to his height. In the Iconic column, Greek architects adopted a ratio of one to seven, which they saw as the more graceful ideal in the female form. This profound fascination with numbers only began with simple fractions.

Greek artists also applied the subtler geometry of the Golden Mean-- which equates the smaller segment of a sublimely divided line to the larger segment as the larger is to the whole-- to the form of their sculpture-- male and female-- and to their temples. In the golden mean they had discovered a compelling notion of dynamic balance and internal harmony. They had found a consistent numerical order both in the sublime world of abstract geometry and in the real world of living things. Golden rectangles crisscross the plans and elevations of the Parthenon, just as they crisscross the interior spaces of Platonic solids like the icosahedra. Logarithmic spirals implicit in the golden rectangle form the crisscross pattern of seeds in pinecones. Nature, geometry, and art sharing a common organizing principle.

The drive towards Pythagorean idealization in classical Greek architecture and sculpture entails structuring their shapes so that they would resonate to a cosmic harmony. For a brief moment in the tumultuous career of human culture, Doric and Ionic visual culture embodied a finely woven fabric of art, science, and spirituality.

The modern idea of science as observable, measurable, and experimentally verifiable natural functions arose when Copernicus replaced the earth with the sun at the center of planetary orbits.

On a simple level science is knowledge of the world of nature. The human mind-- perhaps on the basis of its internal physical functioning-- seeks, recognizes, and responds to regularities, cycles, and patterns; prefers order-- even an incorrectly conceived order-- to chaos. The Greeks in their scientific account of the cosmos got a number of important things wrong, notably the place of the earth in the scheme of things. Hermes Trisgemistos had argued in the third century BC that the earth orbits the sun, but Aristotle's geocentric model of planetary motion won the day. In fact, with Ptolmey's addition of epicycloidal planetary retrogrades, the geocentric model prevailed for nearly eighteen centuries. Then, in 1534, Nicholas Copernicus offered a simple, elegant account of planetary motions that put the earth and her planetary companions in circular solar orbits and moved the stars into an unimaginable vastness of space. Maps of the earth's surface underwent a corresponding change from Ptolmey's flat disc with the Holy City of Jerusalem at its center. In the wake of the fifteenth century's voyages of discovery, our image of the earth became a sphere projected onto a gridded plane with shapes of landmasses and oceans accurately drawn to scale.

The idea of projecting a virtual image of three dimensional space accurately to scale onto a two dimensional space had been pioneered by artists led by the Florentine, Fillipo Brunelleschi, a generation before Copernicus. Vanishing point perspective, invented by Brunelleschi sometime during 1425, established first the artist and then after him the scientist as the objective observer and surveyor of real space.

Raphael used the new scientific perspective to set the sacred event of the Marriage of the Virgin in a scene of ideal perfection, where polygonal buildings could be conceived in crystalline purity and set in a measured illusion of depth, where figures at ten times the distance stand one fifth the height of those in the foreground. The world submits to mapping on grid coordinates so long as the artist remains at a fixed, detached viewpoint.

Thus, in the Early Renaissance, artists actually anticipated and added impetus to science, perhaps because the artists had trained themselves to be keen observers of nature just when science was laying its foundations on close scrutiny of the physical world. Living equally in both the worlds of art an d science, Leonardo da Vinci called the human eye the supreme scientific instrument. And as if to prove his point, he practically single-handedly invented what we now call the art of biomedical illustration, elegantly rendering his observations of dissections performed without the benefit of formaldehyde. The skepticism of da Vinci and other artist/scientists like Albrecht Durer did not reject or preclude spirituality. Rather, they looked upon their anatomical dissections as discovery of the hidden architecture of the Divine.

In our century, much of science, particularly physics, takes place in realms beyond the ken of human sight where only mathematics can interpret the architecture of the cosmos. (Shades of Pythagoras' "All the world is numbers.") In 1927, Werner Heisenberg published his Principle of Uncertainty in the form, "Change of position multiplied by change of velocity exceeds Planck's constant." (Delta q times delta p >h). Planck's constant being the level of energy that differentiates one electron orbit from another in atomic structure. At the level of theoretical physics, Heisenberg's theorem, explains the impossibility of simultaneously calculating both the location and the velocity of electrons. Beyond the realm of the subatomic, the theorem translates into the notion that one cannot observe a phenomenon without altering it. Contrary to the faith of Renaissance artists and scientists, one lives constantly in a subjective, not an objective relation to the observed world. Jacob Bronowski, in his book The Ascent of Man persuasively argues that the Principle of Uncertainty should be called the "Principle of Tolerance," because it lends mathematical elegance to idea that knowledge can never be absolutely, dogmatically correct.

Forty-two years prior to Heisenberg's scientific formulation, Paul Cezanne had intuitively given form to the same conclusion. His 1885 Basket of Apples abounds with violations of the laws of perspective. Multiple viewpoints, shifting viewpoints, motion between the observer and the observed, manifest doubt, are all that can account for the discontinuities of contours of the tabletop and bowl. Some say that Cezanne just could not draw properly to account for his failure to render the obliquely viewed plate as an ellipse. But would anyone argue that David Hockney just could not quite manage to

frame his Portrait of Andre Emerich in the viewfinder of his Polaroid camera in 1982? Cezanne had overthrown the notion of the fixed, detached, objective surveyor.

By the signal year, 1927, when Heisenberg published, Piet Mondrian, along with a handful of other vanguard artists, had pushed art beyond its venerable role of holding the mirror up to nature. Reducing his visual vocabulary to a select few shapes and colors as austere and elemental as the physicist's equation, he used the picture plane to articulate the ideas of divine architecture and cosmic order that he had embraced in the spiritual discipline of Theosophy. He had set aside the absolute certainty of the salvation of the elect promised by his native Dutch Calvinism in favor of the more difficult, ambiguous notion of universal spiritual evolution. These pictures became his form of meditation as surely as the sand mandala did the Tibetan monks.'

The tragedy of our times comes sharply into focus in the singular lives of Werner Heisenberg and Piet Mondrian. One with his science and the other with his art had become advocates of tolerance. Yet, both men belonged to a generation that experienced the two most immense, brutal, and squalid episodes of intolerance in all of time, the World Wars. Mondrian had pushed his art into pure abstraction during the First World War in the sanctuary of neutral Holland. One could even say that he pushed into the world of abstract art seeking spiritual refuge form the devastation boiling all around him in the real world. In 1939, after the signing of the Munich accords, he fled for his life from the Nazis who had by then already branded his art degenerate. Heisenberg survived the Nazis and while resisting their pressure on him to develop atomic weapons for the Third Reich.

The long, shifting, and overlapping between art, science, and spirituality holds more than academic interest to me. My work as an artist proceeds in three major currents. First, I create liturgical images and objects for various faiths and denominations, striving to master the variety of styles and symbols called for by diverse spiritual traditions, and trying to harmonize my work to the architectural setting. I find myself enriched by collaborating with clergy, laity, and architects. Second, I create abstract sculpture in which I try to probe beneath the surface appearance of the world to find the dynamic interplay of energies at the heart of matter, to bring the realm of the invisible into sight, to create a sort of visual music. Third, I create unique, original calendric sculptures--seasonal and participatory sundials-- that I hope can momentarily draw us into an intensified relationship to the earth and sky. I try to inform the spiritual images with the precision of the scientific images and to inform the scientific images with the grace of the spiritual, and I try to bring a keen sense of abstract clarity to all three.

As I navigate these three currents, I sense myself simultaneously touring many worlds, or perhaps many dimensions of the one great world. Like a cosmic nomad, I feel free to roam backward and forward in time and space feasting my senses, challenging my assumptions, and taking inspiration from the arts of any period in history and any place on the earth. I think that all artists are in the best sense of the word amateur art historians, because to make art, one must love art. But I also feel compelled to trek into realms beyond art, into of science. Some of my artistic colleagues believe that science is

all analytical and objective, while art is all synthetic and subjective. Science a place fettered by cold fact, while art a place of absolute personal freedom. Jealously guarding a cherished belief in the superiority of intuition and over rationality, they resist scientific thought.

I see no fundamental difference between the two. I think that human creativity unites the artist, the scientist, and for that matter, the spiritualist. No idea comes from nowhere; no creation comes from nothing. Is not creativity a matter of seeing connections between experiences where none has been seen before? The essence of all thought, all language is metaphor, comparison, recombination, whether, like Blake we say "Energy is pure delight." or like Einstein we say, "Energy is mass multiplied by the square of the speed of light."

All creativity begins with a sense of awe and wonder beholding the miraculous, infinite variety of creation. And then asking, how is it all held together? What are the patterns that connect? Ask nature a question in color, and you might get Monet's Garden in Giverny. Ask a question in numbers, and you may get Newton's Law of Gravity. Ask a question in spirit, and you might get the Sermon on the Mount.

Called upon to create Stations of the Cross for a Catholic church with many young members, I turned to the modern technological paradigm of visual imagery: television—illusionistic, close focused, and constantly shifting in vantage.

Carving the altar doors of an Eastern Orthodox Church, I turned away from traditional Byzantine designs, which divide the form into distinct parts arranged hierarchically along the lines of Ptolmey's medieval cosmos. Rather, I conceived of the whole as a seamless continuum more like the way Einstein thought of space. After all, changing our mortal conception of the universe need not alter God's sovereignty over it.

In 1994, the Washington National Cathedral invited me to join in the adventure of the Gothic. While I was serving as Artist in Residence at the Cathedral during 1994, the Clerk of the Works, Canon Richard T. Feller, commissioned me to carve four wooden angels to replace a set that had mysteriously disappeared from a carved gothic lectern. My four musical angels constitute the tiniest knot in the vast fabric of the Cathedral, and in and of themselves do not further our understanding of art, science, and spirit. Their presence in the only pure Gothic structure west of the Atlantic invites us to recognize the engineering genius of the medieval masons. They made the awesome heights and miraculous expanses of stained glass of Gothic Cathedrals possible by solving the twin problems of gravity and wind loading with their invention of flying buttresses. In these elegant half arches, intuitive science opens the way for a mystical metaphor of light.

Photographs of subatomic particle collisions have directly inspired some of my abstractions. Others are more generally inspired by my intuitively held belief that matter is an illusory manifestation of energy. I see them at least in part as silent music filled with harmonies of form drawn from the same scales as the ancient Greeks, drawn that is from nature's numbers.

The third type of image that occupies me nowadays is a throwback to ancient forms like Stonehenge, where our forbears struggled heroically to locate themselves in the awesome, recurrent patterns of the sun and seasons. Stonehenge marks the sunrise on the summer solstice. It may contain other astronomical alignments, lunar as well as solar. It may even calculate lunar eclipses. It has been interpreted many ways by successive generations. Early classicists had it as a Roman temple. Romantics attributed it to the Druids. Modern, computer literate astronomers take it as a proto-scientific calculator. But that it marks the summer solstice sunrise cannot be denied. My seasonal sundial, more modest in size than the great British cromlech, marks the zenith of the sun at the four cardinal points of the year, the summer and winter solstices and the vernal and autumnal equinoxes. It channels sunlight through three carefully cut ellipses-- one each for the solstices and the third for both of the equinoxes-- and projects it onto one of three circles which form a line pointing due north.

There on Salisbury Plain, the ancients threw the Crow's three stones into the jar of water. They threw in their most meticulous observations of the sun's yearly journey along the horizon and through the sky, their science. They threw in the most skilled labor of their hands to shape and arrange these massive rocks, their art. And they threw in their deepest spiritual hope for transcendent life. If nothing else, they bequeathed us a lasting token of their conception of art, science, and spirit and a lasting thirst for the sweet waters of life.

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