

~ LotusWood ~

(On the Ghost in the Evolutionary Machine)



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## The Last Color

Purple doesn't get much respect, considering its august position at the end of the rainbow, fading away in that lonely region of the electro-magnetic spectrum where human visual acuity fails and wavelengths of light become too short and energetic for our eyes to detect. What is the source of this strange prejudice? Why do we systematically exclude this marvelous hue from the pantheon of socially acceptable colors - a status given only to the other five members of the visible-light spectrum: Red, Orange, Yellow, Green, and Blue. We do not paint our houses purple, or our cars. We do not wear purple clothes, or fill our homes with purple consumer electronics. We do not go to work in purple offices, nor take vacations in purple hotels. And we certainly do not like our *prose* purple (good thing there's none of that conspicuously ostentatious writing around here!). Of course there are exceptions and such things are not entirely unheard of, but encounters with purple *are* comparatively rare. When we encounter some man-made thing that is purple, there is that "eyebrow raising" response that we unconsciously make: "Hmm, that house is *purple*." We look askance at people who confess without embarrassment that their favorite color is purple. It's almost as though there were something comic - or *suspect* - about purple.

Purple (and the family of purplish hues) is one sixth of the colors available to us; from a purely statistical perspective we might expect that 16.6 % of all things to which we apply color would be purple, but we certainly do not use it with a propensity commensurate with its magnitude in the spectrum. Detailed statistics on this matter have probably never been compiled, but it seems fairly obvious that we humans use purple, not only less than 16% of the time, but probably far less than 1% of the time. It is an ostracized color. Perhaps it is too lurid, somehow uncomfortably sensual, reminding us of blood-engorged reproductive regions. Perhaps it is the strange intensity it possesses; it is so

evocative, and yet we cannot quite find an emotion to correspond with it. Among the six colors of the spectrum, purple seems to be somehow richer and more vibrant than the others - almost suffocatingly heavy with its saturated, inscrutable energy. It is the darkest, most mysterious color.

It is likely that much of our aversion (perhaps we feel only reticence, and not blatant repulsion, but we avoid it, nevertheless) to purple is unfamiliarity: we simply do not often encounter purple in nature, and have never really learned to relate to it. The endless green of the jungles where we first evolved as a species was punctuated by blossoms and fruits of white, yellow, orange, and red; and the vast half-dome of the sky generated many easily comprehensible spiritual associations for the color blue. But where was purple, other than in the subtly fading terminus of the rainbow? There are, of course, purple flowers, but they are not naturally abundant in most parts of the world; selective breeding in the last 100 years has multiplied their number many times. And there is, also, vaguely purplish hues found in sunsets (and in the shadows of snow and distant landscapes, that take their color from ambient skylight), but such tones are far-removed from the rich, *full-chroma* purples I am discussing here. The historical rarity of pure purple is a strange but true fact: until the early 20<sup>th</sup> century, much of the world lived and died without ever seeing purple, except in the rainbow.

The other five colors of the visible-light spectrum can all be made with naturally occurring pigments. These pigments - prepared from a broad variety of plants and minerals - were (and are) used to make things like paint and ink, cosmetics, dyes for cloth and leather, and glazes for pottery and ceramics, but there was no naturally occurring pigment that would make a genuine purple. Countless attempts to find one failed. A crude, dusky, vaguely purplish color could be produced by mixing blue and red, but because those natural pigments were not chromatically pure, the result was a purple of perhaps only 50% intensity, and nothing like

the luscious, pure violets seen in flowers (which will not yield their pigment in a stable form) or in modern chemical pigments. There was, actually, one way to produce a fairly intense (but still not completely pure) purple from natural pigments: Tyrian purple, harvested from the shells of purpura mollusks. However, the shells were so rare that the dye extracted was vastly more expensive by weight than gold. Even the extravagantly wealthy could not afford it and its use became the exclusive purview of kings. It is for this reason that in ancient times purple was the color of royalty. And how often have you seen a king in the flesh? In fact, it was not until the late 19<sup>th</sup> century when synthetic chemical dyes were first made in Britain that purple entered the realm of common experience (William Perkins, an amateur scientist looking for a synthetic alternative to quinine - a malaria treatment - was fiddling with chemically similar coal gas and inadvertently invented a pure purple dye). Perhaps after 100,000 years of existence without purple, we humans are still a little suspicious of the chromatic newcomer.

### Octaves of Light

Visible light is only a tiny fraction of the electro-magnetic spectrum. We cannot see low-energy long wavelengths like radio-wave, micro-wave, and infrared radiation. Nor can we see high-energy short wavelengths like ultraviolet, x-ray, or gamma radiation. Light is a vast linear continuum of waveform energies, with frequencies ranging from the very low (tens of meters in the radio spectrum) to the very high (hundred billionths of a meter in the gamma spectrum). The human eye begins to detect electro-magnetic radiation at wavelengths of about 7000 angstroms - the color red - and is able to resolve wavelengths of increasing energy up to about 4000 angstroms - the color purple (an angstrom is one ten billionth of a meter). If our powers of perception were just a little stronger, if our vision could resolve just

slightly farther into the ultraviolet at around 3500 angstroms (that is, if we could perceive across a range of frequencies where the longest wavelength was fully *double* that of the shortest wavelength) we would see a very interesting pattern emerge - a strange and wonderful pattern that is second nature to any musician...

Sound is also waveform phenomena, a linear continuum of ever-increasing energies ranging from low frequencies to high. There is, however, a mysterious phenomenon *rolling around inside* that linear continuum, a regular, periodic repetition of sameness called an *octave*. Strictly speaking, an octave is nothing more than a doubling of frequency; if a particular tone of 440 Hz (vibrations per second) is doubled to 880 Hz, they are one octave apart. What is truly strange is that, despite the fact that one tone is much higher in frequency and energy than the other, *they are the same note*. All this is so obvious to musicians that they may wonder what the mystery is here; if you are not familiar with music theory, just hum the first 2 notes of Dorothy's famous song from *The Wizard of Oz* (*Some-where...over the rainbow*) - they are the same note, one octave apart. Now this is a very strange thing for a linear continuum to do.

Imagine a wailing siren, beginning at a very low pitch, the lowest you can hear (about 20 Hz), gradually and steadily going up in pitch towards the highest pitch you can hear (about 20,000 Hz) - an ever escalating ascent of increasing energy. The effect would be like the sonic equivalent of the trajectory of a rocket blasting away into the darkness of space above. But with each and every doubling of frequency, that siren is once again wailing the same note - higher, more distant, more energetic to be sure, but somehow still the same. It's as though that linear rocket were loop-the-looping all the way to orbit. Hiding within that linear continuum is another, *cyclical* continuum. This secret periodicity is also present in light.

The human ear can detect tones across a range of about ten octaves. Perhaps seven of these

are musically useful, and we can hear all of them thundering like the Hosts of Heaven in a Rossini overture or a Beethoven symphony. If all that musical information spread out across seven octaves (with harmonic undertones extending out to the limit of our hearing) had to be compressed into a single octave, the effect would be rather like the sound that came from Edison's first wax cylinder recording device: squished thin to meaningless incomprehensibly. Fortunately, we do get to enjoy a great range of sounds across many octaves. Sadly, we miss most of the great symphony of light: we are not able to see even one entire octave of the electro-magnetic spectrum; our vision fails as the octave approaches, thus preventing us from actually witnessing the periodic sameness that defines the octave.

We can, however, see the principle at work in a simple pedagogical device used by every young painter: *the color wheel*. When white light is broken up into its constituent parts by a prism, the pattern extends in linear fashion from red through to purple. But it is also possible to artificially map that progression onto a circle: red at the top, blending clockwise into orange and yellow, which blends into green on the bottom blending up into blue and purple. And this is where the color wheel illustrates the point: the purple blends effortlessly back into the top - it is, in fact, a *combination* of blue and red. Purple, at the far end of the rainbow and vanishing into imperceptibility as it approaches the ultraviolet octave ever farther away from the scarlet beginning, gradually acquires an inexplicable *sameness* to red. It's as though the progression is, at once, moving ever more distant, and, simultaneously, moving ever closer. Purple is the chromatic equivalent of the 7<sup>th</sup>, that lonely note of longing just before the octave that musically yearns for resolution in the completeness of the 8<sup>th</sup> note. A doubling of frequency



and energy has brought the wandering adventurer (chromatic or sonic) to a distant, higher plane... and yet somehow back home to the source where it began - a mythological return to the womb where it might begin anew, regenerated and reborn, once again young and vigorous, seeking new frontiers and new treasures...

### The Truth about Lines and Circles

Linear progression and cyclical periodicity are very different kinds of things, and it is difficult to reconcile these separate and distinct modes of being within a single phenomena - waveform or otherwise. How can something be dynamically linear, beginning one place and ending another, and also statically cyclical, beginning and ending in the same place? How can something always be penetrating into new and unexplored domains, and, simultaneously, watching over the same territory again and again? (This logical contradiction is reminiscent of the eerie problem of wave/particle duality: depending merely upon how we choose to make a measurement, the fundamental constituent parts of existence are either *continuous* waves, or *not-continuous* particles. That is, the universe is infinite, and the universe is not infinite. How can it be both?)

In mythological terms, these two aspects represent, one the one hand, individual aspiration, the importance of the hunt, the trajectory of the spear, and the irreversible cause and effect of life and death; and on the other hand, communal harmony, the importance of the harvest, the repetition of the seasons, and the eternal regeneration of new life from the dying seeds of the old.

What brought the *Never-Returning* and the *Always-Returning* together and bound them in a bizarre marriage of opposites? Strangely, this mysterious union of two contrary and even antagonistic modalities - manifest in everything we see and hear around us - has a shape: one of the most wonderful (and abundant) forms in the universe.

If we trace a circle, winding around and back upon itself again and again, and then move that cyclical tracing in a linear direction perpendicular to the rotational movement, we encounter the geometric manifestation of this enigmatic consonance. When linear action (the ethos of aggression directed outwards) is brought together with circular repose (the ethos of nurturing directed inwards), the resulting form is a *spiral*.

### Spirals of Life

This geometric form is everywhere, from flowers to galaxies, but its most immediate relation to humans is its presence in the structure of DNA, the molecular building blocks of living things. The fundamental unit of organic matter (wherein is held all the instructions required to assemble an organism from nothing more than molecules) is shaped like a double-helix: the spiral is the geometry of life itself. DNA is rather like a ladder that has been twisted; it has two outward vertical supports of alternating phosphate and sugar molecules, bound by horizontal rungs called base-pairs. It is down the center of those rungs, along an axial spine of hydrogen bonds, that DNA divides during replication. There are only two kinds of base-pairs - an adenine-thiamine rung and a guanine-cytosine rung - and so when the DNA divides, the severed base-pair rungs can only reconnect with the correct base partner - a very precise molecular lock-and-key mechanism. The order in which these base-pairs are stacked up on top of one another is how genetic information is stored in the long, complex DNA molecule. DNA endeavors to ensure that the replica will be a faithful copy of the original, and there is an army of little enzyme proofreaders that check and verify the work of duplication.

It is by the mechanism of DNA, working its mysterious morphological alchemy, that life gradually rebuilds and reshapes one form into other, different forms. This gradual genetic restructuring process is called *evolution through random mutation*

and *natural selection*. In a nutshell, life began, so the theory says, something like this:

About four billion years ago a randomly-formed complex compound of hydrocarbons cooked up in the bubbling soup of the early earth ocean, found itself, quite accidentally, with a chemical structure that somehow enabled it to initiate a bafflingly simple chemical reaction: it chemically attracted and assembled atoms and molecules identical to its own constituent parts from the surrounding soup and, somehow, *chemically assembled a copy of itself*. And the copies, which had this same unusual property, made copies of themselves - and so on. Bombardment by high-energy ultra-violet radiation (and perhaps also from cosmic rays - the thunder of distant super-novas) caused random errors in the replication process. 99% of the errors were catastrophic, and so the deviant molecules were no longer able to make copies of themselves. But those remaining mutations (1% or less) were actually more robust and even better equipped to make copies of themselves. And so the process went, and after only twenty iterations of this wonderful chemical reaction, there were billions of tiny replicating molecules, and then trillions and trillions. It is, perhaps, not too surprising that with so many little chemical factories churning out new little factories, that once in a great while some extraordinary accident would happen, and a new development would have a significant advantage over previous and subsequently obsolete models - and thus begin making superior little factories. This happens in our human-made factories all the time - and we are far less prolific than nature. Scientifically speaking, there is no intention, no pre-set inclination toward a particular result in this process; mistakes happen and they are almost always detrimental. On rare occasions these mistakes are beneficial and the lucky organism is better able to exploit opportunities in the environment, and more likely to pass the beneficial adaptations to their offspring. The whole process is accidental: sometime you get organic muck and sometimes you get civilized intelligence and space

exploration.

Evolution is the best explanation we have for how life on this planet came to exist in its current form, but the theory does leave a few nagging questions unanswered...

Some people wonder how the process got started in the first place; this is the *Argument against the First Replicator*. Evolution is simple...once you have a replicating molecule; just sit back and wait for mistakes to start happening. But how do you get that first self-replicating bundle of atoms? The structure of even the very simplest replicator molecule, possibly some comparatively simple variation of RNA (ribonucleic acid), would still have to have been *so* complex (at least 20,000 specific atoms randomly falling into a perfect 3-dimensional matrix with not one atom out of place) that one couldn't reasonably expect it to have formed by random collision and cohesion (a one in  $10^{40,000}$  chance, according to calculations done by astronomer Fred Hoyle, co-discoverer of stellar nucleosynthesis, who also coined the term *the Big Bang*). With only  $10^{80}$  fundamental particles in the observable universe, and only  $4 \times 10^{18}$  seconds since its creation 14 billion years ago, well, there simply hasn't been enough roles-of-the-dice for such a *fantastically* improbable event to have occurred based purely on chance: if every particle in the cosmos had a collision event once per second for 14 billion years, you'd only have had about  $10^{100}$  events. Of course, blind chance was not the only force at work upon those bustling atoms in the early terrestrial soup; nature and chemistry favor a certain few kinds of possible chemical bonds over a vast number of other statistically possible combinations that are chemically impossible. But this line of thought is almost more unsettling. The laws of the universe are such that the formation of complex self-replicating molecules, contrary to one in  $10^{40,000}$  odds, was *inevitable*? What are the odds of getting a law *that specific*? It's not scientifically satisfying to require that the emergence of a perpetual chemical chain reaction (now four billion years and a hundred

billion iterations old) somehow be *written into the code of the cosmos from the beginning*.

(Some people, including DNA co-discoverer Francis Crick, think that maybe the first replicator came to earth on the back of an asteroid from somewhere else in the universe where life had already evolved - an idea called *panspermia*. But how did *that* proto-replicator arise?)

Some people wonder, in general, how carbon, hydrogen, oxygen, nitrogen, and the other elemental components of the organic molecules of which we are made, know how to do the truly astounding things they do (the *Argument against Teleological Nature*). Of course, organic compounds don't know anything at all; like a dropped stone that does not "know" how to fall but achieves that end nevertheless, these amazing chemicals simply react according to physical properties inherent in their nature. But that doesn't really answer the question. We can change carbon into other substances, but we cannot break into the "cosmic code" and give carbon properties other than those it has; chemical properties are immutable and therefore infinitely strong, but, it seems, made of a substance so fine and delicate that it can never be detected. And so if these "properties inherent in their nature" are not attached to the matter-stuff of the world, where are they and what are they made of? How do they get from wherever they are to wherever we are? And if they're not anywhere, or made of anything at all, in what way do they exist? Sometimes it seems rather like these beautifully perfect, mysteriously intangible properties were *designed*. Perhaps there is an as yet unknown physical principle at work within the matter-stuff of the cosmos, a secret inclination of carbon that facilitates the creation of replicator molecules - and thus life - by entirely natural processes. But again, where did these "natural processes" - this inviolable codex of procedures unerringly obeyed by all the matter and energy in the universe - come from? They must be antecedent to the creation of the universe, itself a natural process, and so where did they reside before that?

Some people wonder, in particular, about the Second Law of Thermodynamics, the principle of nature that demands that, because some energy is always lost in any exchange, all systems must degenerate from an initial state of maximum order to a final state of maximum disorder where no further functional or observable change can happen (the *Argument against Increasing Order*). Contrary to the ever growing amount of entropy (disorder) in the universe, evolutionary processes are making structures of ever-growing complexity and sophistication. That's OK, says thermodynamic principle, because the system (the earth) is able to export its waste energy out of the system (to space). But if entropy is, to a significant extent, a statistical law - there are a near infinite number of disordered states and comparatively few ordered states, and so chaotic states are simply far more likely to occur - why don't we see periodic retrogressions in the evolutionary pattern? Why aren't some things *devolving* into comparatively primitive forms? Four billion years is a long time to keep rolling sevens.

Some people wonder how one form (a small rodent-like creature, for instance) becomes another dramatically different form (a bat, for instance), without becoming coyote food in all the tens of thousands of years it takes to evolve through the in-between stages; this is the *Argument against Intermediate Forms*. An eye with only 25% of the visual acuity an eye one million years hence will possess, is still quite a bit better than no visual acuity at all. The same adaptive advantage provided by an eye in the process of evolving into a better eye, however, is not obviously conferred to a paw in the process of evolving into a wing. A small rodent is an obviously well-adapted creature, as is a bat. But after a process of many thousands of generations, in that final evolutionary step before the erstwhile rodent fully mutates into a proto-bat that can fly (even poorly), it is only a clumsy mouse with six-inch webbed-fingers. How could such a ridiculous beast survive among crafty predators?

The wing, it is argued, *must* have provided

some adaptive benefit. If a full wing allows you to fly from place to place, a half-wing must provide some partial gliding ability (it is supposed), permitting one to survive a fall from a height of  $x$ , and a proto-wing of only half that size perhaps allows one to fall from a height of  $\frac{1}{2}x$  and survive. Perhaps. But a wing is, of course, an arm with fingers that exceed the body in length. A half-wing, then, which is said to provide this gliding benefit to be enjoyed when falling out of trees, would have been a hand with fingers nearly body-length in size. A strange beast - especially so in comparison with every other tree dweller in the forest canopy...all of whom have *small dexterous hands* (or gripping claws) to navigate a constantly treacherous landscape that is entirely unforgiving of bizarre flightless rats with preposterously long, webbed fingers. And if the strange beast did not live in the trees he was so demonstrably unsuited for, what then is the benefit of the mutation? The end point of the mutation, a fully functioning wing, is an obviously useful adaptation. But one is justified in wondering how it survived a maladapted liability - an excellent faller, but equally clumsy on ground or in tree - for so long.

Perhaps the clumsy fellow first evolved in an environment very low in predators. Perhaps they reproduced like mad, and there were just so many of the pesky things that the predators couldn't eat them all. Perhaps they tasted bad. And perhaps one can be forgiven for wondering if, somehow, something in the environment sometimes makes a special *accommodation* for such obvious maladaptations. It does indeed look like an inclination in the process *actively seeks* a significant advantage to be gained only at the amazing *end-stage* of a multi-generational mutation, and so influences local conditions to provide protective developmental time for long and difficult evolutionary transitions. It is a curious tendency for blind chance to exhibit.

It is sometimes asked, "Where *are* these strange, *intermediate forms*?" The world is a large place, the unseen part underground even larger and harder to get at, and the fragile treasures we seek

are small indeed. It should actually be surprising, not that we haven't found more of the intermediate forms, but that we were lucky enough to find such a good fossil specimen of *archaeopteryx*, the astounding transitional species between dinosaurs and birds. We actually know about quite a few of these intermediate species and are always finding more in the fossil record. But the study of genetics has made the point almost moot. The presence of common genes in people and bacteria demonstrates that *there must have been* an unbroken succession of intermediate forms between an ancient common ancestor and the modern descendants. We will eventually find more *therapsid* fossils, the curious mammal-like reptiles of the dinosaur age that subsequently spawned the hairy live-birthing creatures on our part of the tree of life, but they are just attractive decorations on an argument made much more forcefully by genetic evidence. Fully 7% of human and bacterial genomes share the same genes; that means their mutual great great great (and so on, several billion times) grandfathers were the same guy – even if he was only a tiny pre-Cambrian organism in an early, watery age of the world.

But other problems persist. More practically-minded (and less philosophically-minded) people wonder about the simple arithmetical nuts and bolts of the problem - about rates of mutation and distribution. Mammals have a genome of about three billion base-pairs, and 3% (90 million) of those are expressed in the coding (the remaining 97% of inactive genetic material serves no known function). When we look at the genomes of closely related species within a particular genus, we see that often it is only a difference of 1% that distinguishes the genetic composition of one species from another. It is, therefore, perhaps only a difference of 1 million base-pairs that separates a species from its evolutionary predecessors. The transmutation of *Homo-erectus* to *Homo-sapiens*, for example, seems to have required about 1 million beneficial point-mutations in the genome, and seven million years for those genetic changes to then propagate through

a herd of perhaps 10,000 individuals. Simple.

Here the question has become *significantly* more concrete than “How did life on earth arise?” or “What are the Laws of Nature?” We are talking here about statistical probabilities that mutations will occur in specific numbers at specific places on the genome, and that those genetic changes will then disseminate at a specific rate through the species by interbreeding. We have reasonably accurate variables here, numbers that can all be dropped into a reliable equation that will add up... or not. Mathematically speaking, it turns out that it is *astoundingly* improbable that such genetic transmission of beneficial adaptations might occur in the time available. Even if we are unnaturally accommodating with our variables - allowing for mutation rates in the gametes (reproductive, “single chromosome set” cells, like the egg and the sperm) far in excess of what actually occurs in nature, allowing that mutations happen in the active sites on the genome only, allowing that beneficial mutations are never accidentally “un-mutated” away, allowing for larger herds (where you have more mutations but require more time for dissemination), or allowing for smaller herds (where you need less time for dissemination but have fewer mutations) - the math doesn't add up. The process simply needs more time to accomplish and transmit the changes - *much more*. We are not supposed to be here for *another billion generations* or so.

And yet here we are, with our obvious morphological similarity to chimpanzees with whom we share about 98% of our genetic identity. Evolution is a fact of nature, but there seems to be an important mechanism at work here that we have not yet identified. There are two ways to explain the significant discrepancies between the math and reality of genetic dissemination. 1) There may have been many identical mutations happening in different individuals simultaneously and thus spreading through the herd at a much faster rate, or 2) there may have been long strings of ready-made genetic coding already present in the unexpressed region of



the genome waiting to be “turned on” by appropriate genetic and/or environmental conditions. In either case (the precise repetition, in great number, of impossibly improbable events, or the entire history of the living world written into the first self-replicating molecule), the mutations cannot be random or accidental. Four billion years is indeed a long time to keep rolling sevens - *unless the dice are loaded*. Evolution is a demonstration of natural *intention*; it looks like the universe already *knows* what it is building...

One final point about all this procreation is the conceptual catalyst that fuels the whole endeavor: *libido*. Where did libido - the extraordinary affinity that nature has for itself, the inexplicable compulsion of the forms of the cosmos to come together and recombine into new forms - come from in the first place? Once present, it's easy to understand how it persists. But the origin of this relentless desire to entangle, in atoms and galaxies and everything in between, is a complete mystery. Of course, if it were not present, nor then would nature be. But that's a poor explanation: it only explains why something that isn't (a *non*-self-recreating universe)...isn't. Fortunately for us, however, *our* universe is really, *really* horny...

### A Ghost in the Machine

This evocative, much-borrowed phrase was first used by Oxford philosopher Gilbert Ryle, who was arguing against Descartes' idea of an irreducible mind/body distinction. He, along with many other modern critics, disagreed with the idea of an immaterial soul, a “ghost in the machine”, operating the body like some kind of heavenly puppet master. He believed, rather, that the mind is simply what the brain does. But it is also true that conceptualizing ideas is what the mind does, and it is a little harder to establish a satisfactory connection between conceptualizing ideas and the brain.

Descartes might be forgiven for believing in,

what is still today, a slippery but still highly compelling description of the phenomena. The Mind really does seem immaterial, even though it is in many observable ways somehow connected to the body. Neurons and synapses are real things that we can manipulate in controlled experiments, and those laboratory investigations have revealed a startling mutability of memory, perception, behavior, and even identity. The stuff which makes us unique and individual is not near so permanent as we like to believe. The mind and brain yet possess many secrets and perhaps most of these will be discovered in the fullness of time. Some, on the other hand, will probably never be revealed.

One of the remaining mysteries is by what mechanism, and in what form, we actually archive memories and ideas. On the one hand, it may be the case that a unique and particular synaptic matrix of neurons (each with a unique orientation of molecules) corresponds to a particular idea. That is, some specific circuit of electrical activity in the brain represents a bird (or some other objective fact) and corresponds with such things out in the real world. But if that “specific circuit of electrical activity” represents a *subjective* fact (like liberty), then to where or to what other kind of thing is that correspondence directed? The synaptic “picture” of a bird corresponds with a living bird, but the synaptic picture of liberty corresponds to...? On the other hand, it may be the case that a very specific orientation of neuronal and synaptic machinery actually *is* the idea and not merely a cognitive representation of it. But if the cognitive representation of a fact *is* the fact, then what is that “other” world out there beyond our skulls? Does the world project reality into our minds, or do our minds project reality out into the world? And if the answer is “both are true”, that really supposes a far more *intimate relation between world and mind* than we can ever satisfactorily explain.

These mysteries are actually asking the same difficult question: What and where is the *intent* within the cognitive processes of the human brain,

and what and where is the *intent* in the evolutionary processes of nature? Perhaps there is another mechanism at work in nature, operating in some fashion for which we do not yet have a conceptual framework. It is completely understandable that science is loath to invoke totemic spirits when faced with an apparently intractable problem; that's not what science is. Science seeks good answers to good questions and, like Gilbert Ryle, has no patience for inquiry-ending notions like an ethereal poltergeist hiding in the nuts and bolts of natural processes. Such an idea is scientifically ridiculous. Where is this ghost hiding? Why can't we see it, or in any way detect its presence? How old is it, and will it eventually die? And if it is conveniently "non-physical", and therefore not accessible to any test we might wish to perform upon it, then how can it possibly interact with and actually affect any physical process? How does the intangible move the tangible?

Scientific expeditions will take us ever deeper into oceans of the unknown, and yet nature's depth is far greater than any probe of human manufacture. In an important sense, each great discovery merely opens new vistas and new frontiers of exploration. We never get close to the ever-regenerating invitation to keep advancing. There *is* a ghost in the machine: something that we cannot explain has intention and with it is able to affect change in the material world...through *consciousness*. Perhaps this intention is a natural process we do not yet - and may never - understand, and the ghost is merely a metaphor and poetic fancy. And perhaps intention really is some *other* kind of process entirely, and the lonely Ghost is watching and waiting still for the intrepid among us...

### A Lotus in the Spiral

**W**e see in this image of the mythological forest an incarnation of the Ghost in the Machine, a luminous spirit dwelling within the living machinery of nature, guiding it

to a specific destiny. Her gown begins in glowing purple, and spirals down to dark ultra-violet, seeming to vanish into nature, but the meadow - and the world beyond - is still very much suffused with its presence. In Her hands She seems to magically shape some strands of Her hair into a descending double-helix which ends in a strange symbol - another geometric representation of the mythological union between action and repose.

At the terminus of the spiral we see a beautifully harmonious composite form consisting of two geometric shapes in perfectly balanced conjunction. One form is an upward-pointing triangle; like a mountain to be climbed, like a pyramid to be built, like a burning flame it is the direction of our ambitions - the image of aspiration. The other form is a downward-pointing triangle, and like the yonic triangle it resembles, it is the image of the womb - the still and silent sanctuary beyond the known world that is the mysterious source and destination of all life.

This ancient symbol has many names. In India it is known as the *anahata* - the central, or "heart" chakra. In Hindu thought, the body possesses two filaments of "subtle" energy that form a double helix around the spine, crossing at seven intangible energy centers called chakras. The chakras are somewhat like mediators, points at which specific energies of our interior nature engage with corresponding energies out in exterior nature. The energies of the lower three chakras are directed outward, receiving the world into the self: eating and excreting (engaging the self through survival), reproduction (engaging one other through sex), and ambition (engaging many others through achievement). The energies of the upper three chakras are directed inward, pushing the self out into the world; the shakti's journey (appropriate meditation will awaken the sleeping serpent at the base of the spine and bring it through the successive chakras into mystical illumination) up the "Lotus Ladder" ends finally in a liberation through the thousand-petaled crown chakra, an escape from

the Illusion of the Self, and consciousness returns to that nameless void whence it came. Between those oppositely oriented energies is the center of perfect, interpenetrating balance where Yoni and Lingam, Yin and Yang, dance.

The “subtle” substance of these energy centers is not perceptible to the conventional senses - that is, they are invisible. But we sometimes wish to represent things that cannot be seen and so these chakras have been given shape and color that seemed, to the ancient shamans who designed this system, symbolically appropriate. The seven chakras are traditionally shown as a rainbow of lotus blossoms, a chromatic representation of spiritual potential. The lower three centers of *terrestrially-oriented* energy are pictured as follows: 4-petaled root survival (*muladhara*) is *red*, 6-petaled genital desire (*svadhisthana*) is *orange*, and 8-petaled abdominal ambition (*manipura*) is *yellow*. Correspondingly, the upper three centers of *celestially-oriented* energy are pictured thusly: 16-petaled throat vocalization (*visuddha*) is *blue*, 2-petaled brow visualization (*ajna*) is *violet*, and 1000-petaled crown realization and resolution (*sahasrara*) is blazing *white* - all colors in conjunction. The heart chakra (*anahata*), where the self-making energies invert to a self-negating orientation, is pictured as a 12-petaled blossom (which represents the Circle of Space and Time) that contains the 6-pointed star (which represents Life - the fleeting but never-ending collision of That which Burns and That which Quenches). And this lotus of spiritual re-orientation is *green*.

Green is the traffic light that is an indication to proceed after a time of pause. In Orphic, Hermetic, and Arthurian traditions, green is the color of the Grail Chalice, a symbolic representation of the sacred vessel of renewal that contains a solemn promise: the living blood of the *god who has fallen*. Such signs and symbols have their basis in nature: green is the *rise of spring*, the redemption of the world after the frozen slumber that follows *the fall into red* (in China, this vernal resurrection that

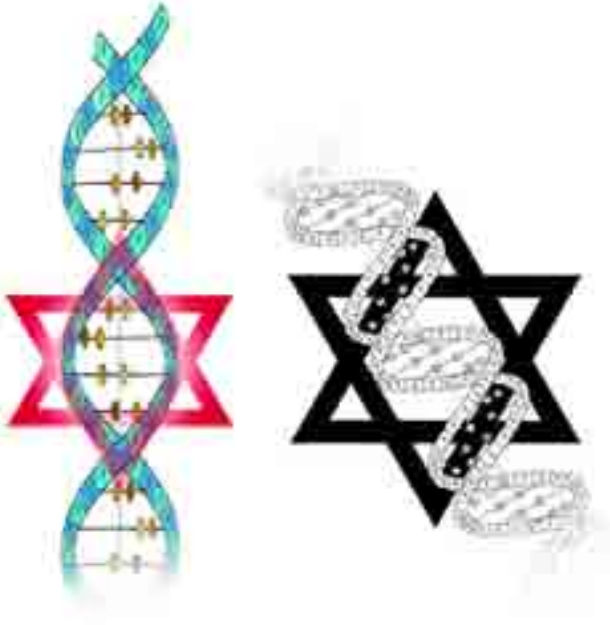
succeeds the long decline is called *the Ascension of Yang*). Green - the chromatic opposite of red, the color of violence and destruction - is the most tranquil color, a proclamation of fertility, joy, and abundance. Furthermore, green is the very center of human visual acuity where our eyes are most perceptive, the color-range in which we see the world with the most accurate and complete detail. Even though it is the color we see most clearly, its very abundance means that it also obscures or even confuses; unknown secrets and treasured mysteries of nature dwell in green. Natural selection chose this center of our visual acuity (between the limits of red and violet) because there is no more abundant color in the living world than the green of the photosynthesizing chlorophyll that carpets the habitable regions of the earth. And green is also the color of beginnings, the organic radiance of that mystic place of primordial origins where life began, long ages past, in an otherwise empty and barren world. As the color of the living flesh of the world, it suggests perpetual regeneration and immortality; as the color of the nutrient-rich waters that flow through, surround, and fructify the landed parts of the earth, it is also symbolic of the *womb*.

If the universe has a most sacred intention, surely Life, this ancient and tumultuous globe of self-recreating green, is it. We will return again to this motif of the Green Center of Transformation, in a *cosmogonic* context, at the end of this book.

In *this* image of primordial green (and the unseen, ultraviolet intention from which it grows), we have seen that these two simple forms - the spiral and the six-pointed star - are the confluence of opposing archetypes, graphic representations of the mythological marriage between Heaven and Earth, Beauty and Power. This extraordinary integration is symbolized here by the curious hybrid-symbol (composed of both the double helix *and* the anahata) that flows from Her luminous *crown* like a manifesting idea. But this strange geometric fusion is more than mere creative artifice: *it's real*, and actually present in the living molecules of our genetic

identity. An idealized representation of the double helix - two twirling verticals bound by horizontals - reveals the hidden Lotus of Creation dwelling within...

kind of comment, but one is rather obliged to listen to someone with 3 honors degrees in science. So I grumbled a bit, but scraped off the flowers I was painting and started again. I'm not actually sure if what I did subsequently was better or not, but Lizzy certainly thought so, and I very much like that fact that this is her favorite painting.



\* \* \*

### Personal Notes on *Lotus Wood*

I think it is unlikely that my wife, a dedicated professional who has very little patience for philosophy, will ever read these words, so I'm going to venture an observation that I think would annoy her: she's not too interested in the mythological work I do. Certainly my friends and family are *mostly* ambivalent about paintings that are not landscapes ("When will he grow up and do *respectable* work?"), but Lizzy surprises me sometimes. I had painted the background trees and ferns of Lotus-Wood, and also the foreground figure and helix. I was just beginning to paint the extreme foreground where the gown disappears into a carpet of purple blossoms. I thought the flowers I was painting looked just fine, but Lizzy came into my studio, full of concern: "No, those are wrong," she said with authority. Now, an artist doesn't want to hear that



