Mirror-Image Asymmetry, Chirality, and *Suttree*

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To be transformed
To turn yourself inside out like a glove
To spin like a planet
To thread yourself through yourself
So that each day penetrates each night
So that each word runs to the other side of truth...

Anna Kamieńska, “Transformation” 79

1 It begins in the untended riot of vegetation in Knoxville. In nature’s time-so-deep-as-to-be-timeless, the ceaseless activity of evolution (McCarthy calls it “delicate cellular warfare in a waterdrop” [13]), the longest striving of all that presents itself, paradoxically, in the guise of unexamined stillness and resilience at the margins of violent human incursions. It starts with an innocuous detail in the opening passage of *Suttree* (1979) that observes the way that certain vines wind and spiral. In *Suttree*’s “gray vines coiled leftward” (3) a world begins unfurling. Its tendrils reach into the construction of all material things, so far as can be known, from the atoms that comprise us, to the unusual biology of identical twins, to the question of what constitutes an aberration in the fabric of the universe, and the relation between material and moral substance. So much can depend on an observed detail.

2 At its simplest, *chirality* is the property of the handedness of things, and it must be conceded at the outset that handedness is itself a conceit deeply rooted in the firmament of human experience and our very way of seeing the world—one so intrinsic to our worldview, in fact, that we rarely think about it. Anthropomorphically speaking, we can refer to objects ranging from spirals, wood screws, and plants as left-handed or right-handed based on the way that we apply our conveniently opposable-thumbed paws to the turning of them. Although it is none too intuitive, being able to distinguish between left and right is counted a developmental milestone even as it imposes a kind of semantically inscribed prejudice in our thinking and way of seeing (consider the mischief worked on
the western mind in those earliest dualistic lessons of childhood: inside/outside, clean/dirty, and the very important left/right).

3 There is nothing intuitive about the left/right distinction, as anyone who has taught a child knows. My father, a veteran of U.S. Marine Corps, often recalls how he was asked to teach left and right to certain recruits who had missed this lesson, a distinction that takes on a certain compelling urgency in a fields-of-fire situation. It is also innately referential and subjective: Martin Gardner posited the “Ozma Problem,” noting that it would be impossible, without looking at the same object, to communicate the distinction between left and right if ever we communicated with an extraterrestrial intelligence. Previously, Immanuel Kant and William James had wrestled with dimensions of the same issue. Finally, the 1956 “Wu experiment,” based on the beta decay of cobalt-60, came along and disproved to physicists’ satisfaction the conservation of parity, thereby making it possible to describe an experiment that could be replicated to definitively convey the meaning of left and right.2

4 Of course, explaining that the three neutrinos in our universe are left-handed, and the nonconservation of parity in beta decay etc. is probably not the easiest way to teach the notion to children; it would be like building a refrigerator to explain the concept of cold. Taken for granted, the everyday-ness of our left/right framework for seeing the world obscures many fundamental mysteries: how do we know the difference between left and right without reference to additional planes? How does the human body, in its very construction, know the difference, and locate certain organs according to a left-right bias? Why are some things (indeed, most living things) more right-handed?3

5 To have a look at chirality and how it operates in the imagination of Cormac McCarthy we must begin by dispensing some scientific terminology that may not be familiar to literary scholars. And it will be important to ask some forbearance on the part of the nonspecialized reader with the assurance in advance that concepts as various and apparently unrelated as physical cosmology and the handedness of plants (for plants can indeed be classed as left- and right-handed) will find illustration in McCarthy’s literary work. The first half of this paper looks at the science of chirality, and the second half at how it is manifested primarily in one of McCarthy’s novels.

6 The organizational principle for this essay is, fittingly, one of mirror symmetry: the second half really cannot be well understood without the first. And a reader who is interrupted at frequent intervals with literary illustrations might have a difficult time following the thread of the scientific context, which will be provided here with broad strokes and a certain amount of necessarily gross simplification for the sake of reaching the literary analysis in the second section.

7 A vast scientific literature of chirality awaits the curious, though much of it is highly specialized. The most important book on the topic is remarkably accessible, however. Oklahoman and popular science writer Martin Gardner’s The Ambidextrous Universe, first published in 1964, was retitled The New Ambidextrous Universe and went into a third revised edition (1995) to include such rising concerns as string theory. Gardner’s indispensable book is unlikely to be surpassed for its playful but sophisticated insouciance in laying out the many dimensions of handedness, symmetry, and asymmetry in the world. In fact, it is credited as an influence on science-minded Vladimir Nabokov, whose work Gardner cites in his own; Gardner would in turn be cited by Nabokov in Ada, or Ardor: A Family Chronicle. In fact, Gardner’s hunch that Nabokov’s Look at the Harlequins! (1974) had been influenced by his study of symmetry and asymmetry was later confirmed.
by “two scholarly papers—one by a literary critic, the other by a historian of science.” (New Ambidextrous Universe 307) It is entirely possible that McCarthy took some influence from Gardner’s work as well, and later in this paper I will document the influence on McCarthy’s work of at least one author who wrote about chirality.

For purposes of this brief study, which focuses a bit more narrowly on the biology of chirality, James P. Riehl’s book, Mirror-Image Asymmetry: An Introduction to the Origin and Consequences of Chirality (2010), offers a layperson-friendly overview of the topic, and like Gardner’s book, is steeped in the author’s lifetime of fascination with it. Much of the material summarized here regarding chirality in human development is derived from Michael Levin’s “Left-right asymmetry in embryonic development: a comprehensive review” (2004), an article that provides ample context for the science behind chirality, twinning, and what I’ll term, conveniently but pejoratively, “malformation”—all matters of some interest to McCarthy that are explored, principally, in Suttree, as well as other of his works.

Certainly, McCarthy explores chirality in a variety of other texts—consider, for example, the overtly chiral pairing of Black and White in The Sunset Limited (2006)—but the majority of the examples offered here will come from Suttree, since it is more concerned with the biological in its exploration of symmetry and asymmetry. And an understanding of chirality should perhaps be grounded in biology and our chemical composition, as these things, too, are reflected in the text.

Chirality offers some lessons about how we indeed spin like planets, and how mirror-image opposites, when reconciled, speak to the importance of asymmetry, of being threaded through oneself as a means to spiritual revelation. Elsewhere, poet/scientist Katherine Larson’s Radial Symmetry takes a close look at aquatic cnidarians—think jellyfish, sea anemones, corals, comb jellies and their five-pointed cousins, certain starfish, sand dollars and sea urchins—which have a symmetry different to our own. As we wonder at our universe (or multiverse, as the case may be), we might hope to get beyond the suppositions of bilateral symmetry that would pair science and poetry as “opposites,” and go back to the sources of things, a single center, the unified place. Chirality and the interplay of symmetry and asymmetry is a transformative concept in nature, in human experience, and in the philosophies of deep-seeing writers. Understanding chirality in turn reveals new dimensions of scientific and philosophical meaning in McCarthy’s work. What I am proposing is a new way of reading his work, and for some, it may offer a new way of seeing the world around us. I cannot pretend to answer all the questions I raise here, but neither can the current science surrounding the issues. My looping is instead a design, echoing McCarthy’s, in the hope that you might be drawn through yourself and run to the other side of truth.

First, the term “chirality” derives from the Greek word for hand, and it is one of many brilliant coinages from Lord Kelvin, whose fertile mind was perhaps better suited to the twentieth century than the nineteenth. In simplest terms, a system is chiral if the mirror image of the system cannot be superimposed on the original system. The most familiar example is at arm’s length: it would be very odd if you were born with two left hands, in which case no one could accuse you of twiddling your thumbs! In simplest terms, then, chirality is the property of handedness. Some things that partake of chirality are the
same except for being reversed along one axis (our mirrored hands, for example), thus the common phrase, *mirror-image asymmetry*—a term of art relevant to *Suttree* and to which we shall return.

Chirality turns out to be profoundly consequential at the molecular level. The molecules in the cells of living things are chiral, and, as James Riehl notes, “For more than 100 years scientists have known that the building blocks of proteins and DNA are composed of only one of the two mirror-image forms of amino acids” and a “special group of [right-forming] sugars” (59). Couched in scientific language, “Exclusive homochirality would seem to be a unique aspect of life (at least life as we know it!)” (Riehl 66), and it remains to be seen if the universe offers exceptions to our terrestrial rule. All naturally occurring proteins from all living organisms consist of amino acids with left chirality; it was established by the mid-twentieth century that those sugars forming the helical structure of DNA and RNA have right chirality. Think of these, if you like, as the Legos by which living things are made, with a simple interlocking pattern to ensure stackable compatibility. On the other hand, consider the function of incompatibility to prevent miscoding, not unlike the way that a piece of Ikea furniture is engineered so that a wrongly inserted part will not connect with a mismatched one.

DNA is right-handed, in that the helix spirals in a clockwise direction; there are websites devoted to exposing, with nerdish glee, scientific bloopers in media illustrations depicting a DNA molecule quite impossibly turning in the other direction. Biological molecules are by nature chiral because they are built from single *enantiomers* (each one of a pair of chiral molecules that mirror each other). And amino acids, the essential ingredient of living things, furnish chiral building block molecules. It is precisely because biology is chiral that the chirality of drugs turns out to matter quite a lot, as different enantiomers can produce very different reactions to the body’s chiral architecture. The classic case of this is Thalidomide, which was widely prescribed as a sedative for pregnant women during the 1970s. One of its enantiomers makes an effective sedative, and the other, tragically, causes severe birth defects. Moreover, the drug as processed (interconverted) in the body makes a racemic mixture—one in which left- and right-handed enantiomers of a chiral molecule are found in equal proportion—so the benign enantiomer cannot be guaranteed.

The Thalidomide problem surfaces in American pop culture when Walter White holds forth on this textbook example in *Breaking Bad* (Season 1, Episode 2); he will later bargain for his life by pointing out that his methamphetamine is “enantomerically pure” (Season 4, Episode 1), adding some additional currency to the mirror-image motif of the series, in which reflected images and characters (like White-Fring) abound. As *Vice* journalist Jason Wallach points out, White might have used the example of methamphetamines for chirality: “d-methamphetamine induces classic stimulant effects, whereas l-methamphetamine is only a weak stimulant but an excellent decongestant, which is sold over-the-counter in Vicks® inhalers under the pseudonym les-desoxyephedrine.” Needless to say, any chiral drug marketed as a racemic mixture must now be proven pharmacologically and toxicologically safe for each enantiomer. When one enantiomer is as effective as another, American pharmaceutical companies have gamed the system by “flipping” a molecule and securing a fresh patent just before intellectual property rights expire and a drug becomes generic.

In any case, chirality is so intrinsic to organic chemistry that entire journals are dedicated to its study, including, naturally, *Chirality*, which recently celebrated the award

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of a 2016 Nobel Prize in Chemistry to longtime contributor Ben L. Feringa. An important branch of evolutionary biology is devoted to sorting out the presentation and significance of chirality in living things. Its study entrains a range of fields of scientific enquiry, including physical cosmology. In fact, an important goal of the Comet 67P/Churyumov-Gerasimenko spacecraft landing was to see if chiral molecules exist in space (the study of meteorites is mostly inconclusive because of the likelihood of tainted samples). The discovery of chiral molecules there would lend some credence to the comet “fertilization” theory—that a comet delivered some of the complex organic molecules and l-amino acids that set earthly evolution in motion (see Riehl, Chapter 3).

Other theories abound as to the origins of chirality on earth, including the influence of the nuclear non-parity-conserving weak interaction and even the way that neutron stars generate UV circular polarization. Indeed, atoms and their particles themselves demonstrate chirality in their spinning, so it may fairly be said that chirality informs the very smallest things revealed to us by scientific observation. It also begs a reconsideration of what, precisely, we mean when we speak of chiral molecules, since they consist of atoms with chirality, fermions with chirality, and even massless particles—perhaps a case of turtles all the way down! If racemic or “opposite” chirality (a preponderance of r-amino acids) were discovered elsewhere in the universe it would suggest the part of chance in determining chirality here on earth going back to the very beginnings of things. Writing in *The Guardian*, Andrew Rutherford was prepared to say, “A mirror version of DNA could perfectly well exist, but it appears that the coin was flipped about 4bn years ago, and every life form since has twisted right.” This conclusion, however, seems at best premature and at worst a bit anthropocentric, at least until we are acquainted with the denizens of more distant reaches of the cosmos.

For now, suffice it to say that we may be in something of a golden age of chirality, from *Breaking Bad* to Nobel Prize-winning areas of scientific enquiry. Chirality obtains both in the origins of the very smallest things as well as in the larger forms of living things, and it is the latter that we turn to now. Organisms themselves can be symmetric, racemic (occurring in equal proportions of left-handed and right-handed individuals), or asymmetric. In the first category, animal body plans take a variety of symmetries, including radial, chiral, bilateral, and spherical. The human plan, as it happens, is pseudo-bilateral: we like to think we’re nicely symmetric along the vertical (dorsal ventral) axis. Imagine a paper cutout of the human form, with dotted line from the nose to the navel, fold, and the two sides would meet neatly in mirror-image symmetry.

In reality, of course, the symmetry is far from perfect (take an honest look at yourself and notice your two differently sized feet, breasts, or testes, as the case may be), though studies of the perception of human faces show that we are hard-wired to see the symmetrical as the beautiful. Beauty, in that sense, is truly skin-deep. The left-right (LR) axis tells a different story about our inner construction, beginning with familiar example of the heart and the positioning of the organs within the body. As Michael Levin puts it, “Vertebrates have a generally bilaterally symmetrical body-plan, but this symmetry is broken by the consistently asymmetric placement of various internal organs such as the heart, liver, spleen, and gut, or the asymmetric development of paired organs (such as brain hemispheres and lungs)” (3). There is chirality in the corkscrewing of your intestines, for instance. And this anatomical chirality has important consequences that are only beginning to be understood: “The mechanisms which ensure invariant LR asymmetry of the heart, viscera, and brain represent a thread connecting biomolecular
chirality to human cognition,” writes Levin, “along the way involving fundamental aspects of cell biology, biophysics, and evolutionary biology. An understanding of LR asymmetry is important not only for basic science, but also for the biomedicine of a wide range of birth defects and human genetic syndromes” (3).

Before looking at some of the consequences to asymmetry that Levin identifies, however, let us take a look at the topic of chirality as it obtains broadly to the natural world around us. Chirality may be a familiar concept in terms of our species, but it prevails among many other organisms, including, for example, insects that have exquisitely evolved communication systems based on chiral pheromone signatures. And then there are plants. Consider a sprouting vine that reaches a horizontal filament of wire. Will the plant wind around the wire to the left or the right? It turns out that roughly ninety percent of the world’s plants favor a right-handed helix, which is to say (somewhat confusingly) that they wind in an anticlockwise fashion from the ground up. Contrary to common conception, plant twining does not seem to be correlated in any way to the sun’s movement through a particular celestial sphere, by the Coriolis effect, or any other hemispheric influence (Edwards et al. 795). The other roughly ten percent of plants are either lefty-contrarians or unfussy-ambidextrous sorts.

Curiously, the percentage of right-handed plants is comparable to the global average of right-handedness observed in people. Handedness in humans is a non-heritable, non-Mendelian trait, so it cannot be predicted in the classic dominant-recessive way. Handedness varies among identical twins at about the same rate as handedness in the general population (Riehl 189). Which suggests that the interaction of genes with environment likely drives handedness, implicating the process of socialization—and perhaps the notably commonplace practice of training children to write with their right hand. Right-handed chimpanzees are twice as common as left-handed chimps, and some claims have been made for the increasing occurrence of right-handedness in human populations, based on sources ranging from cave painting to the analysis of ancient remains.

As Levin notes, “A huge literature on brain lateralization phenomena in human beings exists as well, but many of these asymmetries are secondary and arise as a result of cultural environmental biasing factors” (3). Which is another way of saying, despite the outpouring of literature about left- and right-brained people and handedness crossover, much of what you think you know about the topic may be wrong, and despite many theories, from spear throwing to socialization, no one knows exactly why human right handedness prevails globally and across cultures. Add to this a good bit of web-based mythology, including, for example, the widespread (and debunked) notion that polar bears are predominantly left-handed, and it soon becomes apparent that countless studies have done little to clarify the essential facts of southpaws in any species.

Having said that, some interesting and legitimate studies have been done on predator-prey interactions and handedness. For example, the overwhelming majority of snails are right-handed (their shells turn clockwise). Various reasons have been postulated, including the alignment of cellular microtubules, but another line of explanation proceeds from the idea that their chirality could confer a selective advantage depending on the handedness of predators, such as snakes or crabs. The limbering of a sea snake’s jaws and its angle of attack, for example, might make one chirality easier to swallow than another. So there are indeed cases where selective pressure can explain handedness. Interestingly, mutations causing a switch in handedness are correlated with speciation
events, since, for example, opposite-handed snails have mechanical trouble mating. Some species, like the familiar fiddler crab, are racemic in their handedness; if you see a group of them, you might notice that the dominant claw occurs roughly equally on the left and the right. There are also well-documented cases, such as lobster claw morphology, in which chirality is determined by neurological activity. Spending one’s whole existence reaching out from a craggy niche in the same direction would suggest that it is best to play to the circumstances.

On the whole, though, as Dr. Sarah Huber explains it, “There are several lines of evidence to suggest that ’handedness’ is often selectively neutral and simply the product of chance. First, we see both left and right handed organisms, and these organisms have overlapping distributions and ecological niches. Second, handedness seems to ‘run in the family.’ Organisms that are closely related and share an evolutionary history have the same direction of spin—what biologists call phylogenetic inertia. A trait evolves in a lineage, and over time it persists because there are no forces to change it. Handedness is a homology, shared because of common descent.”

In this we come full circle, with handedness as a coin-toss, absent some force to change the bias. Notwithstanding the sophistication of the scientific understanding of molecular chirality and genetics, it is astonishing to consider how many mysteries of handedness continue to elude our understanding. A passage from Levin enumerates some of them:

The establishment of left–right (LR) asymmetry raises a number of fascinating biological questions. Why does asymmetry exist at all? What are the implications of asymmetry for the normal structure and physiology of the heart, gut, and brain? Why are all normal individuals not only asymmetric, but asymmetric to the same direction (i.e. why a consistent bias and not a 50/50% racemic population, given that individuals with full inversion are not phenotypically impaired)? When, during evolution, did handed asymmetry appear, and were there true bilaterally symmetrical organisms prior to the invention of oriented asymmetry? Is it connected to chirality in lower forms (such as snail shell coiling and chirality in some plants)? At what developmental stages is asymmetry initiated in vertebrate embryos? How conserved are the molecular mechanisms establishing correct asymmetry in animals with drastically different modes of gastrulation? And, how can the LR axis be consistently oriented with respect to the anterior–posterior (AP) and dorso-ventral (DV) axes in the absence of any macroscopic feature of chemistry or physics which distinguishes left from right? Answers to these questions require a detailed understanding, at the molecular, genetic, and biochemical levels, of the formation of biased asymmetry in embryos. (3–4)

Incredibly, we have no idea how nature can even establish the template for left-right asymmetry, since we don’t know how cells are able to orient on that axis: it is one thing for the heart to be on the left side of the body, but how in the world does the body, and the cellular material that comprises it, know which side is the left? By the fourth or fifth week of pregnancy, by whatever means, cells receive the instructions to determine the laterality of organs—as Levin and his coauthors waggishly titled a paper concerning the role for the cytoskeleton in left-right asymmetry, “It’s never too early to get it Right.” But where do the instructions come from? As Levin writes,

The LR axis itself follows automatically from the definition of the AP and DV axes, as it is perpendicular to both; however, consistently imposed asymmetry across it is fundamentally different from patterning along the other two axes. Firstly, while the AP and DV axes can be set by exogenous cues such as gravity, or sperm entry point, there is
no independent way to pick out the left (or right) direction, since no known macroscopic aspect of nature differentiates left from right. (4)

If natural selection can be described as the “non-random survival of random variants” as Richard Dawkins is sometimes paraphrased, what evolutionary reason is there for chirality? We simply do not know. Levin acknowledges various theories that have been put forward for the consistent asymmetric chirality of organs, including “optimal packing, fluid dynamics, maximizing surface area of tubes, etc.” but concedes that “there is no obvious reason for why [organisms] should all be asymmetric to the same direction” (4).

A recent issue of The Philosophical Transactions of the Royal Society B devoted to grappling with “Provocative questions in left–right asymmetry” shows that many of these questions remain unresolved ten years after Levin’s summary article. Intriguingly, some studies of ciliates suggest that “molecular chirality directs whole-cell chirality,” and have led some researchers to conclude that “cell chirality may be a general property of eukaryotic cells” (Inaki 1). In fact, “explanted linear heart tubes from chicks or fish develop dextral looping in culture, indicating that this morphogenesis is independent of the LR body axis” (8). In other words, the organs can develop LR asymmetry even when they have no body to provide a frame of reference! Adding to the complexity of these questions, that result cannot be generalized across organisms; a prevailing question, as expressed by A. Richard Palmer, remains, “Do common rules govern how direction of asymmetry is determined (symmetry is broken) during ontogeny [the course of development] to yield an asymmetrical individual?” The title of his contribution to the special issue sums up the problem: “What determines direction of asymmetry: genes, environment or chance?”

As with so much in biology that seems merely stochastic, there is the temptation to discern a pattern and call it order. Yet even in cases where genetic information has been scrambled, there are observable patterns. For example, in human hermaphrodites, ovaries consistently develop on the left, testes on the right. Laterality defects in conjoined twins almost always afflict the twin on the right. More recent, identical twins have been observed in which only one has the symptoms of the zika virus, leading to the theories regarding how the virus might cross the placenta (Belluck)—only one of many examples where understanding the role of mirror-image asymmetry is important to preventing birth defects.

And then there are twins, particularly identical twins, who sometimes demonstrate mirror-image asymmetries. And “non-conjoined monozygotic [identical] twins, while not exhibiting the kinds of visceral laterality defects that occur in conjoined twins, do manifest many subtler kinds of mirror-image asymmetry (‘bookend’ or enantiomer twin pairs),” notes Levin. Citing diverse studies, he observes, “Pairs of such twins have been noted to present mirror asymmetries in hand preference, hair whorl direction, tooth patterns, unilateral eye and ear defects, cleft lip, cleft palate, supernumerary teeth, and even tumor locations and undescended testicles” (“Left-right” 15). Some researchers have suggested that “some as yet unknown pathological mechanism is responsible for both the process of twinning itself and the destabilization of the LR axis” (15); similarly, it has been speculated that a small number of left-handers are “pathological” left-handers, meaning that their chirality is caused by an abnormality (Riehl 190).

All of which will be relevant to the discussion of handedness in Suttree in the second half of this essay. For now, suffice it to say that we inhabit a living world of handedness, of spinnings, leanings, and spiralings, all of which are definitional in evolution. Twins
illustrate the action of chirality in the flesh. More broadly, though, chirality turns out to be critical in the way that life forms, is sustained, and changes. And if this holds true to the earliest stages of our biological formation and evolution, we should not be surprised to find it reflected in literature and philosophy as well.

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But if you ride these monsters deeper down, if you drop with them farther over the world’s rim, you find what our sciences cannot locate or name, the substrate, the ocean or matrix of ether which buoys the rest, which gives goodness its power for good, and evil its power for evil, the unified field: our complex and inexplicable caring for each other, and for our life together here. This is given. It is not learned.

(Annie Dillard, *Teaching a Stone to Talk* 19-20)

On the opening page of *Suttree*, McCarthy sets his tale in deep time and the fossil record, accurately describing the stones mined from the Cumberland plateau that contain “in their striae fossil bones, limestone scarabs rucked in the floor of this once inland sea,” (3) the latter clause accurately reflecting the presence of marine organisms in the fossil record dating back to the time when the entire area was submerged and part of the sea floor. There is an evolutionary order to the opening as the reader soon reaches, in the same long passage, “Gray vines coiled leftward in this northern hemisphere, what winds them shapes the dogwhelk’s shell” (3). What winds them? One answer, naturally, is chirality: the plants are wound by chirality, they exhibit chirality, because they are wound. This is a circularity; one may as well say, “Because nature made them so,” but the more we understand of the processes of chirality, the more deeply we peer into the mysteries of nature. McCarthy is pointing to the handedness of vines, and as was discussed earlier, the ones described here coil leftward, placing them in the majority. Either Homer nods, or can be forgiven for subsequent discovery, because McCarthy seems to give some attribution to the now-disproven theory of hemispheric influence on plant-winding: what winds them is not the Coriolis effect. Rather, what winds them is none too straightforward. One might point as well to the Fibonacci series as a repeated template in nature, or to a measure of evolutionary determinism in the common pattern of things represented in the coiled vines and dogwhelk shell. Both are classic illustrations of chirality.
Picture 1: This chiral fossil is between 12 and 13 million years old and was embedded near the city of Merida in the Yucatan Peninsula of Mexico—rucked among the striae from the seafloor. From the Gran Museo del Mundo Maya in Merida, Mexico. Photograph by the author.

Picture 2: “What winds its shell?” Bisected fossilized nautilus shell exhibiting dextrorotary chirality (as well as the Fibonacci series). From the Gran Museo del Mundo Maya in Merida, Mexico. Photograph by the author.
McCarthy’s interest in chirality finds clear confirmation in his notes. In box 19, folder 14 of the McCarthy papers in Wittliff Collections at San Marcos, his jots for Suttree contain a page labeled “Dexter-Sinister-Coriolis.” Michael Crews’s Books Are Made of Books (196–97) points out that at the center of those notes is Joseph Wood Krutch, “a literary critic and nature writer” whose critique of modernity revolves around humankind’s distance from nature. One of McCarthy’s notes reads, “See The Desert Year Krutch—Carlsbad bats.” In The Desert Year, Krutch observes that bats emerging from Carlsbad Caverns spiral in a counterclockwise pattern because of the Coriolis effect (145-146). Fascinated by the tendency toward patterned self-organization in the natural war, Krutch was concerned about mechanistic determinism: “On the other hand, since I am rather prone to hope that there is not a mechanical explanation for practically everything, it would also be gratifying to learn that there was positively nothing at all in my Coriolis Effect theory. One would then be left to wonder just how the Carlsbad community came to agree upon its traffic laws” (264).

Indeed, this line of speculation goes directly to chirality and questions about the underpinnings of order in nature. As Crews affirms, “McCarthy’s interest in Krutch’s reflections find expression in his use of symmetry as a recurring motif in Suttree.” The notes on “Dexter—Sinister—Coriolis” give various textbook examples of chirality in nature: “Plaice flounder sole in the tropics are lefteyed... while those in the north are dextral. But the halibut is sinistral in both hemispheres – perhaps just for the halibut.” There are anthropological examples, too: “Hottentots and bushmen 70% sinistral. Their austral nature.” This amounts to a leap of logic, and influence of hemispheric influence has largely been scientifically discredited, as mentioned earlier. But it nevertheless finds its way into Suttree, with “austral” appearing, as Crews notes, in Suttree’s remembrance of his Uncle Milo, lost off the Chilean coast: “Foreign stars in the nights down there. A whole new astronomy. Mensa, Musca, the Chameleon. Austral constellation nigh unknown to north folk” (128). Moreover, Crews correctly notes that Suttree’s entire sense of self is grounded in the notion of the right/left and the sinister. In the same “Dexter” notes McCarthy has copied a quotation for Philip Massinger’s play, The Virgin-Martyr, “Left-ey'd knight of the antipodes Philip Massinger” (115-16).

The very first pages of Suttree announce that it will also be in some sense a study in mirror-image chirality and a/symmetry. The “murengers” have walled in a presence (“the thing’s inside” [4]) and the question is posed, “[W]hat’s the counter of his face?” [my italics] Shortly after the movement of a cat across cobblestones is described as “sewn in rapid antipodes over the raindark street to vanish cat and countercat” (4) in the first of numerous doublings in the novel.

Indeed, in the earliest pages of the novel Suttree is contemplating, in stream-of-consciousness, “The delicate cellular warfare in a waterdrop. A dextrocardiac, said the smiling doctor. Your heart’s in the right place” (13). From the standpoint of chirality, there isn’t much that’s amusing about dextrocardia; having the heart on the right side guarantees a short life, although complete mirror reversal of internal organs (situs inversus) is generally harmless. The warfare in a waterdrop is evocative of the zygote and cellular conflict described 100 pages later. Suttree observes the lamplight and shadowy corners “[w]here insect shadows war. The reflection of the lamp’s glass chimney like a quaking egg, the zygote dividing. Giant spores addorsed and severing. Yawing toward separate destinies in their blind molecular schism. If a cell can be lefthanded may it not have a will? And a gauche will?” (113). The image is important enough that he will return
to it, self-referentially, much later (“You can tell me, paradigm of your own sinister genesis construed by a flame in a glass bell” [414]), and this is arguably one of the most pregnant passages in Suttree. It touches on Suttree’s stillborn identical twin even as it raises a question about the nature of evil, determinism, and free will. There are ways in which it might be said that nature chooses sides—though it should be conceded this language of agency, of a cell having a “will,” which McCarthy employs in Suttree, is nothing more than a convenient conceit. Did the universe will a preponderance of L-amino acids? Or was this simply a matter of chance, a cosmic coin toss of the kind that fascinates McCarthy? After all, his fascination with chaos science and what is conventionally called chance might put the subject in a different light. Murderous Chigurh’s “random” coin toss to determine whether Carla Jean will live or die in No Country for Old Men (2005) suggests that indeed all things move toward their end, and what is commonly perceived as a random outcome is predetermined; one of the greatest human follies is the belief that chance shapes our ends when it stands to reason that the range of possible outcomes becomes more and more narrow by the minute.

Note that Chigurh couches the outcome of the ultimate coin toss in terms that are suggestive of chirality: “Every moment in your life is a turning and every one a choosing. Somewhere you made a choice. All followed to this. The accounting is scrupulous. The shape is drawn” (emphasis added, 152). Returning to the fundamental imponderability of the origins of chiral asymmetry—genes, environment, or chance—it might be said that all become determinisms. A turn, a bend in the universe, and the shape is drawn. As mentioned earlier, one line of thinking is that the die was cast for chirality in the earliest moments of the universe. Perhaps the early arrangement of the universe set the stage to create UV circular polarization from white dwarfs, neutron stars, and so on. Perhaps the course was set by the fact that “in 10^{18} molecules (a million trillion molecules) there would be one more L-amino acid than D-amino acid due to [the] nuclear nonparity-conserving weak interaction” (Riehl 72). With world enough and time, even the slightest bias could tip the scale.

One might easily go to an ontology here. Is it possible that there is a rightness to things, since the universe we inhabit so favors this asymmetry? And if that rightness is a kind of inscription, does it furnish a constant in the equations of natural law, or is it a law in its own right? Much has been made of the moral valence of “right” and “left,” so it’s a rather striking coincidence that our part of the physical universe indeed seems predisposed toward the rightness of things. Put differently, from our limited observations, the universal script slants to the right. Elsewhere I have written about the importance of the concept of logos in McCarthy’s work—and logos is the ordering principle of the Christian universe (“In the beginning was the Logos” etc.). The question I wish to pose here is whether chirality in some way underpines the logos, as an essential element of whatever natural and by extension moral order there be, in contrast to what McCarthy terms the gauche will in Suttree.

Before moving along, that leap of logic might best be spelled out this way:

1) Chirality imposes an observable bias throughout the universe, distinct from what we might expect to witness (a racemic universe) if pure chance controlled.¹¹

2) There is an ordering principle at work in the universe.

3) This is evidence of design, since design alone can account for a favored direction throughout nature.
And it is a leap of logic, for the third statement completes the circularity. Even if the prevalence of chirality contests randomness on one level, it is itself no refutation of material determinism, especially since we can only speculate about the chain of causation, and our observations are very limited (consider chaos theory's emphasis on sensitive dependence in initial conditions). Moreover, many would say that order does not of itself require a designer; rather, order simply is. A good deal of order has already been inferred in random-appearing/chaotic phenomena through chaos theory and differential equations. So it might be said that randomness determined the original tipping, after which, the bias became general. Perhaps it makes the existence of opposite chirality—call it the sinister aspect—all the more intriguing. Is the cell that rejects the dominant chirality in some sense, as McCarthy suggests in *Suttree*, “willful”? 
"The road descended the granite face of the sierra like a hairspring" (The Crossing 136). Hairsprings, also called balance coils, are chiral spirals essential to the working of timepieces—and time figures prominently in the novel. The two views above are public domain images from Frederick J. Britten’s On the Springing and Adjusting of Watches (1887), 6–7.
The material determinism to which McCarty returns relentlessly throughout his opus raises questions of perception, narrative, and witness as well. Could it be that the true metaphysic is within our very substance? Consider this syllogism and its relationship to the last example:

1) The chiral nature of the physical universe inscribes a quality of handedness in the material.

2) Our very substance, then, records the direction of the origination of all things.

3) Ergo it would seem that metaphysical reality is written within the physical world and within us, and that this understanding, even when ineffable, is nonetheless with us.

This conclusion chimes with David Tracy’s *The Analogical Imagination* and a long tradition of theologians countenancing a creator who is more like the created world than might be expected. Compare this line of reasoning to this passage describing the heretic’s realization in *The Crossing*:

1) He saw that his demands upon God resided intact and unspoken also in even the simplest heart. His contention. His argument. *They had their being in the humblest history.*

2) For the path of the world also is one and not many and there is no alter course in any least part of it for that course is given by God and contains all consequence in the way of its going and outside of that going there is neither path nor consequence nor anything at all. There never was.

3) In the end what the priest came to believe was that *the truth may often be carried about by those who themselves remain all unaware of it.* They bear that which has weight and substance and yet for them has no name whereby it may be evoked or called forth. (157-58; my italics and line breaks)

McCarthy enters into the territory of apologetics here, reflecting many traditions, including, I think, an Aristotelian predilection for a prime mover, though elsewhere he plays on Platonic forms. There is little reason to assume that these views are McCarthy’s own, or to accord the final say to the priest here—at least no more so than any other of McCarthy’s characters who speak their truth. There is, however, reason to give some authoritative weight to the notion of the teller and the tale. It is generally conceded that the Border Trilogy is a frame tale—consider the *hushaby* of the pretty horses lullaby that begins it, and the dream of Billy Parham that concludes it—conferring ultimate reality only to tale itself, right down to its epigraph (“... The story’s told/Turn the page” [n.p.]).

The priest finally concludes that “the lesson of a life can never be its own. Only the witness has the power to take its measure. It is lived for the other only” (158). Whereas “God needs no witness” (158).

Another syllogism, then, drawing on McCarthy’s Christian narratology:

1) The ability to take a lesson presupposes a larger context for meaning. Human lives require witness “to take their measure” and be validated (“There is another who will hear what you never spoke” [158]). By contrast, God needs no witness. (“The priest therefore saw what the anchorite could not. That God needs no witness. Neither to Himself nor against” [158]).

2) Synthesizing various declarations from this section of *The Crossing* and elsewhere in the Border Trilogy, tales need no witness to be true and there is only one metanarrative of truth, ultimately (consider the truth of folk tales and allegories alongside a postmodern novel).
3) Ergo, the truth of a story must proceed from a place beyond signifier and symbol. Paradoxically, stories speak to our need to be witnessed in order to confer meaning, even as their real meaning proceeds from, and conducts to, a source of meaning that requires no witness. To that extent, stories could be a means of witnessing the inscription of godhead to/in us, even as their spiritual truth is obfuscated by language and our need to be witnessed. We comprehend the meaning of a story only as far as “what we have made of God” (158).

A further “proof” might be added to this, since tales are stamped with an irrefutable order if they are to have meaning. Consider this observation:

1) Space is multidimensional and multidirectional.

2) Time, both in narrative and human understanding, is unidirectional; it is a syntax for what happens in the universe, and in narrative controls a morphology derived from the expected order of things (observation conditions expectations of causation).12 “A form without a history has no power to perpetuate itself. What has no past can have no future” (Cities of the Plain 281).

3) Therefore, there is an ordering principle at work in stories that gestures toward the inscription of a logos.

Stories, then, contain a metaphysical reality; as with the chirality of things, they necessarily contain direction that is independent of what they say (expression), but their ability to say anything is dependent on that direction.13

Where that direction comes from is the mystery that we fail too often to see. The chirality of DNA defines the mode of expression that is called a phenotype, and so it is with time and narrative. So directionally time-bound are we that while it is possible to write a story beginning in media res or even in reverse (a textbook example being Fitzgerald’s “The Curious Case of Benjamin Button,” [1922] which has a protagonist who ages in reverse), the story ultimately is understood within the mind of the reader, and indeed can only be meaningful, through its linear rearrangement from start to finish. “You can't rewind the universe and run it over again,” says one of the characters of Whales and Men (Cormac McCarthy Papers, Box 97). As Martin Gardner points out in The New Ambidextrous Universe, “It is easy to see a mirror-reversed world... But seeing a time-reversed world poses difficulties” (292). Gardner examines this topic in some detail, pointing out that modern physics countenances the possibility of not just antiparticles and antimatter but an antiverse where time and space might be reversed. Gardner’s complicated analysis spans chapters 28-31 of the book, investigating the reconciliation of free will and determinism, among other things. In one thought experiment, he muses that “two worlds with opposite time arrows are analogous to two worlds that are mirror images of each other,” and in such a world, intelligent beings would be “living ‘forward’ in their time”—but that communication between time reversed worlds would be “ruled out by logic” (291-292).

This is indeed the stuff of science- and other-fiction genres. Even when authors toy with nonlinear chronology, magical realism, etc., it makes no matter, because time imposes a forward-running syntax on the truth of a story, and the story is its own place. As the caretaker of the ruined church says in The Crossing, “The story on the other hand can never be lost from its place in the world for it is that place.... And like all corridos it ultimately told one story only, for there is only one to tell” (142-143).14

I am no expert in narratology, and my interpretations here are probably as crude as my philosophical conclusions. These “proofs” are not going to satisfy logicians nor
theologians; rather, they are a thought exercise to show the main drift of argument. And yet it seems clear that there is something important in both the dialectical and analogical dimensions of McCarthy’s imagination. Garry Wallace remembered a conversation in which McCarthy said he “thinks the mystical experience is a direct apprehension of reality, unmediated by symbol, and he ended with the thought that our inability to see spiritual truth is the greater mystery” (Wallace 138). This recapitulates McCarthy’s distrust of language, and also rephrases several notions above. Spiritual truth—a logos—flickers up from the unconscious, the story-as-story (not as language), the meaning in the dream of life.

<table>
<thead>
<tr>
<th>Language</th>
<th>(Un)consciousness</th>
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<tr>
<td>Script</td>
<td>Inscription</td>
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<tr>
<td>Evolution-acceptable</td>
<td>(Un)Language</td>
</tr>
<tr>
<td>Symbol</td>
<td>Logos/meaning</td>
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<tr>
<td>Syntax</td>
<td>Sacrament</td>
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<tr>
<td>Matter</td>
<td>Clarity</td>
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<td>Symmetry</td>
<td>Asymmetry</td>
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<td>Teleology</td>
<td>Loops/loops</td>
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<td>Neo-Darwinians</td>
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<td>Site</td>
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<td>Witness-dependent</td>
<td>Witness-transcendent</td>
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<td>Experience</td>
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<tr>
<td>Language</td>
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<td>Constructed truth</td>
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<td>Impediment</td>
<td>Originality</td>
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<td>Empathy</td>
<td>Grail</td>
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<tr>
<td>Substance</td>
<td>Tale (simple narrative)</td>
</tr>
<tr>
<td>Twinning</td>
<td>Unified self</td>
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<tr>
<td>Interconvertibility</td>
<td>The-ontological</td>
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Figure 1: A brief exercise in tensions a la Cormac McCarthy

The best way I know to sum this up is: **language is to consciousness what matter is to chirality.** To be clear, my purpose in all this is not to enter apologetics, or to offer an argument from design, or to go so far as to claim that McCarthy is affirming a teleology in some holistic way in his opus (though it may be possible). If the language/chirality analogy holds, it brings a consistent mode of interpretation to McCarthy’s constant interrogation of natural law. For if chirality bears some relation on what has conventionally been called natural law, then natural law, through thesis and antithesis, is unquestionably an enduring area of interest in McCarthy’s work. A twist on natural law is encapsulated in the thinking of *Child of God’s* (1973) Lester Ballard, who cannot begin to comprehend how hawks mate, but remains confident in the knowledge “that all things fought” (168)—a conclusion not dissimilar to Hobbes’s revision of natural law presuming the state of “war of every man against every man”—the well-known doctrine of *bellum omnium contra omnes* (Hobbes 83). For Suttree this awareness extends even to the microscopic things in a drop of water. If natural law dictates the goodness of life, what if life is inclined to be, in some sense, so zealously protective of itself as to be viciously amoral or outright evil?
McCarthy had little chance of avoiding the complications of evolution. The “old tattered barrister” whom Suttree encounters had “been chief counsel for Scopes, a friend of Darrow and Mencken and a lifelong friend of doomed defendants, causes lost, alone and friendless in a hundred courts” (367). The figure was modeled on John Randolph Neal, an eccentric onetime University of Tennessee law professor and a TVA supporter. Neal, whose best claim to jurisprudential immortality was his work as the defender of John T. Scopes in the famed 1925 trial, would have been familiar to McCarthy’s father, chief counsel to the Tennessee Valley Authority. As a boy, one of Cormac McCarthy’s chief hobbies was collecting fossils and other specimens in the hills around Knoxville, so it does not go too far to say that evolution was in the water he drank, the land he walked, and the people he encountered. What comfort is the natural law so carefully drilled into a young Cormac McCarthy in his Knoxville parochial school when the primary lessons of Darwinian evolution invite conclusions such as the last sentence of Suttree’s prelude: “Ruder forms survive” (5)?

Indeed, the much-quoted phrase from Suttree is a direct reflection of the evolutionary discourses in which Charles Darwin, not Jean Baptiste Lamarck, proved to be correct. Lamarck saw evolution as driving biological systems toward complexity and perfection; Darwin was perfectly at peace with the propagation of all things dull and nasty. In The Descent of Man, and Selection in Relation to Sex (1871), Darwin pondered the relationship of his evolutionary theory to ethics, writing,

The virtues which must be practiced, at least generally, by rude men [emphasis added], so that they may associate in a body, are those which are still recognized as the most important. But they are practiced almost exclusively in relation to the men of the same tribe; and their opposites are not regarded as crimes in relation to the men of other tribes (178).

In other words, proscriptions of murder within my tribe may have little bearing on my willingness to murder within yours; in Suttree one indeed sees the minimal virtues that permit rudimentary association.

Darwin pointed out also that civilized human society could achieve a state that transcended mere survival of the strongest, in which a meek person could contribute just as much as an aggressive one. He recognized the limits of his own theory in this respect, and he was careful to point out that his speculations on the evolutionary society were in a separate and distinct stream from evolutionary biology. The microbiological understanding of genetics that led to neo-Darwinism was not yet available, after all. The interesting question here is whether McCarthy’s declaration that “ruder forms survive” flirts with social Darwinism, affirms evolutionary theory, or goes against it.

His interest in these matters extends as far as debates regarding whether consciousness and language are in some sense evolutionary. In his recent “The Kekulé Problem” (2017) essay, Cormac McCarthy posited a separate channel, after the fashion of Darwin and his ethics, for language: “There is no selection at work in the evolution of language because language is not a biological system and because there is only one of them. The ur-language of linguistic origin out of which all languages have evolved.” Reflecting further on this, McCarthy admits,

Influential persons will by now of course have smiled to themselves at the ill-concealed Lamarckianism lurking here. We might think to evade it by various strategies or redefinitions but probably without much success. Darwin of course was dismissive of the
idea of inherited ‘mutilations’—the issue of cutting off the tails of dogs for instance. But the inheritance of ideas remains something of a sticky issue. It is difficult to see them as anything other than acquired. How the unconscious goes about its work is not so much poorly understood as not understood at all.

Thus the author confirms his interest in the divide between Lamarck and Darwin. It is not the only place where McCarthy’s probes the limitations of Darwinism. As Michael Crews points out, McCarthy’s dialogue fragments contain a note about Gordon Rattray Taylor’s *Great Evolution Mystery* (1981), a critique of conventional Darwinism that McCarthy “seems to have taken seriously,” in Crews’s estimation (270). “[Darwinism] dismisses the captain and puts the stoker at the helm” concludes one character in *Whales and Men*—an oddly teleological declaration if it is taken to be for McCarthy’s view (Cormac McCarthy Papers, Box 97).

McCarthy’s interest in the relationship between semantics and consciousness has been a point of rumination going back at least to that unpublished screenplay, in which a character named Peter associates the formation of linguistic consciousness with the problem of evil, asking, “What was it that had made us outcast in this paradise created for us. What had made us refugees from joy and orphans of delight? What was it that characterized our species, that was found nowhere else in nature?” The answer, naturally, is language, which contains and supplants our experienced reality, leading Peter to the conclusion that it led to the very expulsion from Eden: “We were put into a garden and we turned it into a detention center.” Viewed this way, language containerizes reality and limits it in turn. Consciousness, as we experience it, is mediated by symbol (going back to the pre-lingual cave man epiphany, as McCarthy puts it in the Kekulé essay, that “one thing can be another thing”) and expressed through the wholly inadequate, affected mirroring of language. The unconsciousness, stamped with our deepest animal origins, is the thing.

So one of the essential properties of language in McCarthy’s view is that it imbues our reality with a quality of secondary-ness. “To God every man is a heretic,” explains the chapel-keeper in *The Crossing*; “The heretic’s first act is to name his brother. So that he may step free from him. Every word we speak is a vanity” (158). There is not space enough to unpack the Cartesian complexities of McCarthy’s stance here; suffice it to say that in the Kekulé essay, he suggests that the unconscious is, foremost, a biological system—“a machine for operating an animal”—and that it can potentially access realities and ideas without attaching language to them. As sculptor Robert Smithson once observed of consciousness, “You don’t need existence to exist” (qtd. in Julavits). To which might be added, a thing or property does not require language to exist—but one of the questions McCarthy raises in the Kekulé essay is, where does the language come from if not the unconscious, which might be exquisitely evolved to its own inscrutable purposes?

Although the Kekulé essay has elicited a good bit of interest as a new publication, McCarthy had essentially already written it, albeit in his fiction and certain unpublished writings. For example, in *Cities of the Plain* (1998), in Billy Parham’s conversation with the Mexican man beneath the bridge: “It is not the case that there are small men in your head holding a conversation. There is no sound. So what language is that? In any case this was a deep dream for the dreamer and in such dreams there is a language that is older than the spoken word at all. The idiom is another specie and with it there can be no lie or no dissemblance of the truth” (281). This agrees quite exactly with McCarthy’s conclusions.
in the Kekulé essay; what are dreams, if not the unconscious dispensing with language to get our attention about what matters?

The interplay between the unconscious and language in some respect might be said to resemble that of what sculptor Robert Smithson liked to call a dialectical situation (Julavits). He once explained his Spiral Jetty sculpture, fashioned of black rocks and positioned on a remote edge of the Great Salt Lake, this way: “What you are really confronted with in a nonsite is the absence of the site.... In a sense the nonsite is the center of the system, and the site itself is the fringe or the edge.” Writing in the New York Times, Heidi Julavits added, “Sites and nonsite, in other words, involve the equal interplay of consciousness and matter.” This might be enlarged to say that the unconscious is implicated in the interplay of site and nonsite, too. Driving on an unfinished stretch of the Jersey Turnpike at night with his friend Tony Smith, Smithson recalled Smith in that moment “describing the state of his mind in the ‘primary process’ of making contact with matter.” “In the same essay,” writes Julavits, “[Smithson] noted that Freud referred to this commingling experience as ‘oceanic.’” McCarthy’s fascination, for example, with whales as an expression of a deeply evolved consciousness in Whales and Men explores the possibility that they channel an ancient, “oceanic” unconscious.

McCarthy was intrigued by the possibility that whalesong might express something essential about the deep, prelingual past. In “The Kekulé Problem” he posits that language is non-evolutionary. “The difference between the history of a virus and that of language,” McCarthy writes, “is that the virus has arrived by way of Darwinian selection and language has not. The virus comes nicely machined. Offer it up. Turn it slightly. Push it in. Click. Nice fit. But the scrap heap will be found to contain any number of viruses that did not fit.” Darwinian evolution, after all, relies on discards and failed experiments. Poet Katherine Larson, contemplating the sea as the starting place for genetic evolution, sees “Not perfection... but originality” (“Ghost Nets,” section V). Originality is the right term of art because it extends both to the origins of things and the relentless creativity of nature, including its penchant for creative mutation and creative reuse (consider the oft-cited rule, that, with the exception of manatees and certain sloths, all mammals, from giraffes to bats, have seven cervical vertebrae).

Nature can seem ruthless in its evolutionary experiments, which result in such phenomena as spontaneous abortions, terratomas, and so-called parasitic twins competing in the womb for a better purchase on life from the moment the zygote splits. The resulting suffering is one manifestation of the theodicy of natural evil. It is also an enduring concern for McCarthy. Suttree suffers from nightmares in which he sees his dead twin, “a sinister abscission,” borne on a bier (80). The autopsy of Lester Ballard, the killer of Child of God, is a reminder (to turn the tables on Wordsworth) that we dissect to murder, seeking pathologies of the body to explain the sources of evil, which might originate in something as innocuous-seeming as a sinister cell. Discovering a tumor in Ballard’s brain might give some comfort to those who would explain the mystery of evil in the man. Perhaps it started with the leftward-yawing zygote.

This much is certain about the Suttree passage: it is a study in chirality that evokes ancient notions of gauche/sinister/not-right, the word “sinister” appearing a half-dozen times in the text. A cell with left-handed chirality could indeed go its own way, and, depending on where it was situated, might go against the grain. Cornelius Suttree is haunted by the possibility that he might be the “evil” twin, in some measure responsible for his stillborn and forever-lost sibling. Back to the early pages of the text, then:
The ordinary of the second son. Mirror image. Gauche carbon. He lies in Woodlawn, whatever be left of the child with whom you shared your mother’s belly. He neither spoke nor saw nor does he now. Perhaps his skull held seawater. Born dead and witless both or a teratoma grisly in form. No, for we were like to the last hair. I followed him into the world, me. A breech birth. (14)

A high percentage of twin births result in head-first presentation of the first, breech of the second. Suttree’s stream of thought affirms that his lost brother was a mirror-image twin. Recall the earlier conjecture that a pathological mechanism might be responsible for “both the process of twinning itself and the destabilization of the LR axis.” It might be said that genetic coding errors often arise with twins, and some would say that twins are themselves a kind of coding error. But which one was Suttree? The passage is ambiguous. He was the second to be born; does that make his stillborn brother the ordinary, or the gauche (left-handed) human enantiomer, if you like? This much is certain: for much of the novel Suttree feels incomplete and guilt-riddled because of his lost twin, a yin in search of his yang. Upon visiting Immaculate Conception Church, he thinks, “The virtues of a stainless birth were not lost on him, no not on him” (253).

From the very beginning, then, Suttree sees himself in relation to his stillborn twin. The language of the novel is shot through with chirality, in fact, beginning with his recollection of drinking from a mountain spring: “Under the watercress stones in the clear flowage cluttered with periwinkles…. A rimpled child’s face watching back, a water isomer agoggle in the rings” (13). One does not customarily apply the term “isomer,” which refers to molecules with the same chemical formula but a different left-right arrangement of atoms, to a human being. But this is a novel about human enantiomers, and enantiomers, after all, are just one type of isomer. Since Suttree sees his mirror-image face, he is perhaps seeing the likeness of his lost brother—a ghost, in other words.

The term isomer resurfaces at one other point in the novel, when Suttree encounters two possum hunters who are identical twins, “alike to the crooks in their stained brown teeth” (358). They share a story of chirality and falling simultaneously “out of black walnut trees at the identical same minute eight mile apart. I broke my right arm and Fernon his left’n and he’s lefthanded and me right” (360). Suttree will be reminded of his lost twin when the brothers conduct a mind-reading experiment, after which “Suttree stood up. The hunter spun about and faced his unarmed image across the file, his sinister isomer in bone and flesh” (361).

So, once again, we have a dextral and sinistral twin, and the language of chemistry applied to human beings. There are many allusions to astronomy, astrology, and the zodiac in Suttree—indeed, Cormac McCarthy’s notes suggest that they were part of the plan for the novel—and since Vernon and Fernon are hunters, we might ask if they are an unlikely Castor and Pollux. In other words, with their appearance, Gemini strides into the novel.

Why so many twins? Recognizing that doubling, in the literary sense of “splitting” a character into the familiar and the strange, is a stock element of gothic fiction, it might be said that there is something more happening in McCarthy’s work with the reconciliation of Suttree and Othersuttree. The quest for wholeness and the self-integration of opposing forces is the human story writ large, not to say the major religions, and a significant part of the mythic journey, per Joseph Campbell, the coming back to the self. Cornelius Suttree comes to wholeness precisely by being split. Consider
my own textbook example of the sort of “phraseological appropriation” well documented in Michael Crews's *Books Are Made out of Books*:

<table>
<thead>
<tr>
<th>Possible source text in Yeats’s “Crazy Jane Talks to the Bishop”</th>
<th>McCarthy’s reworking of the material in his journalia/notes</th>
<th>Muted allusion in final text of <em>Suttree</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>“A woman can be proud and stiff When on love intent; But Love has pitched his mansion in The place of excrement; For nothing can be sole or whole That has not been rent” (Yeats 263)</td>
<td>As I grow old will not my spirit mend by rending? And my eyes gather a visionary’s light all dusty with loveliness like the sun by morning? Until my heart is an ash charred by charity (torn page) (Cormac McCarthy Papers, Box 19, Folder 13)</td>
<td>“Some doublegoer, some othersuttree eluded him in these woods and he feared that should that figure fail to rise and steal away and were he therefore to come to himself in this obscure wood he’d be neither mended nor made whole but rather set mindless to dodder drooling with his ghosty clone from sun to sun across a hostile hemisphere forever” (287).</td>
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</tbody>
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94 Suttree has done his share of slumming in Knoxville’s places of excrement, to be sure. The “ghosty clone,” the doppelganger “othersuttree” is Suttree’s chiral twin, and the passage shows a strange dependency between the two.

95 Yet the chief epiphany that Suttree later shares after being sick unto the point of death is this: “I learned that there is one Suttree and one Suttree only” (461). He declares it to an uncomprehending priest from his hospital bed in an overtly heretical cooption of catechistic monotheism and its “one God and only one.” It is a radically individualist reclamation of the divine. Yet there are multiple ways to interpret the statement: has Suttree incorporated his enantiomeric twins into a single entity, a whole self? Or has he simply come to terms with chirality, and his identity quite apart from the lost twin? In other words, has he let go and accepted his asymmetry? Regardless, it seems that, in the language of cliché, a demon had to be conquered or at least accepted before there was any prospect of wholeness. The twins must be separated to be conjoined and reconciled.

96 Suttree’s vision of the end also prompts him to say, “Nothing ever stops moving.” Chirality suggests that asymmetry and movement, as much as balance and stasis, are the chief facts of the human condition. Writing in the “Introduction to provocative questions in left–right asymmetry” in *The Philosophical Transactions of the Royal Society B*, in an introduction that owes much to Gardner, the editors submit,

97 [I]ike symmetry, asymmetry is also pervasive in our aesthetics, where it lends a provocative contrast, representing the dynamic, the unexpected, the emerging and the innovative. Together, symmetry and asymmetry comprise the proverbial Yin and Yang, the black and white, the metaphorical good and sinister. Both are essential for completeness, but too much in either direction disrupts a critical balance—symmetry unchecked by asymmetry transmutes order, harmony and beauty into static, sterile and monotonous. Asymmetry unchecked by symmetry becomes aberrant, unrestrained and chaotic. (Klar 1)
They add that biology “holds no exception to this duet.” McCarthy, notes Michael Crews, “was drawn to images of art as either formally static or dynamic” as he worked on *Blood Meridian Suttree* during the 1970s. Crews traces sources in McCarthy’s notes and works on this tension, including Wyndham Lewis’s *Time and Western Man* (1927), Oswald Spengler’s *Decline of the West* (1922), and Michel Foucault’s *Madness and Civilization* (1961, 105-10). In any case, it might be said that this tipping property contains the seeds of creation and destruction; that which spirals is already headed toward its separate destiny, subject to the laws of entropy and gravity. Life persists on earth because the planet has not yet spiraled toward or away from the sun. In the longer view, in Yeatsian terms, things fall apart, and the center cannot hold in an entropic and expanding universe.24 Indeed, the expanding universe as we know it is made of spiraling stars, gases, etc., substances that turn and rotate with their own gravity-bound chirality, in some cases spiraling into the compaction of black holes in a cosmic illustration of what it means to circle the drain. Robert Smithson’s famed sculpture “Spiral Jetty” on the shores of the Great Salt Lake is a visual rumination on the fact that “the world is slowly destroying itself… The catastrophe comes suddenly, but slowly” (Julavits).25

Reflecting on expansion and contraction—the spiraling gyres of the physical universe—in an unpublished fragment of *Whales and Men*, McCarthy writes, “If this looping process is the way it works then there’s no need for teleology.” As Smithson himself made clear, the Spiral Jetty sculpture is as much about creation as destruction. And McCarthy’s vision for the great loop of chiral destruction and creation is made clear in *The Road*: “Perhaps in the world’s destruction it would be possible at last to see how it was made. Oceans, mountains. The ponderous counterspectacle of things ceasing to be. The sweeping waste, hydroptic and coldly secular. The silence” (231). Here, again, is Gardner’s exploration of worlds and antiworlds—“at the extreme limit of the expansion our world will enter a space-time singularity” where contraction begins, the arrows of time reverse, and “The universe, in brief, will turn into a time-reversed world of antimatter” (294). This speculation is not particularly new—as Gardner points out, Socrates speculated on such cycles of reversal in *The Statesman* dialogue. Indeed, the writer’s vision is closely akin to Smithson’s “Spiral Jetty”; Smithson once described the postindustrial landscape as “ruins in reverse.”
Picture 4: “The pin has been pulled from the axis of the universe” (The Crossing 146). Public domain photograph from Wikipedia of sculptor Robert Smithson’s (right-handed) Spiral Jetty, deemed a “profound monument to catastrophe” by New York Times writer Heidi Julavits.

Perhaps we might even speculate that our felt sense of profound mythos, and whatever logos that reason may extract from the world, has its underpinnings in the chiral dance of symmetry and asymmetry. Indeed, everything is moving, and we feel it in our deepest substance. Poetry often intuits what science says in a different idiom, and vice versa. If evolutionary theory is a way of exploring the memory of life in the universe, writ large, then poet Katherine Larson wants to show us “Memory. The invention/of meaning. Our minds with deeps/where only symbols creep” (“Ghost Nets,” section XI)—whether they are expressed in mathematics or some other semantic. Manmade labyrinths, which are often designed as a form of spiritual exercise, generally demonstrate chirality in their winding; the movement transcends semantic meaning.

We, and the stuff we are made of, wander, spin, gyre, and turn. We may long for wholeness and symmetry, but we cannot deny our asymmetry or the tilt and motion of our cosmos, our atoms. McCarthy’s imagination has a turn in it, too, and for attentive readers it opens up the mysteries and essential importance of chirality in both the spiritual and material dimensions of the human journey.

Picture 5: Stone at the entrance of the Newgrange Tumulus (c. 3200 BC), Ireland, presenting both dextral and sinistral helices. Photograph by the author.
Picture 6: Zoomorphic petroglyph of Coiled Snake, Nine Mile Canyon, Utah. From the 970 West Digital Collection, Mesa County Public Library. Photo copyright Randy Langstraat; reproduced by permission of the photographer.

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NOTES

1. The author is indebted to Katherine Larson and Sarah Huber for thoughtful discussions and guidance on the topic of chirality and asymmetry in evolutionary biology. Also to the students of Baylor’s graduate English program, Joseph Vuletich, and Michael Crews. And to Martin Gardner, for being Martin Gardner.

2. See Gardner, Chapter 18.

3. My own journey into the astonishing regressions and expansions of chirality began with the detail from that opening passage of *Suttree*, prompting me to ask, with child-like insistence, a series of why questions to any expert who was patient enough to offer a reply: why do so many living things favor asymmetry in a certain direction? Is it that way everywhere? What causes the bias? Why do compounds tip that way? And so on. Following the why through the hall of mirrors led me to the limits of what is known about the origin of things and to long-forgotten lessons in organic chemistry, and finally, to a presentation of my findings as an invited lecturer in American studies at Baylor in early 2015. This article owes much of its substance to that fascinating exchange and to colleagues who enlarged my understanding of the evolutionary biology of chirality. But its genesis is ultimately in McCarthy’s scientifically observant eye for detail—indeed, a lowly plant on one of his pages—and his ability to recast the all-too-familiar in the vivid light of literary imagination.

4. A recent number of *The Philosophical Transactions of the Royal Society B* was themed on “Provocative questions in left–right asymmetry” and compiled and edited by Michael Levin, Amar Klar and Ann Ramsdell. While shedding new light on the topic and bringing Levin’s research up to date, it also demonstrates that many of the fundamental riddles of chirality remain unsolved. This itself is somewhat astonishing: given the current intimacy of our molecular scrutiny of DNA, one might expect that the genetic mechanisms of direction, which would seem necessarily to inhere in the first construction of living things, to have been outed by now. But this has not happened.

5. Louis Pasteur was another pioneer in the concept of chirality, having discovered that differently polarized suspensions of crystals rotate life differently—clockwise and counterclockwise, according to optical rotation. He correctly inferred that something was going on at the molecular level.
6. According to its online publisher’s overview of the journal’s aim and scope, “The main aim of the journal is to publish scientific work on the role of molecular asymmetry in both biologically active and non-biologically active molecules in respect to their pharmacological, biological, and chemical properties. Drugs, pesticides, and other xenobiotics will be a major interest” (Chirality).

7. It remains true, however, that brain asymmetry remains the most compelling explanation for handedness, since language and fine-motor control are located in the left hemisphere of 97% of human brains—and the left hemisphere controls the right hand. On the other hand, fMRI brain scanning is rapidly changing and complicating the nuanced understanding of where certain brain functions typically take place.

8. Among the unproven theories: the influence of the earth’s electromagnetic fields.

9. Though hardly dispositive of that theory, the percentage of left-handers in the mentally developmentally delayed population is 20% (vs. 10% in the population at large), and among the severely delayed, 28% (Riehl 189).

10. The summary of Krutch and quoted text is from Crews (2017, 196-98).

11. Curiously, this tendency against purely racemic distribution of compounds is itself a feature of living things. And the fact that chirality of compounds changes very gradually after death is what allows for the carbon-dating of organic materials.

12. I am speaking here of ordinary time in human experience, without reference to relativity or the five (or more) arrows of time that physicists describe. Interestingly, the laws of nature are symmetrical with respect to time, with the notable exception of the second—entropy is conserved.

13. Here I am using the second register of logos, per Merriam-Webster: “reason that in ancient Greek philosophy is the controlling principle in the universe.”

14. Michael Crews writes of this passage, “McCarthy’s gestalt cosmology derives from multiple sources, but the archives confirm Teilhard de Chardin is one of them” (272). Of course, the singularity of stories has long been a matter of intrigue for literary critics and psychologists. For a relatively recent entry in this vein, see Christopher Booker’s The Seven Basic Plots: Why We Tell Stories (2004).

15. For his part, Martin Gardner, a masterful logician and investigator of all things chiral, conceded, “I don’t think there’s any way to prove the existence of God logically” (qtd. in Yam).

16. McCarthy uses the term “logos” repeatedly in both his unpublished and published writing. See Gienzsa, “Last Roads Taken.”

17. In terms of chirality, it is interesting to consider which of these belong on the left, and which, on the right. Many, it will be observed, do not submit easily to such alignments, and can be flipped. It is to be hoped that the valences of these terms, and the usefulness of their arrangement, will be worth contemplating. The slant of it could be important.

18. See Gienzsa, “‘Shall not the Judge of all the earth do right?’”

19. The laws of thermodynamics play a part in this as well. Viewed in the long arc, we would expect systems to move away from complexity and organization. David Layzer’s well-known Arrow of Time argument attempts to reconcile the general trend (movement toward chaos) with spurts of increasing order.

20. All quotations from Whales and Men are from the typescript that is available in the Cormac McCarthy Papers, Box 97. Southwestern Writers Collection, The Wittliff Collections, Alkek Library, Texas State University-San Marcos.

21. Compare Beckett’s 1949 declaration of his artistic creed to Georges Duthuit as “The expression that there is nothing to express, nothing with which to express, nothing from which to express, no power to express, no desire to express, together with the obligation to express” (Beckett 103).

22. Case in point, from the essay: “Those disturbing dreams which wake us from sleep are purely graphic. No one speaks. These are very old dreams and often troubling. Sometimes a friend can
see their meaning where we cannot. The unconscious intends that they be difficult to unravel because it wants us to think about them. To remember them. It doesn't say that you can't ask for help. Parables of course often want to resolve themselves into the pictorial. When you first heard of Plato's cave you set about reconstructing it."

23. The tormented heretic of the chapel-keeper's tale in *The Crossing* admits, after attempting to interrogate God in every imaginable way, that "in the end... no man can see his life until his life is done and where then to make a mending?" (156)

24. As articulated in *A Vision* (1925), W. B. Yeats was fascinated by gyres, which are chiral coils.

25. See Smithson's 1972 essay, "The Spiral Jetty." As Robert Kosky notes, "He says he was seeking 'red'—described by G.K. Chesterton in the essay's epigram as 'the most joyful and dreadful thing in the physical universe... the place where the walls of this world of ours wear the thinnest and something beyond burns through.'"

ABSTRACTS

*Chirality* is the property of the handedness of things. The first half of this paper looks at the science of chirality, and the second half at how it is manifested primarily in *Suttree*, one of Cormac McCarthy's novels. Chirality and the interplay of symmetry and asymmetry is a transformative concept in nature, in human experience, and in the philosophies of deep-seeing writers. There is strong evidence confirming McCarthy's interest in chirality, including archival notes on the subject that were eventually translated through his fiction. Understanding chirality in turn reveals new dimensions of scientific and philosophical meaning in McCarthy's work, including his investigation of free will, chance, and determinism; his interest in narrative, consciousness, and evolutionary theory; and his search for a logos—a universal ordering principle in both the material and metaphysical worlds.

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**Keywords:** chirality, evolutionary theory, mirror-image asymmetry, logos, narratology

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