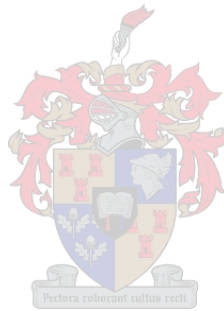# Complexity and Hermeneutic Phenomenology

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**Dissertation presented for the degree of Doctor of Philosophy
at the University of Stellenbosch**

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Co-supervisor: Dr. T. de Villiers-Botha

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DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: November 24, 2008

ABSTRACT

This thesis argues that the study of the brain as a system, which includes the disciplines of cognitive science and neuroscience, is a kind of textual exegesis, like literary criticism. Through research in scientific modeling in the 20th and early 21st centuries, among with the advances of nonlinear science, and both cognitive science and neuroscience, along with the work of Aristotle, Saussure, and Paul Ricoeur, I argue that the parts of the brain have multiple functions, like words have multiple uses. Ricoeur, through Aristotle, argues that words only have meaning in the act of predication, the sentence. Likewise, a brain act must corporately employ a certain set of parts in the brain system. Using Aristotle, I make the case that human cognition cannot be reduced to mere brain events because the parts, the whole, and the context are integrally important to understanding the function of any given brain process. It follows then that to understand any given brain event we need to know the fullness of human experience as lived experience, not lab experience. Science should progress from what is best known to what is least known. The methodology of reductionist neuroscience does the exact opposite, at times leading to the denial of personhood or even intelligence. I advocate that the relationship between the phenomenology of human experience (which Merleau-Ponty explored famously) and brain science should be that of data to model. When neuroscience interprets the brain as separated from the lived human world, it "reads into the text" in a sense. The lived human world must intersect intimately with whatever the brain and body are doing. The cognitive science research project has traditionally required the researcher to artificially segment human experience into it pure material constituents and then reassemble it. Is the creature reanimated at the end of the dissections really *human* consciousness? I will suggest that we not assemble the whole out of the parts; rather human brain science should be an exegesis inward. So, brain activities are aspects of human acts, because they are performed by humans, as humans, and interpreting them is a human activity.

Acknowledgements

Many supporters, counsellors, and friends made this research project possible. I am deeply gratetful for the patient supervision of Willie van der Merwe. During the five- year journey, which led to the present work, at every step of the way, he has been *the model* doctoral supervisor. Tanya de Villiers-Botha, my co-supervisor, who joined this project mid-way helped me with detailed comments on the thesis text, and challenged my case an many helpful points, making certain decisive portions of the manuscript more effective.

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During the latter stages of this thesis project I was invited by the United States Joint Forces Staff College to research and lecture on the problem of scoping complex systems for military operational planning and combat modeling. This invitation let me test the Hermenuetic Phenomenology of Complex Systems in an arena outside of cognitive science and neuroscience. I am grateful to COL Craig Bollenberg, Dean of the Joint and Combined Warfighting School, for his invitation, and to LT COL Matthew Deller, my sponsor and research partner on the project. I am also grateful for the helpful interaction with LT COL Jack Klein, LT GEN Paul Van Riper, LT COL Christopher Prigge, and LT COL Sean Deller, as well as the entire faculty of the Joint Forces Staff College who put the Hermeneutic Phenomenology of Complex Systems to the test of real-world engagement.

Brian Steverson and Bruce Williams generously granted me a leave of absence from teaching duties, which gave time for my research residency. The idea to engage with Aristotle's *On the parts of animals* came from conversations with Michael Tkacz. I'm grateful to Sean Dorrance Kelly for insisting that I deal with Artificial Life, not just rule-based and connectionist approaches to cognitive science, and that suggestion paid of significantly in the course of the research, especially when considered in dialogue with Aristotle. Emily Racek helped both by running library errands for me and proof-reading the manuscript. Though this dissertation is wholly my own work, this project's success is most certainly a group effort, which would never have reached completion without the warm and loving support of my wife, Jennifer, and our two boys, Jackson and Ben.

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INTRODUCTION

In sciences founded on opinions and dogmas, the use of anticipations and logic is good;
for in them the object is to command assent to the proposition, not to master the thing.
Francis Bacon, The New Organon (1960, 45)

In 1998 a print debate between Jean Pierre Changeux and Paul Ricoeur was published under the title *Ce qui nous fait penser: la nature et la regle.* Two years later Princeton University Press brought this book to the English book market under the title *What makes us think?: a Neuroscientist and a philosopher argue about ethics, human nature, and the brain* (Changeux 2000). This notable debate pitted Changeux, an eminentimmanent neuroscientist, against Paul Ricoeur, one of the most competent and articulate philosophers of the 20th century; a man who comprehended both the history of philosophy's great conversation and the minutiae of significant contemporary philosophical debates. Changeux summons a lifetime of neuroscientific research to defend the thesis that "[c]onsciousness occurs in the brain" (Changeux 2000, 52). Ricoeur, on the other hand, argues that the discourse that concerns brain events and discourse that concerns the human person may not be collapsed into one another. He rejects Changeux's reductionist project, and stands within the historic tradition of phenomenology to contend that the human person cannot be reduced to brain states.[1] Phenomenology is the philosophical school of thought founded by

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[1] Changeux's phrase "consciousness occurs in the brain" appears in this context:

Edmund Husserll which, broadly understood, aims at distilling the essences of the objects of consciousness in the mind, and also " inquires into the structures formed by essences" (Grossmann 1995, 659).

The interchange depicted in *What makes us think?* is emblematic of a greater debate: a dialogue between philosophy and neuroscience that threatens the historic project of philosophy itself, most significantly that of Husserlian phenomenology. Tom Wolfe (2000, 91), the insightful American novelist, observes that neuroscience has assumed a hegemony among the disciplines, and now claims authority to pontificate about the full human condition with an audacity previously claimed by philosophy (Wolfe 2000, 91). Neuroscience, however, seems to transcend philosophy's admittedly speculative approach by using data gained in experiments to found its conclusions. By appealing to empirical data, neuroscience promises real answers to questions which philosophy traditionally has only been able to offer reasoned guesses and hunches. Changeux employs this very strategy with Paul Ricoeur, answering him blow for blow, like Archimedes against Marcellus' siege, with a hail of scientific stones, an avalanche of data that leaves the din of argument silent in its aftermath. Ricoeur is outmatched in the encounter. While Ricoeur moves effortlessly through the thought of Spinoza, Aristotle, Kant, Descartes, and the phenomenologists, he is on shakier ground in dealing with neuroscience. *What makes us think?* forces Ricoeur, in his winter years, to engage an opponent who possesses a lifetime of graduate student research projects and his own personal reading of the field. Ricoeur manages to retool, but Changeux's command of the experiment catalogue grants him great rhetorical force, a matter I will cover in greater detail in chapter 3.

What makes us think? presents the battle between philosophy and neuroscience in a manageable scope, permitting one to survey the action on the field, like Xerxes seated upon his throne. But though this debate may seem distant, reserved for specialists, it is one profoundly and intimately near each human being. Each human has a body, made of parts – among them, the brain. How does its work relate to the whole of the body? Or to human experience? How is one to interpret the brain's participation in the complex system of the human person? These questions are at the heart of the debate between Changeux and

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"Ricoeur: But the cortex will never figure in the discourse of one's own body.
Changeux: For an extremely simple reason: there are no sensory endings in the cerebral cortex, whereas there are in the rest of the body. When we have a headache, we do not feel pain in our neurons but rather in the meningeal envelope that protects our brain. One can introduce a scalpel into the brain and remove a piece of the cerebral cortex without the subject feeling pain. Moreover, most surgical operations done on the brain are done with the patient awake. Precisely in order to prevent the essential functions of his cerebral cortex, such as the use of speech, from being altered the surgeon talks with his patient to describe what he or she feels, to pronounce words, to think about

Ricoeur. I believe the interchange shows remarkable insight on the part of both debaters, for each sees an important perspective necessary to make such a dialogue possible. Changeux strenuously maintains the need to take laboratory observations and records seriously. Ricoeur, with equal force, defends the unity of the human person, and reject the possibility of finding the personhood of the human in some collection of chemical process in the brain. However, it seems—at least to me—that the rhetorical weaknesses in Ricoeur's case do not stem from a weakness in his arguments. Rather, Ricoeur does not fully exploit what I will call *a hermeneutic phenomenology of complex systems*, which is implicit in Ricoeur's work (more in chapter 3). A hermeneutic phenomenology of complex systems (hereafter HPCS) permits the *interpretation* of system events, using the principle of distanciation (see chapters 4, 6, and 7), which designates the way in which an event can cause other events that both relate to their source, but are also creative new productions. So it is that a HPCS permits the opening of systems to human understanding and provides an epistemological tool for understanding the relationship between parts and wholes.

Therefore, this dissertation has a primary goal and a secondary goal. The primary goal is to vindicate Ricoeur's hermeneutic phenomenology in its dialogue with neuroscience[2]. I will take up Ricoeur's case against Changeux's reductionism in a way that engages the experimental data of neuroscience. I do this because it seems to me reductionist neuroscience presumes a view of the relationship between mind and body which compromises a correct understanding of the body's relationship to the mind. Neuroscience is, of course, an enormous field, so I will limit the scope of the dialogue to Changeux's articulation of the reductionist position. Changeux's prominence in the field makes my interaction with him emblematic of interaction with the field as a whole, while still remaining faithful to the limit of scope imposed by a dissertation project. My goal will have been met when I am able to provide a Ricoeurian account of the five "advances" of neuroscience which Changeux uses as his leverage in his debate with Ricoeur. My

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something while the operation takes place. Consciousness occurs in the brain, but we have no conscious perception of our brain!" (Changeux 2000, 51-52).

[2] It should be noted here that neuroscience is a multifaceted field, fraught with controversy. There are of course those who approach neuroscience in a way that rejects the possibility of reducing human personhood to some localized patterns in the brain. For an example of brain science approached through an antireductionist approach see Andy Clark (1997). However, Changeux presents himself as representing the advancing discipline of neuroscience as a whole (Changeux 2000, 41-69), with passion and force. Changeux's assessment of the tone of the discipline is not off the mark. I will be arguing that even if some events, critical to consciousness, occur in the brain with seemingly no connection to the rest of the body, it is not reasonable to make the leap that these kind of brain events warrant identifying consciousness as located in the brain, any more than sound can be said to be located in the ear (as some ancients seem to have thought). In taking Ricoeur's side in the debate, I am also having to reply to Changeux's caricature of neuroscience, and indeed I am aiming to present

secondary goal, one that serves the first, is to develop a hermeneutic phenomenology of complex systems. A HPCS will bring Ricoeur's thought to terms with neuroscience, and also with economics[3], patent law[4], philosophy of science[5], strategic modeling[6], and many other fields that engage the study of complex systems. A HPCS then is a tool invented for the work of this dissertation. However, it is by no means restricted to the domain of the dialogue between hermeneutic phenomenology and neuroscience.[7] Brain science studies a complex system, of course.

The project of understanding complex systems requires more than mere number crunching. The latter half of the 20th century saw the explosion of complexity research, and this boom was ignited by the development of a powerful research tool: the computer. When a system's data can be reduced to numbers and variables, computer modeling promises success, especially in modeling the behavior of physical systems. The complex systems of the material world seem easier to model than those of what Edmund Husserl called the *Lebenswelt*, or the life-world. Husserl develops the concept of the life-world in *The Crisis* (Husserl 1970). R. Philip Buckley (1992, 93) trenchantly summarizes Husserl's concept when he writes

> The most general definition of the life-world is that it is the world of everyday experience, the concrete world, the "real" world. Husserl also likes to describe it as the world which surrounds us daily, and thus it is a world that is familiar to us. It is the world which is close-by and it is a shared world, one that is inhabited by other subjects. It is the world within whish one has one's life, with all its suffering and joy, expectations and disappointments, small mishaps and major catastrophes, comedy and tragedy.

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a rival approach to that of Changeux which itself is, I trust, faithful to the experimental reports of brain science.

[3] See chapters 2.3.2 and 6.5.

[4] If prices are acts of discourse then patent claims are also events which open a world of human action to interpretation. In particular, they are economic fictions which permit ideas to have value and be traded, while interrelating to one another as contrasting values due to a competitive marketplace. Hence, intellectual property is another relevant area in which the concepts discussed in chapters 2.3.2 and 6.5 can be applied.

[5] Chapters 1, 2, 3, 5, and 7 will address the application of a HPCS to the philosophy of science.

[6] See 6.5.

[7] Moving beyond neuroscience for a moment, a HPCS may prove quite useful for life in the growing complexity of our global world. The increasing complexity of the human world, especially the massive collection of data generated by human interaction through electronic communication, demands that interpretive systems be developed so that humans can command complexity rather than be overcome by it. Ironically, the technology that was supposed to make data collections more manageable has given us too many data sets to manage.

The material world, it would seem, is far less ambiguous, less dependent on one's perspective to be understood. On a first encounter it appears that one's understanding of the physical world must be somehow fixed and less subjective, the kind of thing ripe for the univocal expressions of mathematical modeling. The human life-world seems fraught with complications: multiple perspectives, contrasting view points, and somehow the plurivocal nature of these contrasting view points is necessary to even make sense of human systems. In economics, for instance, the market price of an item occurs when the wills of the buyer and seller meet in a consensual asset transfer from one to the other. The public transaction of property establishes market price, but that price cannot be understood outside of the "perspectives" of the buyer and seller. Inside the lived human world, economic quantities are being transacted and recorded, indicators developed, as though economies were weather patterns with "barometers". Yet, though economies are in some ways like weather systems, those similar properties in economies subsist for very different reasons than do those of weather systems. For one, an economy's properties are rooted in the way they arise out of the human life-world.

At least in some *rudimentary* fashion weather patterns, ecosystems, and the development of neural pathways in the brain can be modeled mathematically. However, the complex systems of the phenomenological world of human experience present more challenges. Economies, so-called natural language, corporate interaction, the development of organizational leadership, the establishment and decline of political power, the sociology of knowledge, and opposing forces at war with one another all embody complex systems. These systems challenge complex modelers because human ignorance is *part* of the equation, part of the *system*. The "subjective", or put another way the *phenomenological*, is one of the motive forces which make life-world systems function. Knowledge and desire possessed by individuals both give remarkable advantages to players in economies, corporate interaction, leadership, politics, etc. The natural world, as best as we can tell, does not function based on ignorance or passion as the life world does. So it appears the two worlds, the physical world and the life-world, are distinct realms, where never the twain shall meet.

Are the complex systems of the physical world and the *lebenswelt* wholly different? In this dissertation I will argue that they are not so different. Simply put, I will argue that *hermeneutic phenomenology, especially represented of the work of Paul Ricoeur and his model of the text, can model both types of complex systems.* It seems to me that the model of the text helps to bridge the gap between the descriptive work of mathematical modeling and the recognition of what lies behind the numbers. While mathematical modeling is helpful, it is by no means an end in itself. This dissertation will explore the question of how

discerning causes in both the natural and human world is a human hermeneutic activity, one requiring more than mathematical modeling.

Of course there are many complex systems in this world and we are probably quite ignorant of a good many of them. Also, in general, it is impossible to know the totality of a given system when the system is not studied from its genesis, thus researchers are partially ignorant of even the ones they do know—weather systems and economic systems both offer great examples of this feature. Having good system indicators does not necessarily mean that the future states of the system can be known with any precision. One can set up a weather instruments on every square acre of land on the continental United States and still not have the precision to predict the weather. What about all the atmospheric conditions *between* the instruments? The unmeasured portion of the system plays a part too. This feature of complex systems means it is simply not possible for me in this dissertation to evaluate all complex systems and prove that hermeneutic phenomenology can model them all. Instead, I will focus on the current nexus of complexity systems research—brain science. In this way, the primary mission of vindicating hermeneutic phenomenology over the criticism of Jean-Pierre Changeux and the secondary mission of articulating a HPCS synergistically serve one another.

I will argue that the discipline of neuroscience is a hermeneutic enterprise, like textual exegesis or like literary criticism. Through Aristotle, Saussure, and Paul Ricoeur, I will make the case that the parts of the brain have multiple functions, like words have multiple uses. Ricoeur, through Aristotle, argues that words only have meaning in the act of predication, the sentence. Likewise, I will argue a brain act must corporately employ a certain set of parts in the brain system. Using Aristotle, I will make the case that it is absurd to reduce brain acts to a merely connectionist[8] model because the parts, the whole, and the context are integrally important to understanding the function of any given brain process. It follows, then, that to understand any given brain event, we need to know the fullness of human experience as lived experience, not lab experience. Science should progress from what is best known to what is least known. This principle underlies the appeal to empirical observations as the source of knowledge for understanding the physical world. If science proceeds the opposite way, from what is least known, then it proceeds from ignorance. The methodology of reductionist neuroscience does the exact opposite, at times leading to the

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[8] By writing this, I am not denying either that connectionism is a helpful hypothesis or a useful research program. However, the approach developed in this dissertation aims to appreciate and find common ground for several rival approaches, one of which is connectionism.

denial of personhood or even intelligence.[9] I advocate that the relationship between the phenomenology of human experience (which Merleau-Ponty famously explored) and brain science should be that of data to model. When neuroscience interprets the brain as separated from the lived human world it "reads into the text" in a sense. It treats the brain disconnected from its instrumental function. The lived human world must intersect intimately with whatever the brain and body are doing. The path of interpreting brain activity as though brain science can artificially segment human experience into its pure material constituents and reassemble it makes for a makes for a wandering journey. Is the creature reanimated at the end of the dissections really *human* consciousness? I will suggest that we cannot assemble the whole out of the parts, rather human brain science should be an exegesis inward. In some fashion the brain is instrumental for the human to act in his or her embodiment. So, brain activities are aspects of human acts[10], because they are performed by humans, as humans, and interpreting them is a human activity.

The divide between Changeux and Ricoeur may be further clarified when one returns to the definition of phenomenology. Some have treated phenomenology as descriptive only, but I will not be taking that view here. Of the definition of phenomenology, Dermot Moran writes:

> Phenomenology is usually characterized as a way of seeing rather than a set of doctrines. In a typical formulation Edmund Husserl… in his late work *Crisis of European Sciences and Transcendental Phenomenology*… presents phenomenology as approaching "whatever appears to be as such", including everything meant or thought, in the manner of its appearing, in the how (*Wie*) of its manifestation. (Moran 2002, 1)

Likewise, this dissertation will discuss a way of seeing the brain in its relationship to the body and the person. In *The Crisis*, Husserl (1970) is at pains to challenge the dichotomy that arises from the so-called egocentric predicament, which separates lived human experience from the natural world, erecting a barrier between the human world and the natural world. For Husserl this dichotomy threatens the study of phenomena as humanly understood, as "seen as." Thus, the present work does not aim to reduce phenomenology to a mere data

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[9] Consciousness and intelligence are not the best known areas of neuroscience; in fact they are subjects of great controversy. However, humans are well acquainted with being conscious and having intelligence. The challenge that consciousness and intelligence present to neuroscientists does not undermine the given that consciousness and intelligence are preconditions to the very discipline of neuroscience. If humans were not conscious or intelligent, they could not study brain activity.

set for brain science to model, for such a move would miss the global concerns which Husserl so carefully expresses in the Crisis. Phenomenology[11] can do much more.

In my dialogue with Changeux's work, I aim to achieve the opposite: not to situate phenomenology within brain science, but to situate brain science within phenomenology, a task which is nigh impossible if phenomenology is defined as a philosophical discipline which *merely* describes the essences of objects of consciousness. Therefore, I will situate brain science within hermeneutic phenomenology, which takes seriously not only the intentional quality of human thought, but also its referential quality. *This study, then, aims to locate brain science within hermeneutic phenomenology by developing the outline of a hermeneutic phenomenology of complex systems through Ricoeur's model of the text.*

A HPCS opens a door in the Kantian style watertight compartment between the natural world and the lived human world, without collapsing one into the other. Since mathematical models have proven so successful in describing the physical world, I should note that I will not be arguing that the mathematical modeling of complex systems is inferior to that of the hermeneutic phenomenology I propose -- merely different. Computer-aided computation fills in some missing data points that help researchers better understand complex physical systems like weather, ecosystems, and the physical processes in the brain. But there are other complex systems that do not reduce well to computer modeling, though they do reflect the complex elements of physical systems. In economic systems, real people only occasionally act like the little rational actors some economic models say they should be. In military application, one's enemies rarely submit to being modeled. According to Milan Vego, "The enemy cannot be viewed as a system of systems. Humans are not machines. They do not behave the way one wants them to behave. The enemy has a will of his own and is bound to respond to one's action, regardless of one's real or perceived superiority" (Vego 2006, 19). Enemies do not want to be modeled, and in war-fighting situations they work hard to make the task impossible.

Furthermore, I will narrow the scope of my study by making five assumptions:

1. This study assumes a non-reductive physicalism. For our purposes the person is constituted in the body, not in some "thinking thing", as Descartes would have it, separate

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[10] For more detail on this point see chapters 6 and 7.

[11] Phenomenology should not be confused with phenomenalism. Phenomenalism is the doctrine that physical objects can be reduced to sense impressions. In contrast to phenomenalism (as I mention in the text), phenomenology, broadly understood, aims at distilling the essences of the objects of consciousness in the mind, and also " inquires into the structures formed by essences" (Grossmann 1995, 659). Thus, metaphor and narrative can be analyzed through phenomenology, while it is clear that phenomenalism would lack the tools to study metaphor and narrative. Neither metaphors nor narratives are directly accessed by a sense experience (though they do employ knowledge of the

from the body. I have no intention to argue for the existence of a Platonic soul, and the like. For purposes of argument, a person and his or her body designate the same substrate.

2. Also, in the matters that this research treats, it will be assumed that Paul Ricoeur's hermeneutic phenomenology is more or less correct. The thesis that the model of the text can model complex systems is so vast, so broad, that rigorous action must be taken to limit its scope. While I do not agree with every last thing in Ricoeur's work, in the matters discussed here, I will assume that he is more or less right about interpretation, discourse, polysemy, his critique of structuralism, and the outlook of his general project. At some points I may disagree with Ricoeur. For instance, I do not support his full strategy which he employs in his dialogue with Jean-Pierre Changeux (2000). But I criticize Ricoeur, not on the basis of some gross problem in his philosophy, but rather for not fully employing the resources available to him from his own philosophical work.

3. This study takes as given that *function* is the teleology of *process* as *meaning* is the teleology of *discourse* (see chapters 6 and 7). Here Aristotle and Ricoeur find strong common ground in the analogy between Aristotle's notion of the "embodied end" (Checkland 1999, 29-30) or *entelecheia* and Ricoeur notion of the "towardness" of discourse. Of course teleology is a controversial topic. The question of teleology is a very difficult one for the natural sciences, even though the sciences use the language of teleology frequently, sometimes with apologies and embarrassment.[12] I will treat teleology as a heuristic for opening a hermeneutic phenomenological approach to complex systems. A full defense of natural teleology would be its own research project, its own dissertation. Lennox (2001, 146-148) shows how Aristotle's notion of *entelecheia* goes beyond *energeia* (energy or actuality) to refer to complete actuality, which unifies an organism such that where *entelecheia* is present, an animal can be thought to have a soul. Indeed much of Aristotle's *On the parts of animals* aims to carefully develop the interrelatedness of the animal body, which one calls life (for more discussion of this point see chapter 5). The parts operate together in such a way that they cease to be parts, and instead take on a nature which can be given the name of single unified creature. Likewise, Ricoeur (1974, 87) describes language in a similar way:

> This advance of (ideal) meaning toward the (real) reference is the soul of
> language…. the ideal meaning is a void, and an absence which needs to be

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world gained by some sense experience). It follows then that phenomenalism is an incomplete conceptual framework for this study.

[12] For example, Patricia Churchland and Terrence J. Sejnowski (1996, 69) write, "There is nothing mystical about characterizing a biological structure as having a specific function, even though neither god nor man designed the structure with a purpose in mind. The teleological trappings are only that…."

filled. By such fulfilling, language comes into its own, that is to say, it dies to itself.

We see then that Ricoeur's notion of reference shares much with the goal-directed nature of *entelecheia* in Aristotelian substance.

4. This project also assumes that a distinction must be made between the hard data of brain science and its interpretation. While this may seem obvious, my reading of brain science literature has taught me that often the interpretation of the physical data of brain science becomes characterized; for example, Jean-Pierre Changeux claims that the brain projects itself into the world (2000, 41-47). This kind of a statement carries with it a host of assumptions: for one that the projection is accomplished by a part and not the whole system, also that the seat of this projection is an organ, not a person. When pontificated by an eminent neuroscientist, these assumptions are granted iconic status. The case presented here cannot be refuted merely by appealing to commonly held ideas with in the community of neuroscientists, as though the interpretation of that community overturns any other way of interpreting the hard data of brain science. Experimental data has often overthrown the theories held by scientific communities (see Kuhn 1970); therefore, the formulations of a scientific community (neuroscience) cannot be methodologically maintained as a kind of authoritative *ex cathedra* rubric to bar another discipline (phenomenology) from engaging with its subject matter. The mere opinion of a community cannot function as a full warrant for a truth claim, especially the scientific community which is by no mean homogenous in its opinions and reading of experimental data.

5. From the outset I maintain that this HPCS is an incomplete work. The material presented here is the beginning of a research project, with many different tributaries that flow from it. As we pass areas that could lead to further insights, I will specify various further research projects that go beyond the scope of this study.

Given these assumptions, I will develop my argument first with a survey of the major concepts or areas that will be integrated, namely: model theory, neuroscience, Ricoeur's model of the text, and Aristotle's theory of substance and part. The last two chapters will draw these conceptual fields together into one image.

The first chapter will define *model* and *complex system*. I define a *model* dialectically, as both a thing and an action. Firstly, a model is a thing, whether mental or physical, that humans use to represent other things, generally things we desire (1) to become, (2) to understand, or (3) to have or accomplish. Secondly, a model is a mode of action. Models embody purpose while being instruments of that purpose. In short, models are both things that represent and modes of human action, namely goal directed representations. The term

model is difficult to define because there are many kinds of models: scale, analogue, mathematical, metamathematical, scientific, heuristic, and paradigm models, for example. Max Black, Mary Hesse and Paul Ricoeur show that models are metaphor-like, if not metaphors themselves -- saying something "is" and "is not" at the same time. I define complex system according to Paul Cilliers's 10-part definition, and then distinguish complexity theory, nonlinear science, and complex systems, making it clear that I will only be addressing the latter. I conclude the chapter showing the necessity of developing a non-mathematical (not anti-mathematical) approach to modeling complex systems by using the example of price calculation (a mathematical activity) in a socialist economy (certainly a complex system) to show that causes are understood through different means, not only by means of mathematical calculation (though math is certainly useful in some respects).

The second chapter discusses neuroscience, specifically in a way to bring it to terms with Ricoeur's hermeneutic phenomenology. Paul Ricoeur faces problems in his debate with Jean-Pierre Changeux because he does not articulate the hermeneutic phenomenology of complex systems latent in his philosophy and because he permitted direct evolutionary interpretation of brain function (direct in the sense that Heideggerian ontology is a direct interpretation[13]). Brain science can be brought to terms with a hermeneutic phenomenology of complex systems in two ways: The first is that in the way words have a plurality of uses (which Ricoeur labels *polysemy*) the parts of the brain, at every level and in the interaction of different levels, show a plurality of uses, a kind of *functional polysemy*. Secondly, the three models that interpret brain science, namely rule-based, connectionist, and Artificial Life models, each aim to account for different aspects of brain function, but they do not necessarily comport with one another, and Ricoeur's work is used to show how this is the case. Finally, the direct application of evolutionary theory as a model is bracketed on the warrant of the concerns raised by Jerry Fodor and John Searle.

The next chapter offers an overview of Ricoeur's model of the text. A hermeneutic phenomenology of complex systems draws on Ricoeur's notion of symbol, polysemy, discourse, metaphor, the model of the text applied to human action, and the process by which narrative unites multiple, apparently unrelated elements in a non-univocal unity.

The fourth chapter develops Aristotle's theory of substance and part. The development of complex system study has called into question the positivist skepticism toward causation that reigned in the early 20th century. Aristotle, a substantial conversation partner in Ricoeur's work, develops his theory of causation into a theory of complex systems

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[13] See the extended discussion of this point in chapter 4.

in *Parts of Animals*[14], introducing the distinction between *substance* (whole) and *meros* (part). The interrelation of causes between wholes and parts gives rise to two important aspects of complex systems: first, that the parts have multiple teleologies (functions); and second, that a fifth cause, an instrumental cause, comes into play and seems to draw on all four causes without collapsing fully into any one of them. This fifth cause shows how the polysemy of the concept of model is unified in a theory of five causes. As will be shown, the unity of the polysemy of modeling is the scientific counterpart to the mimesis of the poetics of narrative.

In the fifth chapter, I show how the model of the text hermeneutically "opens" complex systems, preserving the relationship between part and whole without separating them or reducing one to the other. Ricoeur's hermeneutic phenomenology accomplishes this for neuroscience because it draws together the discordant features of the rule-based, connectionist, and Artificial Life approaches while supplementing the apparent problem areas of each approach. Hermeneutic phenomenology takes symbols seriously, developing its theory of discourse via a detour through structuralism (thus Cilliers's work applies to a hermeneutic phenomenology of complex systems). Also, part and whole are drawn together both in discourse and narrative, opening the possibility of a hermeneutics of systems. The model of the text draws together the reconfiguring relationship between word polysemy (from structuralism) and predication (from Aristotle), while also preserving an interpretive context for the event of predication. Furthermore, the application of the model of the text to human action shows that Ricoeur's model transcends mere text, and the exegesis of human actions, in part, aims at the exegesis of cause. Human actions require exegesis because their cause is hidden to immediate observation, and we find this same need in understanding the nodes of complex systems.

Finally, the sixth chapter draws together all the separate colors of my argument into one picture, placing neuroscience within hermeneutic phenomenology. While Ricoeur says that brain science and hermeneutics are irreconcilable discourses, a detour through a hermeneutic phenomenology of complex systems permits the data and models of brain science to be brought to terms with hermeneutic phenomenology through Ricoeur's theory of metaphor and narrative. Science can be brought to terms with mimesis$_1$, or *historical* narrative (Ricoeur 1984, 54-64) and mimesis$_2$, or *fictional* narrative (64-70) since science invents hypotheses (fictions) and then tests them through experiments, which are created natural histories. Therefore, science employs both, becoming a mimesis$_3$, which appropriates both (71-87). I show that narrative is logic-rich and that the project of

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[14] This dissertation will use the translation by James Lennox (2001) unless otherwise noted.

neuroscience requires a unity of natural histories in experiments and personal testimony to model brain events. Furthermore, neural images and other scientific evidences are shown to be system events, performed by humans, and thus they are like inscribed text, which can hermeneutically distanciate from its author --something made possible because human brains are in *people*. The implications of a HPCS may be traced through the five warrants that Jean-Pierre Changeux offers for positioning neuroscience over phenomenology, namely: the nature of the brain as a projective system, neuropsychology, brain imaging, electrophysiology, and the relationship between chemistry and mental states. The hermeneutical activity of neuroscience is shown to be predicated on the unity of a person interpreting, the data, research, sensation, etc. Therefore *non-reductive* neuroscience is a species of hermeneutic phenomenology applied to the natural world.

To avoid prolixity, let us begin by seeking a clear definition for both *models* and *complex systems.*

CHAPTER 1

The problem of modeling complex systems: part one

'All truth is simple.'—Is that not a compound lie?—
Friedrich Nietzsche, Twilight of the Idols (1998, 5)

1. INTRODUCTION

This chapter and the one that follows will explain the problem of modeling complex systems. The first chapter will define "model". The second will both define "complex systems" and present a case for why they must be modeled though non-mathematical (not anti-mathematical) means. Though these chapters will not engage brain science[15] in particular, they will set the framework for the third chapter, which will survey the fields of neuroscience and cognitive science. In the in the introduction to this dissertation, I explained that this work is dedicated to taking up the cause of the late Paul Ricoeur in his debate with eminent French neuroscientist Jean-Pierre Changeux, a task which necessitates that

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[15] I use the term brain science here, and at several points throughout this dissertation, as a general term which includes both neuroscience and cognitive science. I'm adopting this convention from Sean Dorrance Kelly (2001) who uses the term "brain science" as his term of choice throughout the book, because he understands the interrelatedness of both neuroscience and cognitive science, and that the precise assignment of both terms is some what of a parochial academic debate. If a hermeneutic phenomenology of complex systems were only to address cognitive science which in large measure focuses on modeling human thought (whatever that may be), then phenomenology would remain relegated to one methodology among many in the so-called "human sciences". For this reason in this chapter I will be pursuing Ricoeur's hermeneutical, phenomenological analysis of the scientific model, and scientific models are used to understand both the physiology of neuroscience and the cognitive operations studied in cognitive science.

neuroscience and cognitive science be addressed. While these two domains may overlap some in the literature, I will use the term *neuroscience* to designate the discipline, which aims to give an account of how the physical processes of the brain occur chemically and electrically. I will use the term *cognitive science* to refer to the modeling of human cognition, thinking. Because the physical processes of the brain are most certainly involved in thinking, these two disciplines cannot be wholly separated. Both involve the making of models for the purpose of understanding, and both are attempting to understand the behavior of complex systems. The terms "model" and "complex system" must be defined if the mission of this work is to be accomplished, if hermeneutic phenomenology is to engage brain science.

Much of brain science involves modeling. The anatomical study of the brain does not open its operation to view. Even the tools of lesion studies, electrophysiology, PET cameras and fMRI require the interpretive work of scientific and conceptual model building so that the physiology of brain function may be understood. The attempt to model the operation of the brain has given rise to at least two major models for understanding cognition: the rule-based model, or so-called "computational theory of mind," and the connectionist model, which has met extensive success in creating neural nets that can mimic certain isolated actions that humans perform, apparently cognitive actions. Thus, it would seem, a hermeneutic phenomenological approach to neuroscience must be able to encompass both modeling, and to some degree, systems studies   .

Admittedly, the terms "model" and "complex system" are notoriously difficult to define, and, if Ricoeur's insights on metaphor and systems (in his case, linguistic and cultural systems) are correct, the univocal language of mathematics may be so "precise" that it is actually *imprecise* for the purpose of modeling complex systems. The situation in the sub-discipline of philosophy of mind would be made all the more precarious if an impoverished understanding of "model" or "complex system" were to disallow access to knowledge necessary for understanding cognitive function in the human person.

Likewise, brain science requires an understanding of how complex systems operate and how one can model them. After all, the brain is itself a complex system, and certainly the most complex physical system humans have studied. This much is certain. Not only does the functioning of an individual brain require an understanding of a complex system, but it is equally true that the brain participates in many other complex systems: so-called natural language, economic transactions, even international political behavior. For hermeneutic phenomenology to successfully engage brain science it seem necessary that it be, at least in principle, able to intelligently represent, or illumine, models of several complex systems. A hermeneutic phenomenology of complex systems must fill a tall order.

This goal of modeling complex systems immediately presents us with two significant problems. The first comes from the work of Thomas Kuhn. Though he claims he did not intend it, Kuhn's *The structure of scientific revolutions* (1970) fixed a wedge between scientific modeling and the real world that scientific models supposedly describe. For Kuhn, a scientific paradigm is a belief in a particular model (1970, 246). However, scientific paradigms are usually multifaceted.[16] The geocentric view of the solar system explained the world with a kind of simple elegance, but the geocentric model still contained many parts, each working together with the others in certain patters. The heliocentric model, at least at the time of its inception, also used the same parts, but arranged them differently. These two examples illustrate how models are not isolated items, but rather are in some sense systems (a point that will be echoed by Mary Hesse below). The connection between models and paradigms, in the context of Kuhn's work, naturally leads to the question of whether paradigms affect the interpretation of complex systems. But at least the natural world seems to testify to its own complexity in a way that transcends any one model for that complexity.[17] "Nature" is filled with many complex systems including ecosystems, weather systems, the hierarchical organization of organism life, neural networks, even the human body. The discipline of natural science employs models that simplify natural processes removing irrelevant information.[18] To build these models scientists use the cloister of the laboratory to remove the natural subjects of study from the undue influences of a teeming natural world.

The second problem is more significant than the first—complex systems seem impossible to model because models simplify complex things. When complex systems are simplified, the very quality of the system, which distinguished it from a simpler system, is removed. A modeler who uses such an approach invariably destroys what he or she intended to model. *This is the central problem of modeling complex systems.*

Likewise, the project of modeling complex systems necessitates that *models* and *complex systems* be defined. The task of developing definitions here is difficult because of

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[16] In this paragraph I go on to explain that paradigms are multifaceted models to some degree. The project of the present work aims to develop something of a universal model of complex systems through the resources of the Ricoeur's model of the text. The reason why I believe this move is a successful one, is that natural language exhibits rich hermeneutic phenomenological resources which open systems to accurate interpretation. Natural language makes this possible because it combines in one gestalt, both a whole and its parts, without reducing one to the other. In fact each depends upon the other. Natural language is a model which contains multiple models, following the definition of model which I offer below.

[17] This is a difficult claim to make with any finality, since it may not be a property of the world itself, but rather our ignorance of its full complexity, consider the contrasting atomic models of Niels Bohr (1934) and David Bohm (1993), or whether light is a particle or a wave.

[18] Notice that the relevance or irrelevance of information depends upon the needs of the researcher. If a researcher were to answer a different question from the one he or she is trying to answer in the

the enormous literature and controversy associated with the philosophical work of trying to understand both models and complex systems. What is more, the definitions of these two terms need to be formulated in such a way that they permit the task of modeling and the subject of complex systems to meet one another. While it is beyond the scope of the present work to present a full history of the philosophical discussion about modeling or the development of complexity theory, it is appropriate to set in context our development of the concept of modeling and the identity of complex systems amidst developments that gave rise to the clarification of each. It will also be important to engage in limited interaction with key conversation partners that have advanced both areas of study.

In what follows I will first explore what it means to model something by considering the work of Max Black, Ian Barbour, Theodore L. Brown, Mary Hesse, and Paul Ricoeur. This discussion will establish that there are many different kinds of models and modeling activities. I will reserve a discussion of the actual unity of these activities, around a central vision of what it means to model, for Chapter 4 of the present work, but the first part of this chapter will present the building blocks necessary for the synthesis that I will develop later. I will show how Ricoeur is situated between Barbour's unity of metaphor and myth and Brown's account of the scientific model as an extension of Lakoff and Johnson's theory of the conceptual metaphor. I will then follow with the subject of complex systems and give a brief introduction to the history of complexity theory, culminating with the presentation of Paul Cilliers's ten-part definition of a complex system. With these two definitions in place, it will be possible to more clearly state the problem of modeling complex systems to which this work is directed. I will close this chapter using the work of Austrian economist Ludwig von Mises to show that computation alone lacks the necessary complexity to model complex systems.

2. WHAT IS MODELING?

I define a *model* dialectically – in two ways that are not intelligibly separable. A model is simultaneously a thing and an action. First, a model is a thing, whether mental or physical, that humans use to represent other things, generally things we desire (1) to become, (2) to understand, or (3) to have or accomplish. Second, a "model is not simply the *entity* we take as a model but rather the *mode of action* that such an entity itself represents. In this sense, models are embodiments of purpose and, at the same time, instruments for carrying out such purposes" (Wartofsky 1979, 142). Models fail as models if they do not

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moment, the "irrelevant" information could be what the researcher most needs. This observation

stand for something one wishes to become, to understand, or to do. A model, to be a model, must have a goal. Models are tools. They embody a purpose. In short, and for now, models are both representations of human actions and modes of human action, namely goal-directed representations.[19]

This two-fold definition encompasses the pluriform work of modeling and the many varieties of models. We can model things within the human psyche, or those of the physical world, but these human artefacts are always made for a human purpose. Return for a moment to the object definition of a model: a thing, whether mental or physical, that humans use to represent other things, generally things we desire (1) to become, (2) to understand, or (3) to have or accomplish. The following examples illustrate the applicability of this definition. When a Buddhist monk aspires to live life with the compassion of the Buddha, he is using the Buddha as a model (1) of the selfless person that he wants to be. Ideally, when a physicist chooses the Bohr quantum model (2) over the Bohm model, she does so because it better explains the atom. When a young basketball player studies Michael Jordan's famous slam dunk from the free throw line in order to duplicate the same remarkable feat, he is using Jordan's slam dunk as a model (3). However, these categories of models need not be completely isolated from one another. Let us return to the example of Michael Jordan. The young basketball player can use Jordan as a model of accomplishment in two senses: The process of Jordan leaping is a model (2), but so is his accomplishment, "the slam dunk," a model (3), since it is the product that the young player wishes to accomplish for himself. So it is that a model of accomplishment has both the sense of process, or system, and product. Additionally, Michael Jordan is also a model (1) in the first sense, as the kind of player a young man may want *to be* himself.

3. VARIOUS KINDS OF MODELS

Clearly, the polysemy (the quality of apparently multiple legitimate meanings) of "model" demands that the word be defined like Aristotle's definitions of "good" and "happiness"—in a way consistent with the pluriform nature of the modeling enterprise, which must appreciate the multiple aims humans may have. In the same way that humans can be inspired by a model, like a young basketball player may be inspired by Michael Jordan, humans can also be dehumanized by their models, especially (though not necessarily) by scientific models. This dehumanization results from the inescapable polysemy of modeling,

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supports the definition of *model* which I will give below.
[19]Through Ricoeur's development of *mimesis*, a model is better seen as a redescription, but for now this definition is adequate to interact with Black and Hesse.

as I indicated above—a model that was intended for one purpose can be used for another. For example, this happens when, say, some interconnected neurons are modeled as a neural net (Def. 2 and 3), but then that system model is held up as a paradigm of what humans are and should be seen as ultimately (Def. 1). Such is a short but, I believe, accurate description of Jean-Pierre Changeux's (1985b) project in *Neuronal Man*. However, at this point I must leave Changeux's thesis and the critique of it for other chapters in this dissertation, since almost the full economy of the present work is directed toward challenging his position.

Philosophers of science have carefully parsed both the activity of model building and the products that emerge from that labour to help meet some of the issues related to the use of models in science. For example, some may ask: Is it possible to know nature directly? Or must it always be modeled to be understood? Or, are scientific models and metaphors basically the same thing? If we are to understand these and other philosophical issues related to models, it is important to carefully consider each of the different kinds of models. Rom Harre, in *The principles of scientific thinking*, gives an nearly exhaustive taxonomy of models (1970, 33-62). The following taxonomy of models is drawn from Max Black (1962, 219-243) in consultation with Harre[20] among others. In the following overview I will describe scale models, analogue models, mathematical models, metamathematical models, scientific models, heuristic models, the employment of a scientific theory as a model, and finally, paradigm models. Each of these models, as I mentioned above, represents the thing being modeled, but each does not accomplish that task in the same fashion, nor do they draw on the same resources to accomplish their task.

3.1 SCALE MODELS

Scale models reproduce the relationships between the various parts of the original they represent, even thought the original dimensions are expanded or contracted. One can build a scale model of a double helix structure. Such a model would be an expansion of the original dimensions. Likewise one could make a scale model of an aircraft carrier that can sit on a desk or float in a bath tub. Such a model would need to contract the originals dimensions while retaining all the original proportions. Scale models generally fit Definition 2, but notice that a contractor who builds skyscrapers may have a model that fits both Definitions 2 and 3.

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[20] Though drawing on "Models and archetypes" (Black 1962, 219-43) as a spine for this section, I have reordered this introduction so that I can refer back to it in Chapter 4, fitting this exposition with my development of the five causes.

3.2 ANALOGUE MODELS

Analogue models find an analogy of characteristics between the model and the original that it represents. Analogue models are often found in literature and are called *types*, *type scenes*, and *motifs*. In literature, types are characters that compare favourably with other characters in the narrative, usually in a relationship of foreshadowing. A character that reverses the analogue model is a *foil*. Type scenes assemble a collection of stock character types and actions often affixed in a familiar setting. One modern type scene is the famous opening of the hard boiled detective genre in which a burned out detective wallows in his office, with a cigarette and a glass of whiskey, only to be interrupted by a damsel in distress. Another famous type scene, one used in adventure literature and action movies, is the arming scene, where in the hero arms himself for battle. Finally, a motif is a concrete object with thematic significance in a narrative. In the epic *Beowulf*, the swords are named, identifying them as motifs in the story.

Analogue models often help us understand a matter, (Def. 2). They can also inspire one to achieve when one finds an analogy between one's self and the model one wishes to emulate. Shame may also follow from the reverse situation. Analogue modeling leads to competition and the improvement of skill (Def. 3) by the same process that makes an analogue model that fits Def. 1. In the sciences, analogue models tend to be more abstract, since they require a certain set of qualities to be conceptually imputed from a source item or situation to the thing being modeled. For example, consider the celebrated gas molecule model, which describes the interaction of gas molecules as billiard balls.

3. 3 MATHEMATICAL MODELS

Analogue models, because of their metaphoric quality, are often easier to grasp than mathematical models, which, as a general rule, are even more abstract, since every part of a mathematical model is a mathematical object. Mathematical models are helpful because they quantitatively pinpoint the essence of a given object of study in the physical world. For this reason, Black recognizes that the very thing that gives mathematical models their greatest blessing also curses them: Mathematical models deal with quantities, not qualities (unless qualities can be reduced to quantities). Therefore, mathematical models are necessarily incomplete, a point that will be addressed more fully in chapter 2. Nature presents of nexus of features and behaviors that fit together in the multifaceted relationships one finds in nature, yet mathematical models are commonplaces in the sciences. Black understands that

[T]he drastic simplifications demanded for success of the mathematical analysis entail a serious risk of confusing accuracy of the mathematics with the strength of empirical verification in the original field. Especially important is to remember that the mathematical treatment furnishes no *explanations*. Mathematics can be expected to do no more than draw consequences from the original empirical assumptions. If the functions and equations have a familiar form, there may be a background of pure mathematical research readily applicable to the illustration at hand. We may say, if we like, that the pure mathematics provides the *form* of an explanation, by showing what *kinds* of function would approximately fit the known data. But *causal* explanations must be sought elsewhere. In their inability to suggest explanations, "mathematical models" differ markedly from… theoretical models…(Black 1962, 225-6)

In other words, mathematical models do not provide causal explanations, a point to be pursued at length near the end of chapter 2, when we consider Ludwig von Mises's economic praxiology and his critique of econometric economic methodology. For now, notice that mathematical models are descriptive only. They do not explain causes; they correlate quantitative data, without giving and explanation of reasons for *why* nature behaves as it does. Newton's equations do not tell us what gravity *is*. They only quantify the observed behavior of masses in motion (and light for that matter), and as such they help predict future behavior given accurate data sets. Mathematical models then are useful tools of scientific inquiry, not complete explanations of nature.

3.4 METAMATHEMATICAL MODELS

Mathematical models are readily used to describe the material world (Def. 2), but *meta*mathematical models do not describe the material world directly.[21] R. B. Braithwaite (1962) defines metamathematics as "the study of rigorous proof in mathematics and symbolic logic" (2). However, in metamathematics the term "model" has two senses. In metamathematics a "model" is "a structure that makes all of the sentences in a given theory true." (Lloyd 1998, 443) But, a "model" can also be "a realization of the axiom system of our theory, or, simply, that they satisfy the axioms" (Tarski 1965, 123). In other words, in

metamathematics, a model can be both the structure that produces a certain set of mathematical objects, or the result of the application of a given mapping assignment—a product, which means that mathematical modeling cleanly fits both senses of Definition 3: namely a thing representing what we desire to have or accomplish.

3.5 SCIENTIFIC MODELS

Scientific models may be subdivided into at least three major classes based on their various uses: (1) heuristic models help one understand, (2) existential models aim to be accurate descriptions of what exists; however, one can also use a scientific theory creatively as (3) a model promote scientific discovery.

3.5.1 HEURISTIC MODELS

The first class, heuristic models are models that illustrate a general concept, like the use of billiard balls to model the behavior of gas molecules, or the use of the solar system as a metaphor for the operation of the interior of the atom. They are often used in science education and may be mistaken in their details but in broad, general terms promote a greater understanding of a general scientific concept. Heuristic models are common in science classrooms especially in grade school where students are not yet capable of understanding the more complex and accurate model of a given phenomenon. Heuristic models need not be inaccurate, but their primary function is to promote understanding, not to be in and of themselves complete explanations.

3.5.2 EXISTENTIAL MODELS

The second use, or type, of model, the existential model, is used by those aiming to accurately describe some part of the world "*as it is*, and not merely offering mathematical formulas in fancy dress" (Black 1962, 229). One cannot consider Bohr's atom or Rutherford's model of the solar system and not think that Bohr and Rutherford believed that they were describing some fundamentally real thing in the universe. Black observes that they develop their models "not *by* analogy, but *through* and by means of an underlying analogy. Their models were conceived to be more than expository or heuristic devices" (229). For our

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[21] Nothing precludes them from being employed creatively to make arguments about physical systems.

purposes, it is important to recognize that brain science aims to develop existential models of human cognition.

3.5.3 Scientific theory as "model"

The final scientific use, or type, of model is the model seen as synonym for a scientific theory, say using the phrase "the evolutionary model" as opposed to "the evolutionary theory." While it may appear that these two phrases are synonymous, they designate two different things: *The theory of evolution* is a hypothesis, which ideally can be tested scientifically and evidenced by historical geology and other means. *The evolutionary model* takes the story presented in the theory of evolution and redescribes other subjects and other disciplines in terms of it. This same clarification can be seen in the contrast between quantum theory and the use of the quantum model. Quantum theory aims to make sense of a given set of data. The quantum model takes the story presented in quantum theory and reconstitutes it so that it can be reapplied in other domains, something that Heisenberg illustrates artfully in his book *Physics and philosophy* (Heisenberg 1993).

The terms *theory* and *model* can be used equivocally, since each can account for the unity among what may at first appear to be unrelated observations. However, a model is a structure which can leave its initial domain of observation and apply to other different situations, while a theory offers a specific account of its initial domain. Theories convert to models when people begin to use them to represent or redescribe domains beyond their initial domain, generally domains (or things) people desire (1) to become, (2) to understand, or (3) to have or accomplish. The social sciences often translate a theory in one domain in science and apply it to a domain of study beyond the theory's initial formulation, thus rendering it into a model (see Black 1962, 223). Black criticizes this tendency because the general application of a theory as a model removes it from the original field of investigation, and this extrapolation often requires the theory to be applied too generally and sometimes mistakenly (1962, 223).

3.6 Paradigm models

Finally, we have paradigm models, which exemplify a type in some way. These can be ideal forms or typical examples, and both roughly fit Definition 1. Paradigm examples fitting Definition 3 are moral examples and exemplary measures of achievement. Harre illustrates that we call a fashion model a "model" precisely because she presents a so-

called, or marketed, ideal of beauty, but he is also quick to point out that "model" here could just as easily be used to specify a model grandmother (Harre 1970, 37).

3.7 THE SIGNIFICANCE OF MULTIPLE KINDS OF MODELS

Why are there so many different kinds of models? An easy answer to this question might be that the suggested definition of model is imprecise or too inclusive. However, our look at the different contexts of the use of the term "model," demonstrates natural multi-valued uses of the term that seems bound around the definition I first suggested. Humans make models to represent other things, generally things we desire (1) to become, (2) to understand, or (3) to have or accomplish. The various examples provided above testify to the accuracy of the first half of this definition. These examples also illustrate that the definition is not too broad or imprecise, because these various examples cannot be collapsed into one another or subsumed under another definition without losing their meaning or their unique characteristics.

The second half of the definition is also supported by this catalogue of the types of models. A careful reading of the various types shows that the material used in one kind of model may well be used in another type. For example, one might use a mathematical structure as part of an existential model of some feature of the natural world. However, one might also just as well develop the model in a way akin to that used in making metamathematical models, except perhaps for the fact that metamathematical models have as their referent mathematical operations, where mathematical models can model physical things. Also, a young basketball player might study Michael Jordan as a paradigm model of the ultimate basketball player, but then apply the model to him by making his own actions an analogical model of Jordan's perfection. The same procedure is illustrated when a theory is lifted from its explanatory domain and used as a model in unrelated domains, a frequent occurrence in the human sciences according to Black.

Furthermore, the second half of the definition establishes the event-nature of models. Models, as actions, are events. The model only becomes a model when it is used by a human[22] for such a purpose. This event-quality of models helps to explain why there seems to be so many different kinds of models that use seemingly the same material, yet seem to

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[22] By mentioning humans here I do not mean to suggest that there could not be other sentient beings (though I remain skeptical about extra terrestrial life, and other fanciful notions). By this comment, I am distinguishing human model building from the accidental similarities that may appear in nature. Accidentally similar items are not necessarily models for one another. They do become models, though, when one human uses one to try and understand another. Thus models are actions, for their

assemble it in different ways or examine it on different levels. A metaphor might help here: consider the view through the lens of a microscope. The focus of a microscope has a very shallow depth of field. If the subject of microscopic examination is of any substantial mass, much of the structure of a microscopic item cannot be placed within the focus of a single plane, so the viewer must turn the focus on the microscope to bring the various levels of structure into focus. If the successive moments in time were not focused toward the same goal by the person looking into the microscope, the information from the various views could not be assembled into a clear "mental picture" of what the full microscopic object looks like.

The various types of models suggest the same kind of process is occurring in the various kinds of modeling. It is as through each type of model is focal plane for highlighting the features of a given thing one desires (1) to become, (2) to understand, or (3) to have or accomplish. I will build upon this point below, but for now it is enough that we highlight this feature of models.

It follows that both the making of models, and the models themselves, summon complex resources into a unity that retains its complexity *in the same event*. In the course of this study I will show how the property of model/metaphors being both simple and complex at the same time offers great promise for the modeling of complex systems.

4. PHILOSOPHERS ON MODELS

4.1 IAN BARBOUR AND THEODORE L. BROWN: SCIENTIFIC MODEL VS. METAPHOR

I will now show how Ricoeur's hermeneutic phenomenology echoes the conclusion of the previous section, namely that metaphors (and by extension, models) draw together complex resources into the unity of an event. Furthermore, the dialectic quality of Ricoeur's approach to phenomenology suggests that his model of the text has the resources to unify activities that philosophers of science may be tempted to divide into separate and seemingly unrelated categories. I will thus try to show how Ricoeur's work provides an ecosystem in which the various kinds of models can successfully contribute to the project of modeling complex systems without collision. After all, many different kinds of models, whether the mathematical formulations of nonlinear science or conceptual models like Warden's (2001) Ring Theory, can successfully model *some* aspects of complex systems. Thus the creation

existence rests wholly on the interpretive work, the interpretive event, of the active, learning, questioning human mind.

of a hermeneutic phenomenology of complex systems requires that I situate Ricoeur's analysis of metaphor within some of the 20th century's discussion of metaphor.

The contrast between the approaches to metaphor taken by Ian Barbour (1974) and Theodore L. Brown (2003b) will be helpful here. Both authors admit the challenge in coming up with a single univocal definition of "metaphor", and, before contrasting the two authors, it will help to point out their substantial overlap. According to Barbour (1974) metaphors and scientific models are closely related to one another. Barbour explains metaphor by its product, in which "a novel configuration has been produced by two frames of reference of which the reader must be aware" (13). According to Barbour, a metaphor is "*not literally true*", rather "it asserts that there are significant analogies between the things compared" (13). One cannot replace a metaphor with literal statements to get at what a metaphor communicates. Metaphors do something more than just convey a single meaning: they are *open-ended*, meaning that one cannot set a limit to how far the analogy in a metaphor may be applied (14). Brown (2003b) substantially echoes each of these points.

However, Barbour makes a clear division between a metaphor and a scientific model:

> Unlike scientific models, however, metaphors – especially in poetry – often have *emotional and valuational overtones*. They call forth feelings and attitudes. Metaphors are dynamic; language becomes an event. The reader is involved as a personal participant and is encouraged to draw from various dimensions of his own experience. Metaphor is expressive of the poet's experience and evocative of the reader's. But the presence of these non-cognitive functions does not require that the cognitive functions be absent. Metaphors influence perception and interpretation as well as attitude. [*emphasis his*] (1974, 14)

Two themes in Barbour should be highlighted. These two themes will better help to contrast Barbour with Brown. I will explain them, then introduce Brown's case for the use of metaphors in science and then contrast Brown and Barbour on these two points of difference. Firstly, Barbour distinguishes emotional and valuational overtones, suggesting that scientific models do not lead to these emotional or valuational overtones. Here we see the very influence at work on Barbour that he is fighting against, namely the positivist distinction between facts and values. He suggests scientific models deal more with the realm of facts, where metaphors lean more toward the realm of values and emotions. This same bias appears later when he distinguishes between cognitive and non-cognitive functions

being affected by metaphor. Developments in cognitive science have shown that "cognitive" function (reasoning) and "non-cognitive" function (emoting and valuing), are not so unrelated, and that the separation of the two seem "quite artificial" (Phelps 2004, 1013).

One may also look before recent developments in cognitive science to see that the stark separation of emotion and reason is unwarranted. For such an analysis we may return to Aristotle, who first organizes the science of logic in the western tradition. Aristotle treats the relationship between emotion and reason in his own corpus in his *Rhetoric* (Aristotle 1993e). Of course, rhetoric—the art of persuasion—must grasp the relationship between logic and emotion, and discern how to employ both together. If rhetoric cannot do this, it fails in its task and proves itself a useless subject of study (at least if one studies it for its original purpose). Thus, we may expect Aristotle's own analysis of emotion in his *Rhetoric* to be helpful here. Furthermore, since it is his analysis of metaphor which Ricoeur (and this chapter) will draw upon as a starting point for inquiry into the subject, we would do well to heed to his remarks on the subject. In Aristotle's analysis of rhetorical pathos, he argues that whether effecting calmness or anger in one's audience, one still affects the emotions (1378a 31-1380b 33). We observed above that Barbour treats scientific modeling as a kind of activity which does not move the emotions, but Aristotle wisely observes that some discourse is crafted to calm the emotions, that is, to permit rational clarity. Such discourse is still thoughtfully interacting with the emotional state of one's audience. Aristotle (see *Rhetoric* 1.1) clearly believes that of the three modes of persuasion—*ethos*, *pathos* and *logos*—the most important to Aristotelian rhetoric is *logos* (logic[23], for our purposes). Because models are in one sense human actions, they cannot be treated as though the human using them are not present. If human emotional states are understood as something we do not have until the passions are moved, my point here will be unconvincing. For Aristotle, humans are always in some sort of frame of mind, some state of *pathos*. The human is "feeling" in his or her frame of mind. Therefore, while it may be possible to discourse about logos and pathos as though they were separate, in reality they indwell and intermix one anther, without the one becoming the other fully. This permits Aristotle to go into great detail about the types of intentional cognitive states (thinking) that will lead to certain emotions (*Rhetoric* 2.2-11).

One may ask why Barbour then would rely so strongly upon distinguishing metaphor and scientific model by the emotional resonance of metaphor. Clearly both metaphors and

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[23] Certainly more underlies the term logos than simply what English speakers today refer to as logic, the science at art of correct reasoning. Logos in Greek use also referred to words, their content and use in discourse. Even a full treatment of just all the uses of logos in the Aristotelian corpus is beyond the scope of the present work.

scientific models will affect pathos if Aristotle's analysis is correct. What factor problematizes Barbour's domain of inquiry such that metaphor's defining characteristic is its power to affect the emotions? It would seem that the factor is this problem is the replacement of Aristotle's view of the interconnectedness of *logos* and *pathos* with a compartmentalizing of mind and its emotions, which Aristotle's definition precludes.[24] Thus, Barbour is mistaken when he distinguishes scientific models and metaphors by their emotional effects, for it is not the case that one affects the emotions and the other not, but that one can enflame the emotions (poetic metaphor) while the other (scientific modeling) promotes calmness and clarity.[25] We could just as easily claim that both are metaphor, which is exactly what Brown (2003b) will argue for below. If so, then it would seem that when the metaphor provokes an emotional response, we call it "poetic metaphor", but the distinction between the two is really quite artificial. For now I will just suggest it may be when metaphor opens nature to our understanding, we call metaphor a scientific model. I will make a case for this below.

Secondly, Barbour accuses metaphor of drawing from our embodied experience, whereas scientific modeling supposedly does not (1974, 14).[26] This powerful point seems clear enough. Poetic metaphor widely draws on human embodied experience to affect emotions and values, and apparently there exists a mostly watertight compartment between lived experience and lab experience.

Theodore L. Brown (2003b) takes issue with the view that science is not rooted in bodily experience. He does so to set up a beachhead for the advancement of metaphor into every area of science. Brown builds his case on the theory of conceptual metaphor developed by George Lakoff and Mark Johnson (1999, 1980). Lakoff and Johnson suggest that the brain "maps" conceptual domains onto one another to form concepts. This process of mapping is performed in a cognitive unconscious. Unlike Freudian unconscious (Freud 1957), which holds repressed sexual impulses (180-185), Lakoff and Johnson's cognitive unconscious is an assembler of concepts from the stuff of other domains of knowledge stored by the mind. The cognitive unconscious creates the brain's knowledge by continually forming concepts by mapping various domains onto one another.

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[24] Aristotle defines emotions as "all those feelings that so change men as to affect their judgments, and that are also attended by pain or pleasure. Such are anger, pity, fear, and the like, *with their opposites*" [emphasis mine] (1378a 20-23).

[25] I am not saying that *the* purpose of a scientific model is to promote calmness and clarity. Poets do not necessarily craft metaphors *just* to inflame the emotions. However, it is still accurate to say that scientific models do this as they guide the human mind to understanding.

[26] The resources of embodiment used in scientific Modelingmodelingmodeling will be discussed in the paragraphs immediately following. For a discussion of what makes lab experience, see chapter 7 of this dissertation.

Lakoff and Johnson present powerful case studies in which they show how many of the greatest ideas in the history of philosophy can be explained as the cognitive unconscious mapping one domain onto another. One particularly powerful example from *Philosophy in the Flesh*, Aristotle is shown to have built deductive logic on a containment metaphor (Lakoff 1999). The locations of the major, minor, and middle terms are treated through Aristotle's *Organon* as containers, which hold material for logical analysis. Lakoff and Johnson make the case that initial development of logic arose from mapping the containment metaphor onto language. In fact, in another work, *Where mathematics comes from: how the embodied mind brings mathematics into being*, George Lakoff and Rafael E. Nunez continue this analysis of the containment metaphor and apply and use it build and initial foundation for the claim that the human capacity for mathematical reasoning is rooted in metaphorical cognition(Lakoff 2000, 27-49). Furthermore, they make clear that this work of mapping domains requires the mapping of embodied life onto our more "mental" activities. Did Aristotle have to experience containers to come up with his metaphor of containment? On some level, yes. However a quick appeal to the matching of sense impressions in the mind, along the lines of what John Locke might suggest, grossly oversimplifies the process. Lakoff and Johnson want point out that the simplistic treatment of experience as a kind of brute sense data is hopelessly inadequate for understanding conceptual metaphor. They advocate an embodied mind, in which the mind's operations, even at their most abstract level, are accomplished through the body. According to Lakoff and Johnson, humans are able to reason because we have hands and feet, because we can sit close to an object and observe it from certain perspectives with our eyes. They advocate that the body is, in a sense, in the mind. The Cartesian separation of thinking and bodily experience, in the absolute terms which Descartes (1993) presents it, appears to be foreign to what is now known about cognitive function. Humans are not thinking things, separate from a body that senses. Thought and sense are wedded together, such that cognition of the one necessitates (speaking generally) cognition of the other.[27]

Brown applies the theory of the conceptual metaphor to the philosophy of science. Like Lakoff and Johnson's case studies of key developments in the history of philosophy, Brown applies the theory of conceptual metaphor to the history of science, demonstrating that the theory of conceptual metaphor accounts for everything from the development of the concept of matter, to molecular models in chemistry and biology, to cellular anatomy, and even global warming. In each case Brown is able to show that the basic components of the theory of conceptual metaphor are in play: first, a source domain that contains the qualities

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[27] For a seminal work arguing specifically for the embodied mind in greater detail than the treatment

to be mapped on the object one wishes to understand; second, a target domain that receives the mapping of the source domain onto itself; finally, an action that applies the source domain to the target domain. What arises out of this interaction is a new, illuminating concept.

It will help to look at each of these components of the theory of conceptual metaphor before moving on to Brown's application of them. The theory of conceptual metaphor starts with a source domain. The source domain is the thing which one wishes to understand. The source domain has various qualities or "entities" (Lakoff 2000, 42). These "entities" will differ on different items, but they act as hooks that join that particular source domain to the second domain, the *target domain*. These "entities" are then mapped onto the target domain such that the source domain is "seen as" the target domain, a process called *conflation* (42). So it is that "Each conceptual metaphor has the same structure. Each is a unidirectional mapping from entities in one conceptual domain to a corresponding entities in another conceptual domain" (42). Through this process of conflation cross-domain mapping occurs, and concepts are born.

This process of conflation is what makes the conceptual metaphor, which Brown argues is the heart of scientific modeling. Brown (2003b) uses the example of the ion channel (see figure 1.1), located in a cell wall, to explain the application of conceptual metaphor in science. He first uses Lakoff and Johnson's systems of distinguishing "source" (the domain that gave rise to the points of illustration) and "target" domains which I discussed above, those which are being used to illumine what the modeler is trying to understand (see figure 1.2).

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given by Lakoff and Johnson see Varela et al. (1991).
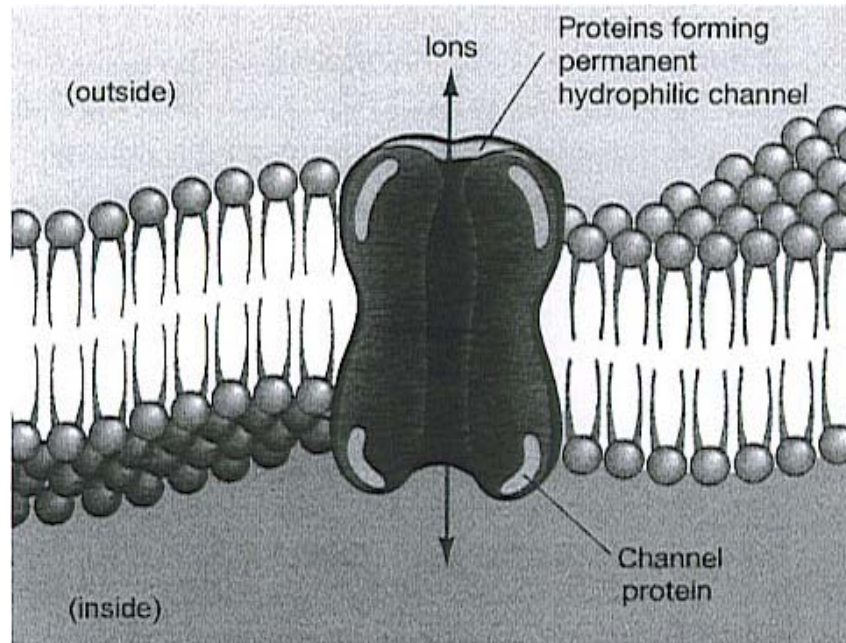
Figure 1.1. A textbook schematic of an ion channel. (Brown 2003a, 21, original source is G. Audesirk 1999, 75)

Source Domain	Target Domain
Channel	*Observations*
Narrow passage between two larger bodies of water →	Rapid transfer of ions between inside and outside of cell
Channel walls may be constructed →	Formed from substances embedded in cell wall
Channel width and depth constrain sizes of vessels that may pass →	Selective for ionic size or change
Channel may have locks or gates →	Ion passage can be blocked by certain chemical agents

Figure 1.2. A knowledge representation schema of the macroscopic qualities of the source domain being mapped onto to a microscopic target domain. (Brown 2003a, 20)

In embodied experience, we find that channels connect one body of water to another. Channels also can have walls, and the width and shallowness of a channel will constrain what kinds of vessels can pass through the channel. Brown points out that the qualities of the water channel common to those that have experienced channels are also the same qualities that apply to the target domain--what cellular biologists call the *ion channel*. Ion channels rapidly transfer ions between the "inside and outside of the cell" (18). The

metaphor of the channel moves the microscopic structures and their operation to the level of the macroscopic, a heuristically useful operation, in a way that holds consistently if the various "entities" in the source and target domains are mapped correctly as Fig 1.2 illustrates.

Brown (2003b, 22-24) also distinguishes visual metaphors from verbal metaphors. According to Brown, a visual metaphor includes both two-dimensional and three-dimensional representations. Consider the two different three-dimensional representations for the chemical structure of methane (CH_4):
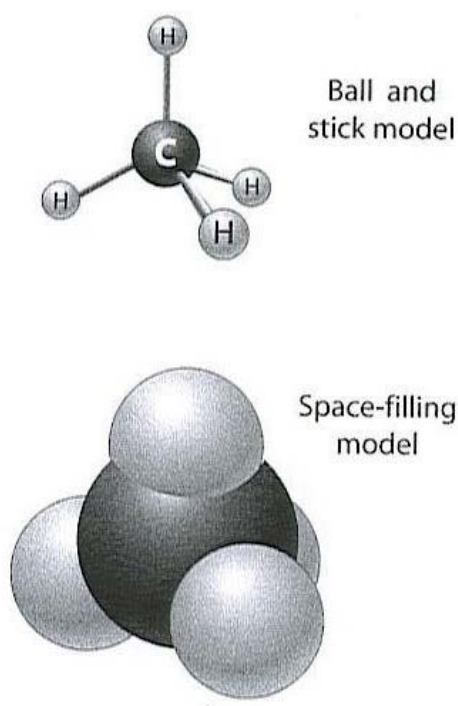
Figure 1.3. Two versions of a visual metaphor for methane (CH_4). (Brown 2003a, 23)

Each model is helpful in some ways more than others, and each emphasises aspects of the known structure of atoms within molecules. The stick model is correct, in so far as in accurately represents the three-dimensional structure of the atom. It also employs different colours to distinguish carbon from hydrogen. However the actual structure of the atom is more like the space-filling model, which accurately follows the van der Waal's radii, but makes it much harder to distinguish the chemical bonds of the molecule. The shape of the various atoms in the space-filling model, especially their rubber-ball-like quality is (scientists suspect) much more like the atomic surfaces found in nature. While the space-filling model does make clear that there are four hydrogen atoms in the molecule and uses the same

differences of colour to distinguish between hydrogen atoms and the carbon atom, it does not lend itself to be assembled with other molecules the way the ball and stick model does.

In either case though, the qualities from one domain are being mapped onto another. What is notable in this example is that we cannot "see" atoms. Chemists have strong warrant for thinking atoms have a round shape, just like space-filling model suggests. However, molecules do not "look" like the models used to illustrate them, which does not mean that the real molecule of methane is absolutely nothing like the models used to illustrate it. That is the point. The two models depicted in Figure 3 communicate something of the structure of methane, but neither one is complete enough to "say it all." Rather, some of the properties of one are being supplied to the other. What is happening here is that the source domain of methane itself is being mapped on to a visual representation of methane, when methane does not "look" like either of these models. We are so used to illustrations of atomic structures that the visual metaphor of the illustration never strikes us as being metaphorical, but if the theory of conceptual metaphor is correct, it follows that such is the case. Thus, the conceptual theory of metaphor suggests visual models are metaphors. `

Brown's use of the theory of conceptual metaphor replies to Barbour's two fundamental differences between the metaphor and the scientific model. If Lakoff and Johnson are even mostly right about the mapping of domains onto one another, poetic metaphor and scientific modeling are the same kind of activity, and likely are the same activity, minus the sociological structures and expectations of the scientific communities that contrast with those who read and enjoy poetry. Thus, it follows that the watertight compartment between "cognitive" (scientific) and "non-cognitive" (emotional/value) functions are not well applied distinctions when used to distinguish the scientific model and the metaphor, since it would seem that the mental operations underneath both processes are the same. Rather, the distinction between scientific model and poetic metaphor has little to do with the metaphor/model and more to do with how a metaphor/model is used in a rhetorical situation. Therefore, Barbour's first distinction between the scientific model and the metaphor fails. The second distinction suffers a similar fate. Lakoff and Johnson argue convincingly that the body is in the mind/brain and its operations. Far from the brain being some abstract computational mind, a kind of computer atop the shoulders, Lakoff and Johnson show that the all of human thought employs the body as the context of thought. Thought presupposes that an agent in a body is thinking. At least for the sciences, Brown's case studies confirm that the embodied cognition that metaphor requires is also at work in scientific modeling. Therefore, Brown confirms that scientific modeling and the making of metaphors are not separate classes of activity, but really one and the same activity, an activity that necessarily implies embodiment.

4.2 SCIENTIFIC MODEL AS METAPHOR AND THE DANGER OF ANTI-REALISM

Paul Ricoeur, in *The rule of metaphor*, develops the relationship between metaphor and referent by examining the relationship between a model and the thing it models. He begins by showing that Aristotle's classification of metaphor as a mere stylistic device (wherein one word is substituted for another to make a sentence more pleasant and memorable[28]) has led to centuries of misunderstanding on the nature of metaphor. Ricoeur goes back to passages in Aristotle's *Rhetoric* and *Poetics* where[29] Aristotle's admits deeper insights into the nature of metaphor, and builds upon those insights to argue that metaphor must be seen as both an act that substitutes one word for another, but also a creative predication which actualizes the potential latent in the system of *langue*, Saussure's term for the system of signs that make up a particular language which a lexicon might reproduce) through the transforming power of discourse (1983, 13).

Since discourse, in Ricoeur's view, is referential, he must offer some account of how a metaphor's apparently deviant predication refers to a nature beyond the system of *langue*. The predication is deviant, because it does not submit to the established network, or system, of sign relationships in *langue* (for a more detailed discussion of *langue* see chapter 6). To meet this challenge he turns to the relationship between scientific models and metaphors. Ricoeur is convinced that scientific models are in fact metaphorical, a conclusion he draws from substantially from the work of Black (1962) and Hesse (1966) discussed below. If scientific models are in fact metaphorical, it follows that if the making of models and metaphors is the essentially the same, then metaphorical truth is possible. Ricoeur is so convinced scientific modeling and metaphorical truth are connected that he underscores the connection in his chapter on the referent of metaphor by stating, "A detour through the theory of models constitutes the decisive stage of this Study" (239).

Ricoeur's connection of metaphor and scientific modeling seems to erode scientific realism, the view that scientific knowledge and things like scientific models actually point to and explain the natural world. Rom Harre (1970) raises just this criticism against models as metaphor. In his comprehensive treatment of the realist point of view in the philosophy of science entitled *The principles of scientific thinking*, he strongly criticizes the view that models are metaphors. To begin his criticism he introduces

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[28] See Aristotle 1412a 18-21.
[29] For an extended discussion and references for these points see the discussion of Ricoeur and Aristotle below.

an example like economic cycles, with its picturesque terminology of inflation and deflation, depression and boom. Somewhere in the background of this system of metaphors lies a model of the economy, and of trade-off, in which transactions are treated as the parts of some substance which can expand and contract, a model which no longer has an explanatory function.[30] The model offers us nothing by way of explanation and no existential hypotheses, but it does provide, in the system of metaphors, a picturesque terminology. Many metaphors are indeed just this, the terminological debris of a dead model. There has been a great deal of muddle about these distinctions, and some writers, particularly Poincare, have not succeeded in keeping the cases distinct. (Harre 1970, 47)

Harre's perspective assumes Aristotle's taxonomy of metaphor, the tangent point for Ricoeur's alternate approach to metaphor. If Aristotle's initial taxonomy is right, if metaphor is merely a stylistic device disconnected from logic, then it follows that metaphor can only promise to muddle the precision of science. Since Harre's overarching project is to preserve scientific realism, he must distance himself from the heuristic device of metaphor as source of any kind of explanation. Though later Harre (1970, 47f) goes on to soften his criticisms a bit, his central concern to retain scientific realism is certainly a reasonable one.

Metaphor is an integral part of Ricoeur's model of the text, so I cannot allow Professor Harre's criticism to go without comment. A more detailed reply will have to wait for the opening of Chapter 5, at which point a hermeneutical phenomenological foundation will have been poured and given a chance to harden. Here, it should be stated that since the aim of this dissertation is to develop a hermeneutic phenomenology of complex systems, it is important that we posses a theory of models that embraces a relationship between discourse and the real world. While the purpose of this dissertation is not to develop a theory of reference which explains how a metaphor can in fact be true (Ricoeur has already done that in *The rule of metaphor*), a proper understanding of metaphor will contribute to the application of the model of the text to complex systems in chapter 4.

As a realist philosopher, Harre aims to preserve scientific realism, and if the scientific model is a mere "metaphor", treated in the truncated way that metaphor has been throughout western intellectual history, then such a view on metaphor would undermine

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[30] With this sentence Harre refers to models which have been overturned by experimental evidence. As researchers come to understand systems better, models which seemed to account for some feature of the world no longer suffice for an account of the observed phenomena. Thus it can be said

Harre's scientific realist project. However, because Ricoeur rejects this truncated understanding of metaphor, it turns out Harre and Ricoeur represent a united front, and Ricoeur serves Harre as an ally, harnessing resources that Harre's analytic Aristotelianism cannot summon. In fact, Ricoeur's *The rule of metaphor* is a defence of metaphorical truth. Though one must use them with care, Ricoeur supports the view that metaphors can be not only beautiful--they can be *true*.

Since the present discussion engages the topic of metaphor, this is an appropriate point to meet Harre's concern and clarify the relationship between models and metaphors. Max Black, Mary Hesse, and Paul Ricoeur believe that we have good reason for seeing some sympathetic connection between models and metaphors, and so to their work we now turn.

4.3 MAX BLACK

Steering a middle course between the anti-model attitude of Pierre Duhem[31] and Lord Kelvin's[32] insistence on using model making as the test for the success of his scientific formulations, Max Black (1962) insists that the making of models and metaphors have a close kinship. Black defines a metaphor according to what he calls the "interaction view" of metaphor (Black 1962, 44-45): a metaphor is (1) a statement, with both principle and subsidiary subjects, (2) both of which can be regarded as "systems of things" rather than "things", (3) that applies the implications of the subsidiary subject to the principle subject, (4) consisting in commonplaces about the subsidiary subject, or suggestions by the writer, (5) and possibly suppressing certain characteristics of the primary subject, (6) and possibly even shift the meaning of words related to the primary subject, (7) without any blanket rules governing the success of the process. In short, a metaphor is a statement that uses apparently deviant predication to say something new and unexpected which illumines the subject of the sentence through a tension between that item and its partner in the comparison, that is both similar and dissimilar to that to which it is compared.

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that the model no longer serves an "explanatory function." For an extended discussion of how this occurs, see the classic by (Kuhn 1970).

[31] Noted philosopher of science Pierre Duhem argued that scientific understanding should produce mathematical descriptions and pristine logical constructions rather than the pleasantly heuristic descriptions of models. For example, Duhem writes, of the English who at the time were famous for making models, "in English theories we find those disparities, those incoherencies, those contradictions which we [the French] are driven to judge severely because we seek a rational system where the [English] author has sought to give us only a work of imagination" (Duhem 1962, 81).

[32] Lord Kelvin (William Thompson) was particularly famous, even more than the rest of Faraday's students, for wanting to illustrate more abstract discoveries about the physical world with both

Black makes the case that models are necessary in the scientific enterprise (1962, 219-243). He takes issue with the view that mathematical formulations are explanations. Above we observed that according to Black "mathematical treatments furnish no *explanations*." Mathematical treatments may *describe* observations but they do not give *causal* explanations. Black argues that metaphorical language does in fact give causal explanation. Rather than allowing analogy to be a mere heuristic device, he draws on Rudolf Carnap's (Carnap 1958, 75-77) discussion of isomorphism in symbolic logic[33] and shows that where isomorphism exists between the two fields of discussion, it is appropriate to model the lesser-known on that which is better known. The model can be carefully chosen to depict the relationships within a body of data, but there are no specific rules for generating a model. That labour depends, in large part, upon the thing being modeled. As Black explains:

> [T]he successful model must be isomorphic with its domain of application. So there is a rational basis for using a model. In stretching the language by which the model is described in such a way as to fit the new domain, we pin our hopes up on the existence of a common structure in both fields. If the hope is fulfilled, there will have been an objective ground for the analogical transfer. For we call a mode of investigation rational when it has a rationale, that is to say, when we can find reasons which justify what we do and that allow for articulate appraisal and criticism. The putative isomorphism between model and field of application provides such a rationale and yields such standards of critical judgment. (1962, 238)

Thus analogical transfer is possible and rational because of isomorphism.

Where does the material to create scientific models (and by extension *metaphors*) come from? Black argues that models not only organize data in a way that explains underlying causes, but that they also contribute to discovery. These pre-discovery "models" he calls *archetypes*. Something like Black's archetypes shows up in the work of Stephen

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conceptual and physical models. The passage mentioned in the note is the wind-up for Duhem's (1962, 81f) fervent critique of W. Thompson's penchant for model building.

[33] According to Carnap (1958, 75) isomorphism is in play when "we say that a two-place relation R is *one-many* (or *single valued* respecting its first-place, or *univalent* respecting its first place) just in case for each second-place member of R there is *exactly one* first-place member of R which bears the relation R to that second-place member." Later he goes on to say that "analogous concepts can be defined for relationships with three or more places." Carnap is, of course, framing his definitions for the field of symbolic logic, but Black recognizes that the definition Carnap uses still applies to the model and that which it models, if it is in fact a good model.

Toulmin. Toulmin suggests that scientific models not only help us interpret observed data but they also help us to rethink what we think we understand.

> The process by which, as we go along, fresh aspects of the model are exploited and fresh questions given meaning is a complicated one…. [O]ne cannot say beforehand which questions will and which will not apply, and it has to be discovered as time goes on how far the old questions can be given a meaning in the new type of context…. It is in fact a great virtue of a good model than it does suggest further questions, taking us beyond the phenomena from which we began, and tempts us to formulate hypotheses which turn out to be experimentally fertile.... Certainly it is the suggestiveness, and systematic deployability, that makes a good model something more than a simple metaphor. (Toulmin 1960, 37-39)

Black draws on Toulmin's observation to develop his theory of archetypes. However, he distinguishes his theory of archetypes from actual scientific models, since archetypes inspire elements of a model, but are not themselves fully assembled explanatory models. While there may be some latent system of concepts or ideas, there is no underlying structure. Black makes clear he is not speaking of metaphors (Black 1962, 241).[34]

> By an *archetype* I mean a systematic repertoire of ideas by means of which the given figure describes, by *analogical extension*, some domain to which those ideas do not immediately and literally apply. Thus, a detailed account of a particular archetype would require a list of key words and expressions, with statements of their interconnections and their pragmatic meanings in the field from which they were originally drawn. This might then be supplemented by an analysis of the ways in which the original meanings become extended in their analogical uses. (241)

Black supports this theory by offering the example of Kurt Lewin. At the opening of his *Field theory in social science*, Lewin clarifies his attempted scientific precision by strenuously attempting "to avoid developing elaborate models" (1964, 21).

Lewin, goes on to describe the work of his research team:

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[34] Black here is discussing the source of material for making metaphors. It is significant that metaphorical predication is not done in a vacuum, but rather is surrounded by a storehouse of archetypal material.

> [I]nstead, we have tried to represent the dynamic relations between the psychological facts by mathematical constructs at a sufficient level of generality. Only gradually, and hand in hand with experimental work, was the specification of the constructs attempted. To my mind, with such a method of gradual approximation, both in regard to the constructs used and the technical measurements in experiments, is by far the most cautious and "empirical." (1964, 21)

While Lewin is confident that he has avoided making models, Black rightly observes that Lewin's work is filled with words like "'field,' 'vector,' 'phase-space,' 'tension force,' 'boundary,' 'fluidity,' –visible symptoms of the massive archetype waiting to be reconstructed by a sufficiently patient critic" (1962, 241). Through Lewin's mistake, Black develops a helpful principle – we may even call it a warning. While archetypes may be inevitable, "The more persuasive the archetype, the greater the danger of its becoming a self-certifying myth" (242). This occurs when the archetype is "used metaphysically, so that its consequences will be permanently insulated from empirical disproof" (242). And one does not need to admit to or be aware of metaphysical use of an archetype to fall prey to it. This does not mean that archetypes should be abandoned. Rather one must be aware that a portion of the scientific project is accomplished with the human imagination. Science is not the bare collection and processing of laboratory data. It requires the human mind in its full capacities to assemble observations of nature and human action into models and intelligible schemas. This reality we need not fear. "The imagination is not be confused with a straitjacket… For science, like the humanities, like literature, is an affair of the imagination" (242-3). Models and metaphors alike flow out of the well-stocked mind, the mind filled and cultivated with the knowledge that makes for archetypes.

One may want to organize models and archetypes in terms of pros and cons, as though one could rank one above the other, but we can see from the above analysis that archetypes and models need not be considered in opposition to one another, as though each had pros or cons. Black's development of them may be likened to Ricoeur's analysis of the relationship between *langue* and discourse.[35] One cannot have one without the other. However, in the way that *langue* has no referent, archetypes are themselves not causal explanations; models do that work. Archetypes may be drawn from several sources; for

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[35] Langue refers to the system of words in a language, for example, what is recorded in a dictionary. Discourse refers to the use of sentences which themselves are the smallest unit of signification according to Aristotle. For an extended discussion of *langue* and discourse see chapters 4 and 6.

example, we may find them in a work of fiction, in some humanly manufactured tool, or even in some aspect of "design" in the natural world. It may also be the case that a theory can function as an archetype and be transformed into a model as seen in the catalogue of the various types of models (presented above). This could be valuable for the reasons Stephen Toulmin suggests above (1960, 37-39). Archetypes can guide further reflection and empirical inquiry, thus leading to new discoveries.

Black's willingness to link metaphor and scientific model may make him a trailblazer when his work is placed before the broadly deductive approach to science that claimed institutional orthodoxy during the first half of the 20th century. However, when set before the backcloth of the history of ideas, Black's theory of archetypes holds some affinity to the ancient idea of commonplaces in the rhetorical tradition of ancient Greece and Rome. While the study of logic today emphasizes the structure of arguments, and particularly the mission of discerning their validity or strength, the ancient study of logic also included the invention of arguments. This development of creative logic is seen in Aristotle's *Organon* which includes works like *Categories* (Aristotle 1993a) and *Topica* (Aristotle 1960), which present structures to help one develop knowledge about a subject. In explaining what the title *Topica* means, E.S. Forster explains that the name of this treatise, *topoi*, seems to refer to commonplaces of argument or general principles of probability, which stand in the same relation to the dialectical syllogism as axioms stand to the demonstrated syllogism; in other words, they are "the pigeonholes from which dialectical reasoning draws arguments."[36] This tradition of using stock structures to help formulate one's thoughts continues in Roman oratory. The famous and anonymous author of *Rhetorica ad Herennium* ([Cicero] 1989) crafted a compilation of rhetorical commonplaces designed to help students of rhetoric find material for their speeches. In the later Ciceronian *Topica*, which markets itself as a translation or adaptation of Aristotle's topics (I-II.8), Cicero offers numerous rhetorical commonplaces for invention that form a kind of creative logic (1954, 383-9). These approaches differ from Black's less organized and more diffused notion of archetypes because the classical rhetorical theorist's tools of invention are by no means vague and defused but clear; in Aristotle's case perhaps too clear and quantitatively overwhelming. These classical rhetorical theories of invention still retain an isomorphic relationship with Black's archetypes in that they serve to organize and develop new conclusions when their structures are applied to a given set of materials.

The interrelation of archetypes and models find some analogy with the interrelation of the various types of models and the information they bear, which I pointed to at the end of

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[36] Here Forster is citing (Ross 1960, 59).

the catalogue of the types of models. If my dialectical definition of models is correct (and it seems to be if we consider the ways English speakers use the word "model") it follows that models are information rich in a way that univocal predications are not. Also, it would seem that the project of modeling, if it requires the conjoining of systems, requires multiple project tasks which must be executed at the same time. This means that the human mind must be doing more than merely assembling univocal symbols through a single chain of computations, or something like that which the Turing machine though experiment[37] would suggest. The theory of conceptual metaphor offers one explanation for how these multiple project tasks are performed, namely that that these multiple projects are performed by a kind of unconscious cognition. Maybe the cognitive unconscious is assembling the conceptual metaphors and serving them up to us all *conflated* ready to cognize. Certainly the details of such a theory are difficult to prove *per se*. But even if this theory is correct, it would seem (in contrast with the Freudian motion of the Unconscious) the source materials for metaphor (we may call them archetypes) are not hermeneutically opaque to us. Hermeneutical reflection, and the study of metaphorical conflation open up the possibility of finding the origin of a metaphor's target domain(s), as we have already seen (see Lakoff 1980, Lakoff 1999, and Lakoff 2000). I will hint now, that this relation between metaphor and its source material will prove useful guide on the in the search for how to model complex systems. For now, it is enough to point to the multi-task quality of the project of making metaphors, but a separation of the project tasks must wait for chapter 4. If Black is correct, and if modeling permits access to different levels of focus, as I suggested earlier in this chapter, then models may be hermeneutically both simple and complex in nature (a nature that has historically been ill-defined), and as such, they may have the means to meet the problem of modeling complex systems.

4.4 MARY HESSE

Mary Hesse credits Max Black with "the interaction view", which she calls his "major contribution to the analysis of metaphor" (1966, 163). In her essay, "The explanatory function of metaphor," she aims to describe the scientific application of this interaction, namely, theoretical explanation "as metaphorical redescription of the domain of the explanandum" (157). Although she does not interact specifically with Lewin, Hesse takes specific aim at the kind of science that allegedly deduces its full content from empirical statements. Hesse builds upon Black's development of the interaction view of metaphor by

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[37] For more discussion see chapter 3.

first identifying a "primary" system, the domain of the explanandum, and a "secondary" system, "described either in observation language or the language of a familiar theory, from which the model is taken" (158). The language describing both the primary and secondary systems has literal meanings. At the same time, the interaction between the two descriptions gives rise to a different kind of meaning – a "metaphorical" meaning. These primary and secondary systems have bound about them an association of ideas and epistemic commitments. Therefore, it would be false to think that metaphorical meaning, arising from the interaction of these two systems, is merely a private matter. Rather, metaphor itself draws on common resources publicly owned within a linguistic community. Hesse writes,

> To understand the meaning of a descriptive expression is not only to be able to recognize its referent, or even to use the words of the expression correctly, but also to call to mind the ideas, both linguistic and empirical, that are commonly held to be associated with the referent in a given language community. Thus a shift of meaning may result from a change in the set of associated ideas as well as in change of reference or use. (160)

These conjoined systems are, of course, not literally conjoined together; rather, this is a fictive conjunction, or according to Hesse, a "redescription." But this redescription has its limits. One cannot take any secondary system and impose it a priori on a primary system, a move that would likely lead to absurdities (161). Metaphor transfers "the associated ideas and implications of the secondary to the primary system" (162-3). Here we see an idea that will be developed more carefully by Paul Ricoeur: the work of the metaphor is not so much the labour of substituting one word for another; metaphor is better understood as a kind of predication.

But how is one to understand that poetic expression and the scientific model are at the same time each using literal language and predicating metaphorically? This question will prove quite fruitful for Paul Ricoeur as he develops his model of the text. We will also find it quite fruitful for developing a hermeneutic phenomenology of complex systems. Mary Hesse makes an initial attempt to answer that question, and her insight will be picked up by Ricoeur in *The rule of metaphor*. She comments,

> An important general consequence of the interaction view is that it is not possible to make a distinction between literal and metaphoric descriptions merely by asserting that literal use consists in following linguistic rules.

Intelligible metaphor also implies the existence of rules of metaphorical use, and since in the interaction view literal meanings are shifted by their association with metaphors, it follows that the rules of literal usage and of metaphor, though they are not identical, are nevertheless not independent. (Hesse 1966:165)

It is significant that the rules of literal use and the rules for metaphorical use are different. If Hesse is correct, the rules for metaphorical use cannot be reduced to rules of grammar, or syntax. This observation by Hesse will be expanded and matured by Ricoeur into a carefully-wrought theory and model of the text.

4.5 METAPHOR AND REFERENCE IN RICOEUR

In chapter 3, we will return to the subject of metaphor as part of our exploration of the model of the text. Here it is useful to look at some aspects of Ricoeur's theory of metaphor that illumine the general question of modeling. Our discussion of metaphor and reference in Ricoeur should begin with the point of departure between Hesse and Ricoeur. Hesse believes that "in the end" the right answer to the question of metaphorical meaning is to identify that meaning with the primary system. Ricoeur takes Hesse's idea of *redescription*, in the strong sense, and reconstitutes his own account of metaphor in terms of it. If metaphor is a redescription of the explanandum, then a realist account of metaphorical meaning must find metaphorical truth in, or at least between, both the primary and secondary systems. If truth is only in either the primary or secondary systems, as Hesse terms them, then metaphors in some way distort the truth by saying that one thing is another. However, metaphorical truth necessitates that the *redescription of the explanandum* (the all together) be true.

But how is one to explain such an idea that requires one to stand between both the primary and secondary system and grip them both in the process of understanding metaphorical truth? Ricoeur explicitly makes clear that his concept of metaphorical meaning will also be explained in terms of metaphors. While his position here is not starkly opposed to anything Hesse claims, it is clear that Hesse takes greater care not to slip into metaphorical expressions in giving her own defence of her theories. Ricoeur appears to take the lead from Black's criticisms of Lewin and is more willing to function poetically to

make his points, for though he writes, on occasion, somewhat metaphorically, he is also very clear. At times too clear.[38]

Ricoeur follows up his discussion of metaphor, in which he interacts with both Black and Hesse, with a first move toward establishing some clear idea of *metaphorical truth*. For Ricoeur "The question may be formulated in the following manner: does not tension that affects the copula in its relational function also affect the copula in its existential function? In other words, does not the dual tension that links the subject and predicate also have a referential quality?   This question contains the key to the notion of *metaphorical truth*." He answers this question in three parts. First, Ricoeur does not distance himself from ontological vehemence.[39] Instead, he chooses to mediate it (Ricoeur 1977, 249). Ricoeur is a realist (see Ricoeur's "Reply to G. B. Madison" in Hahn 1995), but instead of taking Heidegger's short ontological route, he is instead taking a longer hermeneutic phenomenological route to ontology. For Ricoeur, the full connotative thickness of language makes it evident that language cannot be stripped to a kind of bare "meaning." The reader of a metaphor knows both the literal and metaphorical meanings of the expression being encountered. In the overused example "The man is a wolf" no one wonders what is designated by the word "man" or the word "wolf". Yet the reader understands that in the "tension" between "man" and "wolf" there is also a different meaning not contained specifically in either "man" or "wolf". The man is being attributed certain wolf-like characteristics by being characterized, on the whole, as a wolf. Ricoeur draws on Wheelwright's (1968) expression *tensive aliveness* to describe this relational quality drawn over and through the copula.

Secondly, Ricoeur takes issue with Collin Murray Turbayne's (1962) *The myth of metaphor* by insisting that the plus value of the metaphor not be restricted, or limited the way positivist philosophy of science had insisted, but rather is should be identified and appreciated. Metaphorical meaning neither loses the literal, nor collapses the literal fully into the redescription. A proper understanding of metaphor never loses the "as if" character of the metaphor. In other words, metaphorical description must never collapse into either the

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[38] J. E. Smith (Smith 1995, 147-8) comments, "In confronting Ricoeur's voluminous work, shot through as it is with great attention to detail as well as a dialectical subtlety that often makes reading Hegel seem easy, I find it difficult to locate a finite and manageable topic ... before proceeding to the main topic, I must make, partly in self-defence, a confession and a disclaimer. To begin with, I find that reading Ricoeur with a degree of comprehension one would like is a very demanding task and there are many points at which I am not sure that I have understood him correctly. Paradoxically enough, some of the reasons for my difficulty stems from what I take to be efforts on his part to make sure that he will not be misunderstood."

[39] "[O]ntological vehemence" is Ricoeur's own term, referring the strong directedness present in affirming truth, though he goes on to warn against doing so naively, but warns "without it the critical moment would be weak" (1978, 249).

primary or secondary system which must always overlap both systems, yet keep a bit of space in between them.[40] A post-critical interpretation of metaphor enters Ricoeur's famed "second naïveté" without losing itself: one may not collapse the metaphorical meaning into a new literal one. Rather, one suspends the metaphorical meaning among the primary and secondary systems, such that the interpretation draws on both primary and secondary systems, to uses Hesse's terminology.

Finally, this *tensive aliveness* permits one to embrace the "is" and "is not" of metaphor with ontological vehemence. The tension gives rise to a *world of the metaphor* that joins together the two systems through the complex liveliness of discourse, such that, again borrowing Hesse's terms, the primary and secondary systems do not collapse into each other but maintain their structure. Metaphor does with Hesse's primary and secondary systems what stereovision does with the images from the right and left eyes. A stereo image requires the structure of the images in the right and left eyes to not collapse into one another, yet the tension between the two images resolves into depth. Therefore stereoscopic vision is a metaphor of this "is" and "is not" relationship (Ricoeur 1977, 256).

4.6 MODEL AS METAPHOR

Now that we have situated Ricoeur in proximity to Barbour, Brown, Black and Hesse, we can look specifically at his critique of Aristotle's view of metaphor and grasp its significance for the project of modeling complex systems. According to Ricoeur, metaphorical truth is possible because metaphor is a kind of discourse. He argues, through the use of Aristotle's *On Interpretation* (Aristotle 1949), that discourse says something about the world (Chapter 3 will discuss in greater detail how Ricoeur uses Aristotle to develop a theory of discourse). In Ricoeur's discussion of scientific modeling, he connects heuristic function and description, reminding us that this connection comes directly from the work of Aristotle (1977, 244). Ricoeur is both critical and sympathetic toward Aristotle's approach to metaphor in *Poetics* and *Rhetoric*. He is critical of Aristotle's reduction of metaphor to a stylistic device, and he blames Aristotle for the modern view of rhetoric: that "rhetoric" is at best another name for style. However, he is sympathetic toward Aristotle's unembellished but brilliant insights, which suggest Aristotle knows better than his taxonomy of metaphor suggests.

Ricoeur suggests that "The history of rhetoric is an ironic tale of diminishing returns" (1977, 9). Though Aristotle thought that he was saving rhetoric from the vitriolic criticisms of

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[40] Yes, this is an illustrative metaphor to describe how a metaphor works.

Plato and others, Ricoeur argues convincingly that his move to make rhetoric simply the counterpart to dialectic striped rhetoric of its power. He contrasts Aristotle's approach to that of the Syracuse and Sophists. He takes his stand with Nietzsche against the Philosopher, "reminding us that rhetoric was added to natural eloquence as a 'technique,' but that this technique is rooted in a spontaneous creativity" (9). Rhetoric was emptied of its power to shape thought according to Ricoeur because Aristotle's *Rhetoric* is a truce between two rival movements, "one that inclines rhetoric to break away from philosophy, if not to replace it, and one that disposes philosophy to reinvent rhetoric as a system of second-order proofs. It is at this point, where the dangerous power of eloquence and the logic of probability meet, that we find a rhetoric that stands under the watchful eye of philosophy" (12). Greek rhetoric must have comprehended a broader field than Aristotle's program suggests. The great taxonomist meets this problem by shoving what remains of Greek rhetoric, which did not submit to the terms of the truce into the domain of poetics, and "for Aristotle metaphor belongs to both domains" (12).

Throughout his first study in *The rule of metaphor*, Ricoeur mines *Rhetoric* and *Poetics* for insights from Aristotle that contrast Aristotle's official taxonomy of metaphor (1977, 9-43). It turns out Aristotle's brilliant mind knew about metaphor than he thought it did. Ricoeur exegetes two important passages, the first is found in *Poetics* (Aristotle 1993c, 694):

> But the greatest thing by far is to be a master of metaphor. It is the one thing that cannot be learnt from others; and it is also a sign of genius, since a good metaphor implies an intuitive perception of the similarity in dissimilars. (1459a 4-8)

Ricoeur (1977, 23) shows that the phrase to be "a master of metaphor" is better rendered "a master of metaphorising." Grammatically, Aristotle alters metaphor as "a thing" into a *process*, an *action*, which he honours as "the greatest by far". He goes on to say that it cannot be learnt. It is a gift of nature, a gift that includes the use of words. "Are we not now back to the level of finding or inventing, of that heuristic that we said violates an order only to create another, that dismantles only to redescribe?" (23). With this question, Ricoeur sets up a discussion that we have already explored through interaction with 20th century philosophers of science, a discussion prophetically anticipated by Aristotle's intuitive grasp of the essence of good metaphor, namely "an intuitive perception of the similarity in dissimilars."

It has often been said that a metaphor is a simile with like or as removed. However, with that idea in mind, one may be surprised to discover that *Poetics* makes no mention of simile or comparison, but *Rhetoric* assumes equivocal function between similes and metaphors adding nothing to the definition given in *Poetics*. It would seem that metaphor maintains a hegemony over simile in Aristotle's mind. In fact, "in six places Aristotle subordinates simile to metaphor" (24). What's more, Aristotle credits metaphor with an element of surprise.

> Liveliness is specifically conveyed by metaphor, and by the further power of surprising the hearer; because the hearer expected something different, his acquisition of a new idea impresses him all the more. His mind seems to say, 'Yes, to be sure; I never thought of that'. The liveliness of epigrammatic remarks is due to the meaning not just what the words say.... (1412a 18-22)

What causes metaphor to surprise? Aristotle tells us, "the hearer expected something different …due to the meaning not just what the words say..." (1412a 19-22). In the same passage Aristotle reinforces what he explains in the poetics--that the wielding of metaphor requires not just the command of words but also the resemblances between things:

> Metaphors must be drawn, as has been said already, from things that are related to the original thing, and yet not obviously so related—just as in philosophy also an acute mind will perceive resemblances even in things far apart [like Ricoeur's model of the text and complex systems]. Thus Archytas said that an arbitrator and an altar were the same, since the injured fly to both for refuge. Or you might say that an anchor and an overhead hook were the same, since both are in a way the same, only the one secures things from below and the other from above. And to speak of states as 'levelled' is to identify to widely different things, the equality of a physical surface and the equality of political powers. (1412a 9-18)

Armed with Aristotle's account of metaphor, Ricoeur returns to *Poetics*, to observe a strong similarity between metaphor and *muthos*: the poetic imitation of action. Aristotle places *muthos* along with flute-playing in a lyre-playing as modes of *mimesis*. *Mimesis* has generally been translated as "imitation", and Ricoeur sees this as the reason for why "few modern critiques speak favourably about the definition in terms of imitation that Aristotle gives for tragic and (secondarily) epic poetry. Most of them see in this concept the original

sin of Aristotelian aesthetics, perhaps all Greek aesthetics." Ricoeur points out that Aristotle pares down *mimesis* significantly from its boundless use in Plato and argues convincingly that in *Poetics mimesis* "is 'a process,'" the process of "forming each of the six parts of the tragedy, from plot through to spectacle" (1977, 37-38). Ricoeur also shows that these six parts of the tragedy correspond isomorphically with each of Aristotle's four causes. The first three, plot (*muthos*), character (*ethos*), and thought (*dianoia*), correspond to the object, the what, the material, of *mimesis*. The next two, melody (*melos*) and diction (*lexis*), are the means, or form, of *mimesis*. Spectacle (*opsis*), is the manner by which these are depicted. Finally, the parts of tragedy are directed, teleologically, toward *katharsis*, which is not so much a part of as it is the function of *mimesis*, that toward which the *mimesis* is aimed (38).

Though chapter 4 of this dissertation will develop the significance of the connections between the work of modeling and the six parts of tragedy, it is helpful to mention here that the activity of narration, like the activity of model making, is information rich. Following our metaphor of the multiple levels of focus on a microscope, narrative also has multiple levels of focus which can be studied individually and be understood as each partakes in and contributes to the unity of the whole. The organisation of information in narrative and metaphor bear remarkable similarities.

Returning to Ricoeur's analysis of Aristotle, the plot "structure," *muthos*, constitutes *mimesis*. The order, unity, beauty of arrangement that developed all the parts of tragedy are each in different ways elements of *mimesis*. It is therefore a significant misinterpretation of Aristotle to construe *mimesis* in terms of "a copy." At the heart of *mimesis* is a creative tension. Aristotle writes "that poetry is something more philosophic and of greater import than history since its statements are of the nature rather of universals, whereas those of history are singulars [or particulars]...." (1451b 6-8). History tells of what is and was, but poetry tells of what should be. Ricoeur draws our attention to the creative work of *mimesis* in both history and poetry. Both poetry and history lay claim to order a temporal sequence of events[41] which Aristotle believes are not really ordered but are governed by chance. Taking Aristotle's advice, Ricoeur surprises us by showing that metaphors (and scientific models for that matter) are really examples of *mimesis*, but also, in a way, a *muthos* in miniature (Ricoeur 1977, 244).

What is significant about the close relationship between *mimesis* and metaphor? When the work of creatively ordering events is compared with the work of metaphorising, and when the six parts of discourse are compared with the mutable levels of focus in the enterprise of model making, it becomes clear that narrative and metaphor are more than

mere heuristic devices. Rather they each unite rich and diverse forms of information and perhaps create new information. I suggest that this rich diversity is useful for modeling complex systems.

5. CONCLUSION

This first chapter has defined model, and in doing so it has toured the field of scholarly debate regarding the nature and truth value of metaphor. For this initial stage of argument I have shown firstly, it is inadequate to define a model merely as a particular isolated artefact; rather, models are both things that represent and modes of human action, namely goal-directed representations, or better (I will now add), *redescriptions*. Secondly, an assortment of different items and ideas can be called models, so it is legitimate to see the idea of modeling as pluriform and multifaceted. Thirdly, 20th century philosophers of science have grappled with the philosophical problem of models and recognized that scientific models have great kinship with metaphor. Brown breaks down Barbour's watertight divide between models and metaphors. Black shows that metaphors are interactions between partners in an analogy. Hesse explains that models make a metaphorical redescription of the explanandum, and Ricoeur builds upon both Hesse and Black to return to metaphor itself and reconstitute it as a redescription, understood in terms of Aristotelian *mimesis*. Ricoeur also recognized that Aristotle's theory of the four causes (which William Wallace (1996) calls the "model" of the four causes) can be brought to bear on the enterprise of modeling itself. The redescription that constitutes tragic *mimesis* also aims at a goal. In the case of tragedy this goal is *katharsis*. But *katharsis* is not the goal of all *mimesis*, and metaphor is one aspect of mimesis. But nevertheless, mimesis has ha human purpose. Like modeling it is a goal directed human action, but as we saw models, and we could say metaphors as well, are made for many purposes. So Ricoeur's observations on tragic *mimesis* only support my definition of modeling. We have seen in this chapter that *mimesis* in miniature, in the form of metaphor, and *mimesis* on the grander scale, that of tragedy, both aim at some kind of goal. *Mimesis* has a human purpose. If model making is a kind of *mimesis*, no artefact which one might call a model can whole be divorced from the human purposive context which authored its model like quality. This is not to say that the model must only be understood in terms of "authorial intent."

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⁴¹ Ricoeur (1984, 1985, 1988) also takes up this curious quality of story in a more extended discussion.

The hermeneutical vector of this introduction has returned in on itself. The insights of Black and Hesse, about how models are metaphors, have permitted Ricoeur to redescribe the operation of metaphor, not to destroy it but to deepen and extend its applicability to other spheres of discourse. This subsection was aimed at establishing four points: (1) a model is both an artefact and a human action, (2) the project of modeling has multiple simultaneous tasks, (3) metaphors cannot be reduced to "literal" meanings, and (4) both metaphors and narratives can be examined in terms of multiple levels, a quality coterminous with 1, 2, and 3. This last point casts some doubt on the possibility of a univocal super-approach to modeling as an ultimate modeling strategy, like that which one finds in the employment of mathematical modeling. The following chapter will define a complex system, thus making it possible to more carefully pinpoint the cause of the problem of modeling complex systems. At the close of that chapter I will make my case for the incompleteness of solely mathematical approaches to modeling complex systems. Chapter 3 will discuss neuroscience, and the last four chapters of this dissertation will unpack the significance of these four points mentioned above. Chapter 4 will clarify the four simultaneous tasks accomplished by metaphorical predication. Chapter 5 will apply the different levels of focus to the modeling of complex systems. Chapter 6 will examine the relationship between discourse and physical systems. And finally, Chapter 7 will account for the necessity of narrative in the modeling of complex systems. For now, enough has been said on models and metaphors.

We now move to the subject of complex systems. In the next I will attempt to define them in such a way that the account of modeling, metaphor, and narrative can join the subject of complex systems in a unified discourse. My discussion of models and metaphors has emphasized the way in which metaphors draw together complex information into a unity. The way in which models/metaphors arrange that information must wait for chapter 4, but for now it is necessary to define complex systems so that the non-univocal understanding of metaphor may be applied to the study of complex systems.

CHAPTER 2

The problem of modeling complex systems: part two

When complex systems are simplified, the very quality of the system
which distinguished it from a simpler system is removed.

1. INTRODUCTION

The previous chapter defined "modeling". This chapter will define "complex system". Appropriately, then, this chapter will also explain the problem of modeling complex systems, so it is appropriately themed with a key sentence (above) as its appetizer. This chapter will first give a brief overview of the field of complex system studies. It will then define complex system, explain the problem of modeling complex systems, and finally show why a non-mathematical (which should be distinguished from an anti-mathematical) approach to modeling complex systems is necessary. This chapter will also work to develop, for the purpose of this dissertation, a common terminology for a field still fumbling in its infancy.

2. WHAT ARE COMPLEX SYSTEMS?

2.1 THE DEVELOPMENT OF THE MODERN SCIENCE OF COMPLEXITY

Alwyn Scott suggests that the birth of the modern science of complexity can be traced back to the 19th century scientist Henri Poincare (2005c, viii). Poincare presented a

solution to the famed three-body problem[42], which aims to calculate the motion of a planet with two moons. He offered his solution at a mathematical competition which was held by the King of Sweden; however it was discovered that in his solution was a serious mistake. Eventually Poincare came to the conclusion that the three-body problem cannot be precisely solved. The significance of Poincare's conclusion was not widely appreciated until Edward Lorenz (1963) showed that models of atmospheric systems within certain parameters exhibit the nonlinear relationships that lead to chaos. While in a hurry, Lorenz, who was working at the time on computer-modeling weather, only entered 3 of the 6 digits which established his initial conditions. He then ran the computer model. When he returned after getting a cup of coffee, he saw that the second run of the model was predicting markedly different weather.[43] Lorenz concluded from this accident that a small adjustment to initial conditions of the system can significantly alter the latter development of a complex system and used the metaphor of the butterfly's wings causing a tornado to describe the effect in a talk he delivered in 1994. The conclusion of Lorenz's study became popularly known as "the butterfly effect." Lorenz's work confirmed the observation that Poincare made in the first decade of the 20th century:

> Why have meteorologists such difficulty in predicting the weather with any certainty? Why is it that showers and even storms seem to come by chance, so that many people think it quite natural to pray for rain or fine weather, though they would consider it ridiculous to ask for an eclipse by prayer? We see that great disturbances are generally produced in regions where the atmosphere is in unstable equilibrium. The meteorologists see very well that the equilibrium is unstable, that a cyclone will be formed somewhere, but exactly where they are not in a position to say: a tenth of a degree more or less at any given point and the cyclone will burst here and not there, and extend its ravages over districts it would otherwise have spared. If they had been aware of this tenth of a degree, they could have known it beforehand, but the observations were neither sufficiently comprehensive nor sufficiently

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[42] The Three-Body Problem (also known as the N-Body Problem since the problem persists when N is three or greater) was formulated by Newton in his *Principia Mathematica*. The problem deals with a generalization of celestial mechanics where one attempts to calculate the locations of the masses as they act upon one another in motion in which the initial conditions do not determine a collision set. The equations that we know of today to describe this problem were written by Leonhard Euler, to date the problem has not been solved for all conditions, though over the past three centuries thousands of papers have been written on the problem. For a brief introduction to the problem see Diacu (2005).
[43] For more on this story see Gert van der Heijden (2005).

precise, and that is the reason why it all seems due to the intervention of chance (in Heijden 2005, 86, cited from Poincare 1908).

Lorenz's study showed that if the initial conditions are changed only slightly, complex system behavior can and does often alter dramatically. Lorenz takes this point a step beyond Poincare, to point out the practical ramifications of the dynamics of system behavior. A small alteration can have dramatically greater effects than the apparent force of the cause. However, Poincare's conclusion also confirms the mechanism for system dynamics: the system behaves as it does not because causation is not occurring, or because random chance is somehow determining the world. Quite the opposite. The chain cause and effect is still in place. One would be wiser to think of cause and effect as a network of interdependent causality.[44]

The later developments of chaos theory and nonlinear science, those significant advances over the latter half of the 20th Century, may be traced back to Poincare, but some significant mathematical tools that would later be employed for the study of complex systems were developed unknowingly, throughout the first 50 years of the 20th century, especially during the 1930s. The mathematical field of computational complexity theory (which is not the same as the mathematic study of dynamic nonlinear behavior in physical systems), developed through the notable work of Alonzo Church, Alan Turing, David Hilbert, Kurt Gödel, and many others. Steven Homer and Alan L. Selman (2001, 72) explain that complexity theory aims "to provide mechanisms for classifying combinatorial problems and measuring the computational resources necessary to solve them. Complexity theory provides an explanation of why certain problems have no practical solutions and provides a way of anticipating difficulties involved in solving problems of certain types." Today the mathematics developed in the early part of the 20th century has proven quite useful in the field of complex systems study that developed in the second half of the 20th century and which uses some elements of computational complexity theory to study problems related to circuit design, quantum computing, probabilistic computation, cryptography, the development of efficient algorithms, and data security, among other things (73). This study of complex systems has given rise to a new science, called *nonlinear science* by some (see Scott 2005b). Since it appears that the term *nonlinear science* is beginning to be used as a

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[44] By using the term interdependent causality, I am not intending a notion identical to the Buddhist concept of *pratitiasamupada* (or Pali, *praticcasamuppada*) which assumed that causality can be empirically proven (Kalupahana 1992, 53-59). In this dissertation I will maintain that causation is known hermeneutically (see chapter 5).

designator for the study of complex phenomena, I will try and explain what nonlinear science is and distinguish it from my subject matter in the present work.

Before introducing nonlinear science, it is first necessary to define two important concepts, nonlinearity and emergence. A system which when acted upon responds in a way that is directly proportional to the act upon it is a linear system. The direct interactions of masses in Newtonian physics are examples of linear interactions. However, systems that respond in ways that are not directly proportional to the actions upon them show by their reactions the richness of their interactions with other properties, which cannot be accounted for with the proportional relations one expects from linear reactions. Systems that respond in ways that are not directly proportional to the actions upon them are nonlinear. It follows from this definition that linear causation may account for local interactions between the parts of a system, but taken as a whole, linear causation cannot account for the reaction of the whole. This property describes the overwhelming majority of natural systems. While natural systems may often behave in ways that appear to follow linear interactions, it is possible to change very small factors that govern their stability and hurl them into turbulence and instability. Small global temperature changes can significantly increase the number of hurricanes entering the Gulf of Mexico. The lowing of the interest rate of the US Federal Reserve's main interest rate can undermine the stability of the global economy and potentially lead to sweeping changes in the practices of the central backs in every nation in the world. After the fact, it may be possible to work from system events back to some initial causes; however, the behavior of the system is such that it is not possible to trace the relationship between one event and the proportion of its effect. This feature results from the relationship of parts and whole, or from the interaction of outside forces and the hub of the complex phenomena under study.

When a system, or a phenomenon, behaves in sustained patterns of nonlinearity, those patters display emergence, the distinction between a whole of a thing, and the parts that make it up, whether the thing is a system or a phenomenon. The human body then is emergent from the parts that make it up, since it operates as a collection of dynamical system-processes that interrelate with one another in such a way that the total effect cannot be reduced to a single subsystem or part. The term emergence helps us to distinguish between those parts and subsystems and the body, which "emerges" from them. I use the example of the human body specifically to draw attention to a notion implicit in the concept of "emergence," namely the story of how a property "emerges" from the absence of that property, not *ex nihilo*, but *ex alienigenus*[45]*,* from parts to which the whole system cannot be

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[45] See Lucretius, *On the nature of things*, 1.860,865.

reduced. One must handle the term "emergence" with great care, because emergence need not have a developmental history. Hypothetically it is possible, that a system begins already emerged. For instance, a computer model of a weather system may begin with initial conditions, which need not have emerged before their initial definition. Such conditions are set by fiat. One may say that the scientist "emerged" the conditions in his or her own mind, but this misses the point that the weather model is beginning with its systemic properties defined. Without such a situation, all weather modeling would have to grow from no weather, into weather. Emergence is an intelligible concept whether we know the story of how emergent properties evolved, or whether a system's initial conditions were defined at its inception. Either way, emergence is the property of a system or phenomenon wherein we may say that the whole is greater than the sum of its parts, and is irreducible to its parts. This notion of emergence is roughly equivalent to Aristotle's notion of organic substance, which will be discussed at length in chapter 5. Also in chapter five we will trace Aristotle's analysis of the relationship between the four-causal model and its application within an organic whole, such that the whole, the substance, cannot be reduced to the parts. We will also discover that the parts can be understood in their proportional actions upon one another. We will also see Aristotle's remarkable anticipation of some aspects of nonlinear science. For our present discussion, it is enough that we understand emergence and nonlinearity so that I can continue to develop their application in the field of nonlinear science.

2.2 NONLINEAR SCIENCE

Nonlinear science is the study of phenomena and domains in nature and the human life world that arise out of the interactions of more basic elements, such that the phenomena and domains cannot be reduced to the more basic elements. Nonlinear science emphasizes the use of mathematics as a tool for describing the phenomena and domains in which complex behaviors arise. This new discipline focuses on an aggregate of problems and complex phenomena, including emergent entities, problems with chaotic solutions (which exhibit behavior like the butterfly effect), spontaneous nested pattern formation, synchronization of weakly coupled oscillations, shockwaves, and hierarchical interrelationships.[46] Emergent entities are items which show the quality of modest emergence, where

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[46] These categories and most of these examples are drawn from Scott (2005c, ix-x)

[t]he whole has features that are different in kind from those of its part (or alternately that could be had by its parts). For example, a piece of cloth might be purple in hue even though none of the molecules that make up its surface could be said to be purple. Or a mouse might be alive even if none of its parts (or at least none of its subcellular parts) were alive (Scott 2005a, 261).

However, as James P. Crutchfied has observed, "Defining structure and detecting the emergence of complexity in nature are inherently subjective, though essential, scientific activities" (1994, 1). But Crutchfield does show how mathematics helps. The emergence seen in nature has a strong mathematical analogue, and therefore mathematics can be used as a tool to study at least some cases of emergence. Emergent entities are a common feature of nonlinear partial differential equations, but also show up in nature: tornadoes, black holes, Jupiter's Great Red Spot, and schools of fish are each examples of emergent entities. Spontaneous pattern formation also show up in cellular automata[47] in the form of nested patterns (see illustrations in chapter 3), a kind of emergent entity that appears in cellular automata pattern formations (which have been carefully studied by Stephen Wolfram (2002b)). Even Lorenz work, mentioned above, illustrates some success in the application of mathematics to problems with chaotic solutions (see above).

Furthermore, nonlinear science can make a strong case for its utility as a major branch of natural science for examples of spontaneous pattern formation can be found throughout nature. They can be found in the oscillatory pattern in the activity of the heart muscle when under fibrillation, eventually effecting cardiac arrest, also in weather fronts, hydrodynamic turbulence, and the formation of the Gulf Stream. Weakly coupled patterns might be present in neuronal firings, but they certainly do occur in the frequency locking that can occur when several electrical power generators are tied to the same grid. Shock waves (e.g. the sonic boom which occurs when objects travel faster than the speed of sound in the earth's atmosphere) are also examples of spontaneous pattern formation. In each of these examples, behavior emerges out of another system, a whole, which seems, at least at first, to have different properties from those which eventually emerge out of the systems behavior. Each of these things may at least be termed complex phenomena. There appears to be a relationship between parts and wholes, where the behavior of the parts is somehow contingent on the behavior of the system as a whole. Nonlinear science studies these systems of emergence in the natural world, and as such it employs mathematical formulation as it sharpest tool.

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[47] For an introduction to cellular automata see the Artificial Life section in chapter 3.

Nonlinear science also studies hierarchically complex systems. In nature, the most complex systems have hierarchical structures. They are, in a sense, systems of systems. The human body, ecosystems, economic systems, certainly the brain, have hierarchical structures. By hierarchy here, I am not referring to a kind of process abstraction, where there are higher functions, which are on "top," and lower functions on the "bottom". It would be clearer to say that parts and systems work together, in feedback loops[48] of nonlinear causality[49]. It may be that inside a system, a small part will have a great effect on a larger part, but that effect is possible because of the behavior of a system of interrelated parts. Nonlinear causal relationships, far from being a kind of mystic wizardry, may actually be composed of linear causal relationships within a system where one part can affect and feed off another part, and that part can in turn have a similar (or different) effect or influence on its source influencer. This kind of relationship, the so-called *feedback loop*, can influence parts of systems, or even whole systems, or systems within systems. It is very hard to generalize this, and the subject is best covered by examining specific systems, which is why I will devote significant attention to explaining these relationships in the brain in chapter 3. This final kind of subject of nonlinear science, the system with hierarchical structure, is the subject I wish to address in this dissertation. Biological organisms, the brain, economies, and ecosystems are all systems of systems, and as such they are not merely complex phenomena – a nexus of peculiar causes – but rather, the kind of interacting collection of elements systems that organize in hierarchical structures are the subjects treated by this thesis.[50] The field of nonlinear science is so new that the terminology to describe its various

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[48] Feedback loops occur when the energy expended by a system or part of a system returns to it as a result of its work or act on itself, its own system, or other systems. A child kicking her legs on a swing may be thought of as perpetuating a kind of feedback loop, though obviously a feedback loop could be far more complicated. For a more detailed discussion of feedback and feedback loops see Landa (2005).

[49] In a linear chain of causation, event A causes event B, which causes event C and so on. While nonlinear causation must necessarily not be reduced to a simple interaction- schematic, it is fair to at least identify that in nonlinear causation, A, B, and C are part of system or network such that C, could be the cause of A and B, and B could be the cause of C and A, or even in part the cause of itself. When expressed in terms of letters this idea seems quite complicated and almost irrational, but the consideration of real nonlinear causal relationships makes the concept clearer. Take the event of the human heart pumping. That event, in part, causes brain function and cellular nutrition. By doing both actions, it actually is a cause of its own act of pumping. One could try to develop a formal schematic of causal relationships, but the challenge of such a formalism would be to match the nonlinear causal interaction of system parts with a system which tends to favor modeling linear relationships.

[50] Paul Cilliers (1998, 22) applies post-structuralisms anti-hierarchical approach to understanding brain function. My position on the matter is in large part analogous to his, in that I am not arguing for a system of hierarchy where there is an absolute system that rules over other portions of the system (like a homunculus in the brain). Rather, as will be clear from my survey of neuroscience in chapter 2, I hold that the system interrelations between part and whole must be understood with hierarchy in mind. Hierarchy does not designate power, but rather order and channels of influence. In complex systems it is difficult to say whether the "lower" part of the hierarchy is greater or more influential than

tributaries is in flux, and it is difficult to divide the field into fixed areas of research, or sub-disciplines. However, the substantial point here is that this dissertation will be interacting with systems that exhibit complex behavior as systems, which generally either includes the actuality or the possibility of hierarchy.

Returning to the general character of the field of nonlinear science, the mathematics of computational complexity found application to natural systems in the early 1970s. Lenore Blum, Filipe Cucker, Michael Shub, and Steve Smale (1997, 26-27), observe that in the early 1970s, researchers working in a more abstract setting of axiomatic complexity recognized that thousands of unrelated problems associated with NP-completeness[51] were equivalent. In a way analogous to Newton's application of calculus to physics, scientists in many disciplines began to apply these developments in complexity theory and computational theory to the study of the natural world. Researchers were surprised to discover that electrochemical brain activity operates in similar patterns as tsunamis and atmospheric dynamics (see Scott 2005c). The complex behavior of physical systems, employing very different material and organizational substrates (brains, oceans, weather and ecosystems) still seem to display the same types of pattern dynamics. What has evolved from this application of computational complexity theory, computer science, and keen observation of the physical world is the new discipline of nonlinear science which "recognizes that 'the whole is more than the sum of its parts'" (Scott 2005c, vii). While "[l]inear analyses are characterized by the assumption that individual effects can be unambiguously traced back to particular causes" (vii), at its core, nonlinear science rejects this assumption and instead seeks to understand the complex relationship of causes that affect a given situation. Scott observes that Aristotle's insight that nature exhibits the interplay of multiple types of causes, which was passed over throughout much of the 20th century, is now back on the table—the lab table (vii).

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the "higher" part. That question, really is absurd, and in practice ends up being a product of location in the system. A part can have a great effect on the whole.

[51] To explain NP-completeness it is first necessary to introduce *P* problems. "The class of *P* problems contains those problems that can be solved in polynomial time; there is an algorithm that solves the problem with time complexity polynomial in the size of the problem. The class of problems known as NP Problems are those that could be solved if you had an oracle that chooses the correct value at each time, or, equivalently, if a solution can be verified in polynomial time. It is widely conjectured that $P \neq NP$, which means that no such oracle can exist. One great result of complexity theory is that the hardest problems in the NP class of problems are all equally complex; if one can be solved in polynomial time they all can. This is known as the class of NP-complete problems" (Poole 1998).

2.3 Paul Cilliers's definition of a complex system

However, as mentioned above, not all things studied by nonlinear science are complex systems. Nonlinear phenomena often give the appearance of being systems because many will appear to self-organize, to spontaneously assemble themselves. For example, nonlinear systems seem to self-organize into the basic patterns predicted by nonlinear partial differential equations. "These 'coherent structures' of energy or activity emerge from the initial conditions as distinct dynamic entities, each having its own trajectory in space time and characteristic ways of interacting with others. Thus, they are "things" in the normal sense of the word" (Scott 2005c, ix). Recall the examples mentioned above of these "emergent entities" tsunamis, magnetic domain walls, the Great Red Spot of Jupiter, and tornadoes just to name a few. It is a stretch though to call a tornado or tsunami a complex system.[52]

The aim of this dissertation is to develop a hermeneutic phenomenology of complex systems. While complexity theory and nonlinear science are helpful for the study of complex natural phenomena, this work will only address systems. Not all complex things are systems in themselves, as I have shown above, and not all the subjects of nonlinear science are actually nonlinear systems, as I have illustrated above.

A clear definition of a complex system is necessary to philosophically sort a hermeneutic phenomenology of complex systems from other approaches to systems theory, and without a clear definition our thoughts will be prone to wander about, with no sure joints to fit the model of the text to the behavior of complex systems. A first example may be found in William Rasch and Cary Wolf (2000), who see a postmodern turn in the developments of complexity studies. While complexity theory and nonlinear science were developed through the disciplines of mathematics and the physical sciences, philosophers and cultural critics

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[52] If one defines a system as a collection of elements that behave together, then certainly tornadoes and tsunamis are systems, but they are not complex systems by Cilliers's definition. It would be better to use the term "complicated" to describe them, since multiple elements are assembled to produce them; they are not systems, however, since they are self-sustaining. Still, they are emergent entities, or nexus points that arise within a weather system, so they are appropriately termed complex phenomena, phenomena resulting from the behavior of a complex system. To draw on explanations from the upcoming chapter 5 of this dissertation, the heart is a complicated part of a complex system, a body. The more the functions of the heart are understood in terms of the system it serves, the clearer it is that the heart, a complicated item, serves a complex system in a number of complex ways. Thus a beating heart is quite a complex phenomenon. According to Cilliers's definition, a weather system would better be understood as a complex system, where a subset of the system, say a tsunami, may be complicated according to Cilliers' terminology, but not complex. A tsunami is better understood as an individual behavior in a complex marine system. However, when the event horizon is expanded to include the causes of a complicated phenomenon, it may turn out that the phenomenon is part of a complex system. For example, its possible to study Jupiter's Red Spot as an equilibrium state, since the spot has been present on Jupiter's surface for a long time. But the atmosphere of Jupiter as a whole operates as a complex system, depending on how the categories that I will explain in chapter 4 apply to a given situation.

are jumping on the bandwagon, much like the philosophers of the Enlightenment rode Newton's coattails. So it is with Rasch and Wolf in *Observing complexity: systems theory and postmodernity.* After explaining the way that nonlinear science has overthrown the Newtonian worldview, they write:

> More importantly for our purposes, it also enabled philosophers of science to theorize with great rigor and precision epistemological problems that have traditionally bedevilled philosophers, literary critics, and anyone concerned with interpretation and the problem of knowledge: chiefly how to acknowledge the contingency and constructiveness of all description and interpretation without at the same time falling into the trap of "anything goes" relativism (9).

While the interdisciplinary approach of Rasch and Wolf should be appreciated, more is needed than a simple appropriation of systems theory to interpretation and epistemology. How should systems theory and hermeneutics be fit to one another? This dissertation wishes to address that question with the clarity and patience of Ricoeur's philosophical method.

Mark C. Taylor offers a less "revolutionary" approach to complexity. In *The moment of complexity: emerging network culture* (2001), Taylor summons the developments of complexity study as a response to the modern hyper-organized grid world. Taylor offers a comparison between the industrial lines and boxes that typified the modern period and the fluid network approach to architecture, which Taylor attributes to a postmodern cultural outlook. His work aims to describe the movements of contemporary culture according to the model of evolving complexity and seize this moment, not as a time for revolution, but as more of a "tipping point" toward a kind of Hegelian-like[53] development of a human being living in community. He aims at description rather than change. Thus, systems theory becomes an interpretive metaphor for understanding culture, as well as human history.

Neither of these works pays close attention to developing a definition of complex systems, in part because they wish to emphasize the contrast between Newtonian modernity

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[53] Taylor (2001) makes no apologies for his use of Hegel. Taylor presents Hegel as prophetically seeing the dangers of technological culture, and sees his work as an organic response to the mechanistic culture of modernity. Taylor writes, "Hegel's analysis of the logic of the machine and, by extension, his account of mechanistic systems has significant impact on twentieth-century interpretations of science and technology. No philosopher has been more influential in exposing perceived dangers of what has come to be known as "techno-science" than Martin Heidegger. Though Heidegger never directly acknowledges a debt to Hegel on this issue, his understanding on this issue, his understanding of science and technology, is consistent with Hegel's argument in *Science of Logic*" (Taylor 2001).

and the contemporary vision of the world as an untameable complex system. The complex system then itself becomes a model for understanding the world: it need not be defined for it defines everything else. Since the present work aims to model complex systems, rather than to use them to model other things, neither the approach of Rasch and Wolfe nor that of Taylor will work.

Because complex systems subsist among many different contexts and operate by employing many and varied parts, they are famously difficult to define. Some even sidestep the task of defining them altogether. Gregorie Nicholis and Ilya Prigornine make such a move in *Exploring complexity: an introduction* (1989). In the introductory section entitled "What is Complexity?" they offer no direct definition of complexity except to say that "Complexity is an idea that is part of our everyday experience" (6-8). They go on to write: "It is more natural, or at least less ambiguous, to speak of complex behavior rather than complex systems" (8).

Paul Cilliers faces this problem squarely in *Complexity and postmodernism: understanding complex systems* (1998, 3-5). For Cilliers, a complex system consists of (1) large number of elements, (2) the large number being necessary but not sufficient, (3) interacting richly, (4) and non-linearly, (5) generally in short-range interactions, (6) with interaction loops. These systems are (7) open, (8) operating under conditions far from equilibrium, (9) with a history, (10) each element in the system being ignorant of the behavior of the system as a whole. Before moving on I will clarify each of part of this definition:

1. *Complex systems have a large number of elements.* The smaller a complex system is the one more likely that its behavior could be understood with simple algorithms.
2. *This large number is necessary but not sufficient to define a complex system.* Merely having a large number of elements is not enough. To borrow Cilliers's example, "The grains of sand on a beach do not interest us as a complex system." The elements must interact, and not only that,
3. *They must interact richly.* Each element in the system must influence a good number of other elements in the system. Because of the large number of elements in the system, one element can influence another in seemingly unpredictable ways. It is therefore possible that an element can receive the results of an effect that it caused.
4. *The elements interact nonlinearly.* This follows from the rich interaction between all elements in the system. One element can have multiple influences and influence multiple elements in the system, in such a way that traditional mathematical modeling becomes challenging at best.

5. *These elements interact generally in short range interactions*. Practical constraints in the system force the elements in a complex system to send and receive information only from local elements. Usually other elements are only a few steps away, and the demands of local interaction means the transfer of information in the system can be affected by the other elements in the system either amplifying or dampening the influence of that single element.

6. *Complex systems have interaction loops*. Any activity of an element can possibly feed back on itself. This can at times happen almost immediately, and at times after a few intervening stages. But these interaction loops need not be positive; they can also destroy the system.

7. *Complex systems are open*, which is another way of saying that they interact with their environment. Open systems make exchanges with their environment, potentially, with many different kinds of things: energy, matter, even information. To say that a complex system is open does not mean that it is amorphous or indefinable, some vapour that constantly changes shape and then dissipates. The environment of a complex system acts upon it, so also can other complex systems.

8. *Complex systems operate under conditions far from equilibrium*. The perfect equilibrium is death. Living organisms provide the most abundant examples of complex systems. To live, organisms must maintain a number of processes that continually respond and flex in adjustment to other processes.[54]

9. *Complex systems have a history*. It is not enough for a complex system to change. Its present condition, and to some extent, its future depend upon its past. It is rare to see the birth of a complex system. In general, we come upon them in process, and the current state and shape of that process depends upon the history from which emerged the present moment. Complex systems must have the ability to collect information about the external conditions of the system and store that data for further use.

10. *The elements of a complex system are ignorant of the behavior of the system as a whole*. This final point to the definition also points to the root of the problem of knowing complex systems. Each element of a complex system is involved in short-range interactions and cannot access all the information necessary to know the behavior of the entire system. Thus it follows that knowing some of the elements of a complex systems does not necessitate that ones knowledge of the whole is accurate.

A careful reading of Cilliers's definition reveals he is not actually defining a system until sub-point 9 of his definition. Up until sub-point 9, Cilliers could be defining a volcanic ash plume, a tornado. Its possible to have nested patterns and rich interactions, but not a system, as found in the case of a volcanic ash plume which forms complex patterns merely because the earth is venting superheated material. Furthermore, the presence of a feedback loop does not constitute a system. In the case of a tornado the observed complex phenomena of a funnel cloud is actually the product of a larger system, a weather system. The funnel cloud is only a single sensational part of a larger system. When the system loses knowledge of its past, when it ceases to maintain processes which connect it to its previous states, it ceases to be connected to the actions of its past. Its parts dissipate, usually being absorbed into something new. This is the end of the system, death. One may object that there are short lived systems; however, even a short lived system still has a history, all be it a short one.

Cilliers is quick to add two "indispensable" (10) features that distinguish complex systems from merely complicated ones, namely *self-organization* and *distributed representation*.

Self-organization is the ability of systems to apparently assemble themselves. Not only to evolve, but rather, to apparently create themselves. Distributed representation is the seeming ability for systems to remember information across the whole network of interconnected nodes, without the information being contained in any one or distinguishable hub of system nodes. Cilliers is willing to claim these two features as *almost*[55] decisive qualities of complex systems. More foundation will have to be laid before we can discuss self organization at the end of the next chapter and distributed representation in chapter 4. At present it is enough that we have distinguished between complexity theory (a branch of mathematics), nonlinear science (which studies nonlinear phenomena in general), and the study of complex systems, which include brains, natural language, ecosystems, economies, and other systems that fit Cilliers's elegant definition.

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[54] Cilliers's observation here aligns with some of Aristotle's own insights in *Parts of animals* which will be discussed in chapter 4.
[55] I say *almost* so as not to overstate his case. Cilliers may even say they are totally decisive.

3. THE PROBLEM OF MODELING COMPLEX SYSTEMS

3.1 THE PROBLEM ITSELF

A non-mathematical approach to modeling complex systems is necessary because, as Cilliers observes, "To describe a complex system you have, in a certain sense, to *repeat* the system." A purely mathematical approach to modeling complex systems requires that all features of the system be reduced to some kind of operation, some kind of metric or metrics that can govern the mathematical operations. As we observed at the beginning of this chapter, the Three-body problem gives us one example of the practical implications of this problem and also it ubiquity. However, the behavior of complex systems derives from the properties of the parts and wholes that make the system, which may or may not be reducible to rules of operation. I will leave a fuller development of my case for a non-mathematical approach for the end of this chapter. For now, it will be enough to point out that a complete mathematical model of a complex system requires reproducing *every* (every) facet of the system, every node and its interaction with other nodes, and node subsystems, with a mathematical operation. The practical import of this problem has been felt by researchers in Artificial Intelligence over the last forty years (see chapter 3). Models generally simplify what they model, but a model of a complex system must reproduce the complexity it is supposed to model, if indeed the model is to be effective. How does the simple model the complex? This is the philosophical and practical problem with modeling any complex system. If a model is a thing, whether mental or physical, that humans use to represent other things, generally things we desire (1) to become, (2) to understand, or (3) to have or accomplish, then the problem of modeling complex systems is a significant one. Since models are a significant tool for human understanding and accomplishment, it would hard to underestimate the need to model complex systems in an increasingly complex technological and global world. While this dissertation is devoted to developing a hermeneutic phenomenology of brain science, the utility of modeling complex systems reaches far beyond the domains of neuroscience of cognitive science. Model building is an important enterprise for understanding the behavior of financial markets, making business decisions, understanding the strength of an enemy in a war fighting situation, or understanding the myriad of systems discussed in this dissertation up to this point. Modeling complex systems also helps to show a strategic planner if his end state will be accomplished. In short, the need to model complex systems is significant. Given the importance of modeling complex systems, it is clear why so many resources have been invested in researching how to model

systems mathematically, which permits systems to be modeled not only conceptually but also through computer simulation.

When a complex system is modeled computationally it is necessary to derive a whole system from a set of conditions, likely initial conditions, from which the developments of the system can be calculated. While computation can be a powerful tool, computational models require that all things mathematically described by the model be things that can be quantified by a formal language. Not all things can be reduced to a formal language, as Gödel[56] has shown. The problem of modeling any complex system with univocal language, like mathematics, requires that the utmost care be taken to precisely define every element of the system. But is such care even possible? Even that model would be a simplification of a complex system, by definition.

Since the locus of complex system modeling is computer programming, it is useful to see this principle at work in the domain of computer programming. Gregory Chaitin observes the outworking of this program in computer program:

> Now the most interesting thing about the idea of *program-size complexity*, of measuring the complexity of something by the size of the smallest program for calculating it, is that almost every question you ask leads straight to incompleteness... For example, you *can't* calculate the program size complexity of anything, it's incomputable. You can't even prove any lower bounds, not if you're interested in the program size complexity of a specific object… And even though *most* bit strings turn out to be random and can't be compressed into small programs, you can never be sure that a *particular* bit string is random! [*his emphasis*] (2000, 24).

Chaitin is simply making the point that one cannot remove the complexity from complexity, and there is an epistemological problem in trying to compute complexity. For one to compute complexity, one needs a program as large as the complexity being computed. If computers are to be decisive in meeting the need to modeling complex system, it would

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[56] Roger Scruton trenchantly summarizes the significance of Kurt Gödel's work for the project of formalism (1994, 395). "The final blow to the logicist programme was struck by Gödel in his famous meta-mathematical proof that there can be no proof of the completeness of arithmetic which permits a proof of its consistency, and vice-versa. We cannot know, of some system of axioms, which is sufficient to generate arithmetic, that it is both complete and consistent. Hence there may be formulae of arithmetic which are true, but not provable. It seems to follow that no logical system, however refined, will suffice to generate the full range of mathematical truths. It follows too that we cannot treat mathematics as Hilbert had wished, merely as strings of provable formulae: the theory of 'formalism' is false."

seem absolutely necessary to computer complexity. However, it would seem that the program must be at least the size of the complexity it aims to model. Thus, if Chaitin is right, complexity, as such, is incompressible. At least, this will always be a problem if computation is our only tool for the study of complex systems.

It therefore stands to reason that a non-mathematical approach to complexity, though apparently less precise, may be of value. But just before the shoulders drop with a loss of hope, it is important to keep in mind Aristotle's admonition from the opening of *Nicomachean ethics*:

> Our discussion will be adequate if it has as much clearness as the subject-matter admits of, for precision is not be sought for alike in all discussions, any more than in all the products of the crafts.... for it is the mark of an educated man to look for precision in each class of things just so far as the nature of the subject admits… (1094b 12-26) (1993b, 339-40)

Aristotle advises his reader to only exercise as much precision as a subject allows. As a fellow philosopher once warned me, one must be careful in one's analysis not to cut so deep that one scratches the table. Sometimes, one needs to look at wholes instead of parts. In the surrounding context of this passage, Aristotle argues that in some situations it is simply impossible to know everything, or to know the situation with absolute precision. Therefore, Aristotle's point seems all the more applicable to a domain that some of our best mathematicians have labelled The unknowable.[57] We would be wiser to grasp what Aristotle is actually saying. He is asking his reader to understand the nature of the thing into which one inquires. Some matters, some subjects, simply do not give themselves to a false precision, rather Aristotle relies on the commonsense of a mind nurtured through education. Such a mind can grasp a subject, or concept with "precision… as far as the nature of the subject admits" (see above). At present, the *subject* is complex systems. Aristotle's advice is especially relevant here. If we ignore *some necessary aspect* of the nature of the system, then we are still failing to heed his advice. But it is impossible to know everything about a complex system. It follows that we should ask: What must be known?

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[57] This is the title of Gregory J. Chaitin's book length treatment of his own mathematical discoveries. See (Chaitin 2000)

3.2 THE NEED FOR A FUNDAMENTALLY NON-MATHEMATICAL MODEL OF COMPLEX SYSTEMS

Researchers who study complex systems need a nonmathematical model of complex systems, in part precisely because computational models are so valuable for understanding complex systems studies. This counterintuitive truth should be taken to heart, because it is impossible to *apply* mathematical models without understanding the nature of the system being modeled. The developments of the mathematicians often precede the work of physical scientists. Mathematicians play at the frontiers of their own discipline, and then later their play often turns out to be remarkably applicable in to nature, a fact well documented by Morris Kline (1964). In the field of systems theory, where so many different factors are bumping into one another, opportunities for error multiply. While nonlinear science may be a new discipline, economists throughout the 20th century have attempted to mathematically model the fluctuations of various economies. Since differential equations have long been used as tools in economic study (see Mises 1998, 706-711), it was natural to apply complexity theory to economic data sets, since economies are complex systems which necessarily involve calculation. Cars Hommes (2005) shows that nonlinear dynamic models are used in the study of fluctuations in economic systems. Cilliers also uses the example of an economy to explain his ten-part definition of a complex system (1998, 5-7). For this reason I will argue, from the nature of economic systems themselves, that complex systems need to be modeled in a fundamentally nonmathematical manner.

Economic systems are by definition mathematical. Economies cannot exist without some form of calculation, because prices are numerical entities that must be *calculated*. I aim to show how the epistemological necessity of nonmathematical economic modeling is a *precondition* to economic calculation. I will then show that this necessity flows out of the nature of complex systems (and therefore applies to economic systems). If I accomplish these two things, the necessity of nonmathematical modeling will be established. Because economies are complex systems, the epistemological problems and calculation issues that affect economics, at least those that address economic complex systems, should prove quite useful in delimiting a boundary for the usefulness of mathematical models for complex systems.

The insufficiency of mathematical models to fully model complex systems will be shown through a two-step argument, derived from the Austrian economic theory of Ludwig von Mises. It would be beyond the scope of this dissertation to study every last complex system and then argue for the insufficiency of mathematical modeling. Instead I will limit my remarks to one kind of system, an economy. The observation regarding economic complex systems may be extending to other complex systems also. Firstly, I will show that Mises (1990) prophetically recognized the epistemological problem of modeling complex systems

as early as 1920, the year in which he published his article "Die Wirtschaftsrechnung im Sozialistischen Gemeinwesen" or "Economic Calculation in a Socialist Commonwealth," before the advent of nonlinear science, and argued that this problem leads to substantial inaccuracies in econometric calculations. Secondly, I will illustrate this epistemological problem through Mises's insights into the problem of socialist price calculation in the Soviet state, where I will show that misunderstanding a complex system in a way that misapplies computational modeling can lead to the construction of obvious computational fictions (in the negative sense of "fiction")—and in the case of the former Soviet Union, disaster.

Ludwig von Mises identifies a significant epistemological problem with what he calls "complex phenomena" on the one hand and sets his discussion of this point amidst the rival poles of experimental science and theory deduced from historical experience on the other (1998, 30-32). Mises writes, "[w]e are never in a position to observe the change in one element only, all other conditions of the event being equal to a case in which the element concerned did not change" (31). Here we see Mises echoing the situation which is at the heart of the Three-Body Problem mentioned above. Mises (31) compares the study of complex phenomena to laboratory experience. Unlike laboratory experience, which can be controlled and where intruding or irrelevant causes can be minimized or eliminated, no experiment can be done to settle a dispute about the causes of complex phenomena, or as Mises (31) puts it, "Complex phenomena in the production of which various chains are interlaced cannot test any theory." Too many causal chains are intersecting and overlapping. Mises notion here closely overlaps with Cilliers's (1998, 4) notion of *rich interaction* between the elements of a complex system. Mises' complex phenomenon is a nexus of Cilliers's rich interaction. The factors cannot be separated and tested in the way that a laboratory will permit. This does not mean that these factors are unknowable, rather they cannot be understood through direct empirical verification. Likewise, and against the positivists, Mises points out that one cannot depend on observations from the past as a basis for theory (31).

This is because complex phenomena need not hold to historical patterns (which is not to say that they have no history). History is full of pattern upheavals. The remarkable system changes, which have collapsed and remade the spheres of culture, power, science, and economics over the last two thousand years of post-classical history, have each been catalysts of upheaval for the other three spheres. The discipline of history is all the more fascinating for being the chronicle for such upheavals, and those points of greatest change seem to garner the longest chapters. I need recount now how the rise of the power of princes provided a protected environment in Germany for Luther's protestant Reformation; or how the cultural changes of the Reformation freed scientific inquiry from ecclesiastical control and paved the way for the Scientific Revolution; which brought with it the down fall of

the power of princes, the loss of the cultural permanence of Christendom, and the rise of industrial commercialism. Each of these is a pattern upheaval, too ready on the minds of those familiar with Western history of the past Millennium to require more than my mention of them to establish the fact that history is full of pattern upheavals.

Mises sees this as critical to understanding economic systems. Since history is full of pattern upheavals, it is critical to know *why* the upheavals occur, not merely that or when they occur. The metrics and data collecting efforts which can be rendered into statistical analysis may measure a change, but they do not explain a change (see the discussion in chapter 1 on scientific modeling). Mises vindicates his observation by critiquing the Newtonian construct of the economic baseline used in the development of economic theory. Though he supports the heuristic use of an economic baseline, which assumes an economy operating with Newtonian systemic regularity[58] for the purpose of understanding market fluctuations, he makes clear that this is a mere heuristic fiction, because it leaves "no room for the entrepreneurial function. Thus the mathematical economist eliminates the entrepreneur from his thought. He has no need for this mover and shaker whose never ceasing intervention prevents the imaginary system from reaching the state of perfect equilibrium and static conditions" (698). Why does Mises single out the figure of the intrepid entrepreneur? The entrepreneur is the catalyst who challenges the value structure (price valuation structure, not moral valuation *per se*) of the market. Such a figure overturns the pattern upon which the mathematical economists may rest his statistically derived principles of analysis. While political and natural catastrophes may influence an economy from the outside, Mises here gives an account for why economies never reach equilibrium internally, for unless strong force is applied to coerce entrepreneurship out of the market, there will always be people who are planning to profit through innovation. The products which develop through innovation change the value of goods in the market. Here Mises gives economic support of sub-point 8 of Cilliers's definition of a complex system. As Cilliers (1998, 4) observes, complex systems operate far from equilibrium, and Mises argued convincingly that the entrepreneur makes equilibrium in an economy a very unstable condition to be sure. Economies exist because people want to profit, and some can find ways to make better goods and profit all the more.

In a remarkable prefiguration of Mary Hesse's definition of modeling as metaphorical redescription of the explanandum, Mises concludes that complex phenomena cannot be understood by either the approach of mere deduction from past experience or that

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[58] By Newtonian systemic regularity, I refer to an approach to economic modeling wherein monetary transactions occur according to a perpetual "current" state of the market, as though a an economy continues a perpetual condition in which it continues operating close to equilibrium.

of performing experiments; rather, complex phenomena "become intelligible only through an *interpretation* in terms of theories previously developed from other sources." – a comment strongly anticipating the analysis of Black and Hesse (31, emphasis mine). Mises draws this conclusion based on the line of reasoning I have outlined up until this point. If complex phenomena, as he calls them, cannot be understood through the condition limiting confines of the laboratory, or through statistics, or through a prima facia historical study, then it follows that another means is necessary, one that relies on other resources. Domain external to the problem will needs be summoned to the work. Mises does not think that simply any domain will do, and he is critical of such a move, which is why he turns his attention to the study of nature human action, as a framework for interpreting economic data. Economics then is a hermeneutic activity, in which the underlying causes of complex phenomena must be understood through rational reflection informed by the knowledge of human action, understood beyond the confines of the moment, the phenomena in front of the economist, and this study Mises calls *praxiology*. The explanandum of complex economic phenomena is human action. For Mises, complex economic phenomena must be *interpreted*, so we find some common ground between Misesian economics and the hermeneutic phenomenology of Paul Ricoeur.[59]

Mises criticizes econometrics, or what he calls "mathematical catallactics", in three different ways, on the basis of the epistemological problem of complex phenomena (1998, 347-54). Firstly, he shows that economists who wish to reduce economics to a kind of quantitative science can chart data, but the charts, the statistics, and the record prices do not explain the underlying causes for the complex phenomena. "Statistics is a method for the preservation of historical facts concerning prices and other relevant data of human actions. It is not economics and cannot produce economic theorems and theories" (Mises 1998, 348). Mises is not saying that statistics are not helpful in any way whatsoever. Mises instead is maintaining that measurements themselves do not produce theorems and theories. Recall Mises earlier point about the nature of complex phenomena. One can measure one factor, while unknowingly leaving other factors unmeasured, unaccounted for, or even unnoticed. Mathematics can aid an economist, but it cannot do his work of interpreting the causes of complex phenomena.

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[59] By drawing this conclusion, I do not mean to suggest that praxiology and Ricoeur's hermeneutic phenomenology are identical, as though praxiology was simply an economic hermeneutic phenomenology. There may be a difference between Riceour's emphasis on natural language which emphasizes the temporal located-ness of the event of discourse through an Aristotelian notion of predication, and Mises emphasis on praxiology's a temporal emphasis. Praxiology sees into the causes of action devoid of the context of the historical context of an economic event (Mises 1998, 32). In this way Mises and the rigid use of praxiology places it within the Aristotelian tradition emphasizing that true knowledge is that which is universal (Aristotle 1003a 12-15).

Secondly, but related to the first objection, the relationship between costs and prices cannot be reduced to a general formula, but is rather a function of the meeting in the market of individual subjective valuations. Mises argues powerfully that economic value is not objective but subjective (1998, 349-351). The buyer and the seller are clearly placing different values on the item in a transaction (since one wants to acquire the item and the other sell it), and its price is a function of where these two desires meet tangibly within a given currency structure. Mises's philosophy of subjective value stands against the socialist economics of his day, which sought to find some objective measure of value independent of the market and thus accessible to a central-planner in a state run economy. As an Austrian economist, Mises was strongly influenced by the Austrian school of philosophy through the work of Carl Menger, Franz Brentano, and Edmund Husserl, who Barry Smith in *Austrian Philosophy* has argued were Austrian Aristotelians (1994, 299-332). David Gordon (1996) argues convincingly for a strong Aristotelian tradition as the philosophical origin of Austrian economics. A tacit support of Aristotelian ontology permitted Husserl to anticipate the existence of universal structures in experience. So we should not be surprised to find links "between Austrian economics and phenomenology. Thus Husserl, too, attempts to develop a general theory of value on a subjective ('phenomenological') basis" (303). The seeds of a phenomenology of value trace back at least to Franz Brentano, so it's not surprising "that the Brentano school was dubbed the 'second' Austrian school of value by analogy with the 'first' school of Menger" (Smith 1994, 128). Returning to the topic of economics, Mises argues that mathematical economists, by seeking the precision of mathematics over a clear understanding of the causes of complex economic phenomena, misunderstand the actual relationship between cost and price.

It should be stressed here that Mises is not opposed to mathematics. Mises is not arguing that we should abandon the use of calculation at all. He thinks it is absolutely necessary to employ calculation to understand what is happening in an economy, and this is exactly the problem that he finds with socialist price calculation (below). But one may raise the objection that of course the mathematical modeling of an economy is necessary and useful. Of course mathematicians will want to model an economy. "Economys behave as they do because value transactions are symbolized by numbers!' a mathematical economist might reply. Of course the mathematical modeling of an economy can be useful, so long as the model is guided by the understanding of what actually is causing the participants in the market to transact as they do. For Mises, praxiology (the study of human action related to economics) should precede the application of mathematical modeling, not wholly replace it.

It is this praxiology that permits one to make sense of the behavior of markets, and the prices calculated by participants in a market. Mises addresses economists who would

sidestep the market contingent epistemological context of cost and price by inventing some fixed units of utility that can link the various parts of their mathematical economics without reference to the ebbs and flows of the market. Here Mises argues that economists who make this move misunderstand the process of valuing. "[V]aluing that results in action always means preferring and setting aside; it never means equivalence" (Mises 1998, 351). But also "there is no means of comparing the valuations of different individuals or the valuations of the same individual at different instance other than by establishing whether or not they arrange the alternatives in the question in the same order of preference" (351). While Mises may seem to characterize markets as irrational, since market valuation does not seem to occur according to a fixed formula or set of "objective" properties, quite the opposite is true. Through his account of preference, he is offering part of a mechanism for understanding the behavior of economic systems, and that information provides at least on helpful guide to how an economic model of an economy would be constructed. Admittedly, though, praxiology also gives an account for why all mathematical models of market behavior are incomplete. After all, who knows what the entrepreneur is going to do? Thus, Mises shows that because economic phenomena are complex phenomena, their causes cannot be understood through mathematical computation. For this reason, several Austrian economists distinguish between knowledge problems and calculation problems (Yeager 1994). However, it is fair to say that agent programs, or Artificial Life simulations, that model individual behavior and market participation guided by Mises's phenomenology of value could be very helpful in understanding the dynamics of economic systems. This is because, given a very short time horizon, it is possible model the way that participants in a market may respond in certain situations, but the success of this modeling will depend, on Misean terms with the due diligence one has invested in their praxiological research and development. The dispute here is not over whether phenomenology or mathematics has the hegemony, but rather how they inform one another.

The accuracy of Mises' judgment about the interpretation of complex phenomena has been shown by economic history. Mises (1990) predicted, in 1920, that the Soviet economy would self-destruct. In a socialist economy, the means of production are publicly owned. In the consumer market of the socialist economy, for individuals seeking to purchase goods, the prices of such goods can be based upon what the consumer is willing to pay. Thus there is a consumer market even in the socialist economy. The goods that are being purchased exist because the publicly owned means production brought them into existence, not to profit through sales in the market. This fact gives a socialist economy the appearance of functioning like a free market, because people will still participate in a consumer market. Goods will still be bought and sold. These goods exist because someone made them, but

notice that the authority that made them is not making them for a profit, since they are publicly owned. The means of production belong to all citizens.

Mises carefully shows that because the means of production are publicly owned, no market information exists to instruct those who direct the use of the publicly owned means of production. In the socialist commercial market, and in substantially free markets, prices are used to calculate economic decisions. Prices allow an individual or organization to calculate the costs for a course of action they wish to pursue. As seen above, cost and price meet together in the subjective valuation of the parties involved in a transaction. This subjective valuation is not an "anything goes" sort of affair, rather it is the value placed on the good by both the seller and the purchaser, and affixed in time by the event of a potential purchase. This division of labour in an economic transaction allows for prices to be set. No one person can know all information that all participants know in an economy (see Cilliers's definition sub-point 10). Not only that, the price itself exists because of the transaction ('interactions" per Cilliers) between seller and purchaser (see Cilliers's definition sub-point 3 and 9). Where there is no private ownership of the means of production there is no way to tell what should or shouldn't be produced, or for how long, or toward what end. With private ownership, an owner can try to profit, and likewise, she can find out how she take care to set her prices so she can profit. She can choose to make things which will sell in the market, and can avoid investing energy in courses of action that will not lead to profit. This is because she owns the means of production, and if she is foolish with her resources she can loose those means to someone else who will buy them for a bargain and then quite possibly use them more wisely. She can go out of business. Private ownership allows for the existence of a bottom-line. The system of the market limits the prices one can set, and the resources one can call upon. It provides information necessary to know how many caramel candies equal the value of a new Lexus. And that information is important for both caramel candy *makers* and Lexus *makers.* That information tells them what they can and cannot produce, and if they were ignorant of that information, they would not know how many candies or cars to make to run a profitable business. If the means of making candies and Lexus cars were owned publically owned, and not by, say, Toyota Motor Corporation (the owner of Lexus) There is no way to tell if the means of production are being used efficiently. Who decides how many people should get caramel candies, and how many? Who gets a Lexus? Everyone? The privileged few who agree with those in power? Mises summarizes the state of affairs which prophetically became reality in the Soviet Union, and to make the point of how accurately he, himself, correctly *interpreted* this complex economic phenomenon I offer an extended quotation.

One may anticipate the nature of the future socialist society. There will be hundreds and thousands of factories in operation. Very few of these will be producing wares ready for use; in the majority of cases what will be manufactured will be unfinished goods and production goods. All these concerns will be interrelated. Every good will go through a whole series of stages before it is ready for use. In the ceaseless toil and moil of this process, however, the administration will be without any means of testing their bearings. It will never be able to determine whether a given good has not been kept for a superfluous length of time in the necessary process of production, or whether a work and material have not been wasted in its completion. How will it be able to decide whether this or that method of production is the more profitable? At best it will only be able to compare the quality and quantity of the consumable in product produced, but will in the rarest of cases be in a position to compare the expenses entailed in production. It will know, or think it knows, the ends to be achieved by economic organization, and will have to regulate its activities accordingly, i.e. it will have to attain those ends with the least expense. It will have to make its computations with a view to finding the cheapest way. This computation will naturally have to be of value computation. It is eminently clear, and requires no further proof, that it cannot be of the technical character, and that it cannot be based upon the objective use of value of goods and services…. [A]ny economic system of calculation would become absolutely impossible…. The socialist society would know how to look after itself. It would issue an edict and decide for against a building project yet this decision would depend at best upon vague estimates; it would never be based upon the foundation of an exact calculation of value…. Thus in the socialist commonwealth every economic change becomes an undertaking whose success can be neither appraised in advance nor later retrospectively determined. There is only groping in the dark. Socialism is the abolition of rational economy (Mises 1990, 22-25).

While time and history has vindicated Mises, his vindication means something more than a mere triumph of a portion of an Austrian expatriate's economic theory. With little translation, Mises's arguments apply directly to the modeling of complex systems. Mises writes of the need to correctly interpret complex phenomena, and the points of rich interaction in a complex system, as mentioned earlier. Mises calls his own approach to interpreting complex

economic phenomena "praxeology," because he sees himself as a student of human action. Since I aim to develop a hermeneutic phenomenology of complex systems, there is certainly affinity between my approach and that of Mises. But a hermeneutic approach to complex systems should not be limited merely to economics. There are many more complex systems that need to be modeled.

4. CONCLUSION

Modeling is both the crafting of an artefact and a goal directed human activity. The literature on models suggests that there are many different kinds and that they do not easily fit into a single taxonomy. Through Max Black, Mary Hesse, and Paul Ricoeur, we find that models metaphorically redescribe the explanandum, and claim a truth value which is more than a mere heuristic insight. Models, then, are one kind of *mimesis.* Through the detour of Aristotle's *Poetics* we discovered that Aristotle's model of the four causes can be applied beyond the confines of physical material relationship as Ricoeur demonstrated in the organization of the six parts of tragedy as they correspond to the four causes. The strong connection between models and metaphors established four points: (1) a model is both an artefact and a human action, (2) the project of modeling has multiple simultaneous tasks, (3) metaphors cannot be reduced to "literal" meanings, and (4) both metaphors and narratives can be examined in terms of multiple levels.

This chapter also distinguished between complexity theory, nonlinear science, and the study of complex systems. Paul Cilliers's helpful definition of a complex system was introduced. Through the Austrian economics of Ludwig von Mises it was shown that mere computation is not adequate in the study of complex systems; one must first understand the causes in play. Mises shows how misunderstanding causes and complex phenomena can lead to devastating ignorance. I also clearly stated, in agreement with Mises, that mathematical tools are useful and sometimes, as in the case of economics, essential to understanding a given system. However mere mathematical modeling, I argue, is at best incomplete.

In the next chapter we will continue to engage the subject of complex systems through engaging the field of neuroscience, giving special attention to the three major approaches to the brain as a system; namely, the rule-based, connectionist, and Artificial Life approaches. Chapters 3-6 will then take the definition of modeling, the definition of a complex system, and the three different approaches to modeling brain function, and show how Ricoeur's hermeneutic phenomenology, through the model of the text opens a line of

sight to find common ground between these divergent approaches, with the ultimate goal of situating neuroscience within phenomenology.

Having defined model, and complex systems, and having seen the necessity of transcending mere mathematical approaches to complex systems, let us now consider the most complex system.

CHAPTER 3

Complexity and our most complex system

*[G]iven the complexity of even the simplest example of everyday
human reasoning or human-human communication,
too much mathematical precision simply swamps the analysis in pages of complex formulas.
Then, far from increasing our understanding,
the resulting analysis simply obscures the issues of concern.*
Keith Devlin (1997, 289)

1. INTRODUCTION

We are halfway through the introductory material necessary to begin developing a
hermeneutic phenomenology of complex systems rich enough to interact with neuroscience.
The immediate purpose of developing such a system is to situate neuroscience within
phenomenology rather than reducing phenomenology to a data set for neurosciences to
model. The previous chapter defined a *model* and a *complex system*. I defined a *model* both
as a thing and an action. A model is a thing, whether mental or physical, that humans use to
represent other things, generally things we desire (1) to become, (2) to understand, or (3) to
have or accomplish. A model is also a mode of action as it embodies purpose, while also
serving the success of that purpose, and as such are goal-directed representations
(Wartofsky 1979, 142). The Bohr model of the atom was developed toward the human end
of a better understanding of atomic structure. A fashion model retains her profession

because she or he can display clothing in a winsome way, toward the human end that customers may people wish to have the clothing, and to accomplish (in some fashion) looking like the model. Based on the catalogue of the various types of models and the way in which they can be interchanged for various purposes, I suggested that the various models function like the adjusting plane of focus on a microscope, at any one time clarifying various aspects of thing being modeled while possibly leaving other aspects "out of focus". Furthermore, I defined complex system according to Paul Cilliers's ten-part definition: a complex system consists of (1) large number of elements, (2) the large number being necessary but not sufficient, (3) interacting richly (4) and non-linearly (5) generally in short range interactions (6) with interaction loops. These systems are (7) open, (8) operating under conditions far from equilibrium (9), with a history, and (10) each element in the system being ignorant of the behavior of the system as a whole (1998, 3-5).

This chapter will provide and overview the field of brain science so that Ricoeur's hermeneutic phenomenology can engage it. Since I am taking Ricoeur's side in his debate with eminent neuroscientist Jean-Pierre Changeux, I will first relate the central issues in the debate, indicating what I believe to be rhetorical weaknesses--not substantial flaws--in Ricoeur's case. I will then survey the field of neuroscience to make the case that the relationship between parts and systems in the brain is analogous to the relationship between words and sentences in Ricoeur's hermeneutic phenomenology; thus, system parts in the brain have a *functional polysemy*. Then the rule-based, connectionist, and Artificial Life models of cognition will be presented. For each I will offer criticisms (most of which their respective proponents have levelled at other approaches), and I will identify common ground between each model and Ricoeur's model of the text. Finally, I will specify that my interaction with the brain as a system is a diachronic study, not a synchronic study (to use Saussure's terms). While the brain's origins and development through natural history are important, in this dissertation I will apply the hermeneutic phenomenology of complex systems that I am developing to the brain in its current iteration.[60] The controversy between Pinker (1997, 2005) and Fodor (2000, 2005) suggests that moving beyond this issue of the relevance of the brain's natural history to cognitive science is wise.

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[60] "Iteration" seems to me the best word to get at this notion. This chapter is not exploring the brain's evolutionary development, which a difficult research task because as yet no fossil hominid brain has been found, so study of evolutionary brain development is a conjectural discipline, at least at present. Hopefully further discoveries may change this situation. As we shall see in the concluding discussion of this chapter, our aim here will be to study cognition and its substrate (the brain) in its current physical embodiment.

In *What makes us think?,* Jean-Pierre Changeux and Paul Ricoeur, debate over what backdrop should provide the interpretive context to human cognition, hence the title (Changeux 2000). Should human thought be understood through the current state of knowledge of neurophysiology and the models of cognitive science (Changeux's position) or should the phenomenological perspective of lived existence be the irreducible subject of study for what constitutes *mind* (Ricoeur's position). In their marvellous and spirited interaction Ricoeur and Changeux draw out the central points of conflict between neuroscience and hermeneutic phenomenology. At the beginning of their exchange Ricoeur defines his "turf" as the following:

> My initial thesis is that these discourses [phenomenology and neuroscience] represent heterogeneous perspectives, which is to say that they cannot be reduced to each other or derived from each other. In one case it is a question of neurones and their connections in a system; in the other one speaks of knowledge, action, feeling—acts or states characterised by intentions, motivations, and values. I shall therefore combat this sort of semantic amalgamation that one finds summarised in the oxymoronic formula "the brain thinks" (Changeux 2000, 14).

Hermeneutic phenomenology is by definition non-reductionist[61]. In other words, for Ricoeur, the discourse of consciousness and human experience cannot be equated with physical brain states. The human action of discourse may have a variety of different subjects; we might even call them different types of discourse, but discourse nonetheless is performed by humans. Though a kind of discourse may refer to neurons and their interrelationships, such a discourse cannot encompass human action and human interrelationships.[62] Discourse that describes two neurons firing does not refer to the same

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[61] The use of the term "reductionist" is Ricoeur's own (Changeux 2000, 20). By this term, Ricoeur is referring to Changeux's position of reductive materialism, which he advocates in *Neuronal Man* (Changeux 1985a). Changeux's thesis is substantially equivalent the position advocated by Churchland (1986), Dennent (1991), and Crick (1994), which may each be called proponents of reductive materialism. Ricoeur (Changeux 2000, 20) finds an analogue for his view in Spinoza. Ricoeur is thus advocating a position close to the identity theory. Ricoeur is willing to affirm that the person and the brain inhere in the same substrate, but he is unwilling to allow the discourse of brain events and descriptions of consciousness to be collapsed into the same discourse, which is what happens when someone says "The brain thinks" (Changeux 2000, 52).

[62] For Ricoeur, human discourse is not more complex than neuronal discourse, it merely has a different object. A quick detour from Changeux may be helpful here. Consider Daniel C. Dennett's (1991, 43-65) strong criticism of phenomenology in Consciousness Explained. Dennett offers a catalogue of various experiences and then comments "Note that the view from the inside is well known and unperplexing" (63). Dennett goes on to offer a rival approach to phenomenology, what he

object as discourse about two friends shaking hands. It may be the case that neurons are involved in the second event, but two neurons can be made to fire in a petri-dish, something quite different is occurring in the second situation for Ricoeur, who finds it a grand mistake to collapse the one form of discourse into the other. To put Ricoeur's point briefly: neuronal discourse talks about *impersonal objects*, while discourse about human action talks about *people*.

Changeux attacks Ricoeur on this very point, in the strong sense of "attacks." Throughout the corpus of Ricoeur's work, he consistently offers his opponents the most gracious treatment, even complementing some of their insights by incorporating them into sympathetic innovations that insightfully advance academic areas his opponents cherish[63]. Changeux does not return the favour. Paul Ricoeur aims at dialogue; Changeux aims to subvert Ricoeur's anti-reductionism. In *What makes us think?,* Ricoeur's charity leaves him vulnerable, and in the end, Ricoeur presents a weaker defence of hermeneutic phenomenology than its resources can muster (which I will discuss below). Ricoeur gently confesses the weakness of his interaction with Changeux in *Memory, history, forgetting*. Ricoeur explains that he approached the debate as he did because he did not want to situate himself "on the level of a monastic or dualistic ontology but on that of a semantics of the discourses conducted, on the one hand, by the neurosciences and, on the other, by philosophers claiming to threefold heritage of reflective philosophy…, phenomenology…, and hermeneutics…"[64] (2004, 419-422). Ricoeur does not oppose a unity of human mind and physical body (including the brain) in the same "substratum"[65] (421). Instead, he

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calls heterophenomenology which studies the brain from a third person point of view while accepting first person accounts of experience. For Dennett the first person perspective is more reliable, but certainly problematic (77-78). For example, are we to believe a report of hysterical blindness? Dennett's approach on the surface appears close to what I will argue in chapter 7, namely that neuroscience is a kind of *mimesis*₃, where in the individual's testimony and the experiment history are hermeneutically drawn together in a hermeneutical phenomenological act, which opens the physical substrate to causal interpretation. However, I am not organizing my analysis in terms of sources of testimony; rather, I am approaching the whole process through the model of the text and the three types of mimesis, since my aim is to remain faithful to hermeneutic phenomenology. Dennett's first person discourse and third person discourse are not identical to human action-discourse and neuronal discourse, for human action discourse can be third person discourse, but neuronal discourse can never be expressed as first person discourse. The discourse of human action can be expressed in the first, second, and third person, their neuronal discourse can only be expressed in the third person. Ricoeur understands that this is because the two kinds of discourses have different objects, and not because of a problem in language.

[63] For example see Ricoeur's affirmation of Greimas work (Ricoeur 1998, 79), and Ricoeur's (1978, 65-133) interaction with Saussure.

[64] By "hermeneutics" Riceour refers to the philosophical tradition of hermeneutics which he traces through Schliermacher, Dilthey, Heidegger, and Gadamer (Ricoeur 2004, 419).

[65] Ricoeur distinguishes his own position from that of Cartesian dualism calling it a "semantic dualism" (Changeux 2000, 20). Furthermore, Ricoeur clarifies after a lengthy interaction with the particulars of

maintains that talk about one is not talk about the other; to illustrate the point with an example he does not use: discourse about the functioning of the physiology and mechanism of a heart is not the same kind of discourse that describes a soccer player in a match. A soccer player can attain victory, bring honour to his country, cheat and be disqualified, be a hero for young boys and girls around the world. These are actions, specifically soccer-player actions, and to understand these actions without grasping that the soccer player is a person is not really to understand. Few would oppose the truth that the soccer player's heart is intimately connected to attaining victory, to bringing honour to the country. Even cheating requires the participation of the soccer player's heart, and if his heart did not keep beating, young boys and girls would not be inspired. Put simply, one cannot reduce discourse about an object within a person's body to a person. Neuronal discourse is talking about a part of the human body, but it is only one part, not the whole of the body.[66] It is significant, for reasons I will discuss later, that discourse of the brain as a projective system assumes the brain to be a part of an organism, a part of a whole.

This distinction between the discourse about parts and wholes takes on exponential complications when the subject of that discourse is the human person. While *personhood* is a hotly debated philosophical issue, there is not one neuroscientist who thinks that a *neuron* is a person. A neuron does not cheat or feel honoured at victory; it is just a neuron. Even if a neuron has a partner neuron, or a whole host of little buddy neurons, they will not feel love and tenderness towards each other.

According to Ricoeur, a person is an irreducible unity. In *Oneself as another*, Ricoeur defends the unity of personhood against the attacks by David Hume (Hume 1969) and Derek Parfit (Parfit 1986), and uses their own texts to make his point (1992, 127-39). Hume (Hume 1969, 300, cited in Ricoeur 1992, 128), in *A treatise of human nature*, argues, "For my part, when I enter most intimately into what I call *myself*, I always stumble on some particular perception or other, of heat or cold, light or shade, love or hatred, pain or pleasure. I can never attach *myself* at any time without a perception, and can never observe anything but the perception."[67]   Ricoeur replies in turn to Hume, asking who this someone is "who penetrates within himself, and seeks and declares to have found nothing" (128). Hume's argument oddly assumes what it attacks, namely a personal subject.

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neural anatomy, "On [the] plane of action, the correlation between neurology and phenomenology is equivalent to correspondence" (2004, 422).

[66] Obviously the brain is also involved in this action to. By singling out the heart, I am not separating it from the rest of the body. Nor should we do the same with the brain.

[67] Here Hume is attempting to refute Descartes's notion, somewhat commonplace by Hume's time, that somehow it is possible to know one's self as separate from one's perceptions, a kind of approach that Descartes celebrates in several passages in the Meditations (see Descartes 1993, 35-36 as a representative example).

Parfit (1986), according to Ricoeur, argues for radical reductionism[68], denying personhood completely and taking a position philosophically akin to Buddhism[69]. He presents the unity of personal experience as a stream of perceived moments that are associated with the body[70]. Parfit argues that because there is no one thing that remains the same in one's body, or experiences, over the course of one's life, then one has no reason to conclude that one is a self. Ricoeur shows that Parfit fails to "distinguish between selfhood and sameness[71], [and thus] aims at the former through the latter" (Ricoeur 1992, 137). He also uses Parfit's moralizing[72] to critically evaluate part of his reductionism, showing "[w]hat Parfit's moral reflection provokes is, finally, a crisis within itself" (138). Without selfhood, the question of others and how one ought to treat them becomes irrelevant. Events make up the process of nature, changing, interesting perhaps for scientific research, but not something belonging to ethical categories. Events, as such, are not people. Furthermore, without selfhood, one has no way of identifying whose experiences belong to whom. No warrant is given for why one person has his own experience and another person has her experiences. Experience would therefore be subjectless.

By reviewing Ricoeur's replies to Hume and Parfit, it is apparent that selfhood, in Ricoeur's view, is irreducible to something other than a self, than personhood. Sequences of perceptions (Hume) or sequences of events (Parfit) do not constitute the self. Ricoeur deconstructs either account. Ricoeur's commitment to the irreducibility of personhood also supports the project of hermeneutic phenomenology. In Ricoeur's view, discourse is something performed by humans. Humans mean something when they speak. A written text means something, even though it can be removed (Ricoeur would say *distanciated*) from its author by time, place, context, and culture--even to the point that we lose a record of the author's identity. Texts still reveal the world of the text because they were written by people (see *From text to action* Ricoeur 1991). Ricoeur's commitment to both the irreducibility of

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[68] In this context, radical reductionism refers to the view that there is no person at all, not even the epiphenomenon of a person. Changeux argues that consciousness occurs in the brain, but radical reductionism, in this use of the term, takes consciousness as illusory.

[69] For an excellent discussion of the Self in early Buddhist philosophy see David Kalupahana (1992, 68-75).

[70] On this point, Parfit's argument is similar to Hume's.

[71] Ricoeur goes on to explain personhood as that which makes the body "mine", thus Parfit is not able to identify any "difference between sameness and mineness" (Ricoeur 1992, 137). Parfit's argument rests on showing that there is no one part of the body that persists over time, but Ricoeur challenges his argument to make sense of the crisis of personal identity. One might ask about what persists over time, but that question and other questions of personal identity in a narrative are important questions, because they are important to *someone* (ibid.).

[72] Parfit (1986) advocates his view of personhood toward a moral end. If one understands that what one calls personhood is merely as series of events which succeed one another, then one ought to lower one's esteem of one's self and instead treat others with more selfless moral intention.

personhood and hermeneutic phenomenology are not accidental, and in *Oneself as another* Ricoeur powerfully argues his case (113-139, 297-356).

Returning to the exchange in *What makes us think?* the natural question arises: why does Ricoeur underplay his philosophical hand in his game with Changeux? I believe Ricoeur's weakness in the interchange can be traced back to three presentation mistakes: 1) Ricoeur does not meet the rhetorical presentation of Changeux, 2) he does not apply the full and considerable resources of his own philosophical development to neuroscience and 3) he neglects to distinguish between diachronic and synchronic ways of studying complex systems.

A single chapter cannot offer a full reply to Changeux. However, it is reasonable to reorganize and reorient the subject matter from which Changeux draws the resources to argue against Ricoeur. This chapter then may be thought of as a brief for the development of a hermeneutic phenomenology of complex systems that would make possible the interaction of hermeneutic phenomenology with neuroscience. After a brief treatment of what I believe is Ricoeur's first mistake--not engaging the rhetorical presentation of Changeux--I will then move on to an overview of the field of brain science, concluding by indicating common points between both the hard data and the modeling approaches of brain science and the hermeneutic phenomenology of Paul Ricoeur. Finally, I will conclude with statement on limiting a hermeneutic phenomenology of human neural systems to a synchronic study of the brain and body in its current interaction in natural history.

2. RICOEUR'S THREE PROBLEMS IN *WHAT MAKES US THINK?*

First, a little needs to be said about how Ricoeur could have met the rhetorical presentation Changeux. *What makes us think?* is filled with helpful illustrations like those found in neuroscience textbooks. Humans approach inscribed text linearly[73], which is not to say that discourse and text are ultimately linear phenomena. But, one can distinguish the initial linear human approach to text from the approach to imagery, which humans assimilate

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[73] By "linearly" I mean the words of an utterance or an inscribed text must be heard or read, in a linear sequence. The words in a sentence may not be read in just any old order. One *prima facia* exception to this principle might be ancient Greek and Latin which give grammatical information in case endings, accomplishing the same function that word order accomplishes in English. It is note worthy though that ancient prose and poetry writers in both languages use word order for emphasis on top of the grammatical information included in words of their discourse. These authors therefore further support the point that utterance and text are first understood linearly, for their style on two counts relies on the linear sequencing of words. To draw a further example from the smallest unit of discourse, the sentence. It is when a sentence is concluded that its meaning may be understood. At that point the mind may return upon the sentence as a subject of study and approach it "non-linearly" as a unity distanciated from it temporal linear event of its having been heard or read.

by a kind of parallel processing[74] (not to be confused with a computer's parallel processing—to which I draw no substantial analogy, only an illustrative metaphor). Pictures permit multiple propositions to be drawn from their forms at once. It is appropriate then to see an image as a kind of "a text" (see "Reading the visual" in Tony Schirato 2004, 11-33). The molecular models in chapter 1, and also in this chapter, work to *explain* physical, molecular structures. Since the things represented by these molecular models do not "look" like the pictures, the pictures are redescribing an explanandum, and rediscription what texts do. Ricoeur could have articulated his arguments visually as Changeux does, and such a strategy would not have been at odds with Ricoeur's overall hermeneutical project.[75] Since pictures are parallel-processed, we will discover that they share analogous processing with metaphors but for different reasons (see chapter 4). When one views a picture, one sees various pieces of information at once. Colour, texture, shape, brightness, image composition,are each taken into the eye in the process of viewing an image. An image can make multiple arguments at once, and overwhelm the viewer, which is what makes visual propaganda so powerful.

Ricoeur's need to meet Changeux rhetorically may also be understood by Ricoeur's own discussion of the origins of rhetoric (1977, 9-43). Ricoeur rightly observes that Aristotle's *Rhetoric* represents a compromise position between the Sophists, as represented in the philosophy of Plato, for example. In his dialogue, *Gorgias*, Socrates accuses rhetoric of both being mere flattery and aiming to persuade the ignorant through ignorance (Plato 1971). According to Ricoeur, the persuasive power of Syracusean rhetoric was less domesticated by philosophy on this point (1977, 9). As mentioned in chapter 1, Aristotle's (1993e) development of rhetoric was a compromise between philosophy and the wilder political discourse of the period. Changeux is not afraid to undermine Ricoeur in ways that overwhelm the careful plodding of well developed argument, something for which Ricoeur is famous. Changeux meets Ricoeur with an argument, and, more impressively, with a total tonnage of neuroscience studies to rhetorically support his assertion that neuroscience addresses the issues Ricoeur aims to answer through philosophy. By following this rhetorical strategy, Changeux is able to sidestep the actual arguments Ricoeur makes about the

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[74] By "parallel processing" I am contrasting the ways one encounters image and text. Text, and utterance for that matter, require a linear encounter, after which one reflect upon and evaluates it as a unity. Images convey information in a different way, one that permits the viewer to select what he or she wants to encounter. This is the process of selection assumes that an the visual information is available in a kind of totality, permitting the viewer to choose what features deserve greater attention and analysis.
[75] This oversight I have tried to remedy in the present work.

phenomenological unity of human lived experience.[76] In an industrial society the appeal of the expert is powerful, and Changeux wields the authority of the scientific priesthood brilliantly. The flashes of science-article citations and well-chosen illustrations, mute the points that Ricoeur makes in his own text. With regard to style, while Changeux's writing/speaking is well practiced for *Scientific American*, Ricoeur's lifetime habit of writing in a dense, elegant prose[77] hampers him when up against Changeux's punchy clarity. Furthermore, in *What makes us think?*, Ricoeur may be too gracious to a man who aims to undo his philosophical project.

Changeux makes no attempt to conceal his animosity toward the religious traditions in which Ricoeur has found an "indication" (see Lewis S. Mudge's introduction to Ricoeur 1980a, 3) of his philosophy. Near the end of their debate, Changeux begins with his attack on Ricoeur's religious tradition. Ricoeur begs him: "I… ask you to leave the critique of religion to me, in the name of a religious fundamental to which I have access only through a language of religion" (2000, 271).

Changeux replies:

> Excuse me—I cannot remain deaf, dumb, and blind before a dramatic reality whose consequences for modern society are devastating. There is nothing impenetrable about the language of religion, even if it touches upon an emotional sphere that is very deeply anchored in the personality of the believer. I have known the sphere—I freed myself from it, and I'm happy I did (271).

Changeux's comment here, like those in a number of locations in *What makes us think?*, makes for dynamic reading; it is engaging, and well put, but it cannot be missed that he opposes a source of reflection and inspiration which is decisive in the development of Ricoeur's philosophy. Though it is against the style of a dissertation or a journal article to let the *pathos* flow and dress my reader's mind in well-woven silk, imagine if I were to cut loose, with an example of what Ricoeur *could have written* in reply. Some might have objected had Ricoeur made such a move, and directly besmirched Changeux's visionary secular hopes,

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[76] An excellent representative example of this point may be found in Changeux's dialogue with Ricoeur, where he uses fMRI images to show regions of the brain which seem to be affected by bilingual language acquisition (2000, 138-143). Ricoeur does not oppose viewing the brain as a substrate for human mental action; as this chapter shows, Ricoeur is opposed to identifying language as simply located *in* the brain. The diagram then is equally Ricoeur's, in a sense. The issue is *which interpretation will the diagram receive*. This is also a further illustration of how an image is like a text.
[77] Ricoeur is famous for this problem. See J. E. Smith's comment in chapter 1 (footnote 7 as of 11/24/07).

and Ricoeur is too polite to do that—but the point is that Changeux writes not just with *logos* but with *pathos* (in the classical sense), a level on which Ricoeur was equipped to engage as well, but chose not to.

A strong case could be made for why political ideology should be totally irrelevant to the question of "What makes us think?". Indeed, the thought that political ideology should enter the question is at least unsettling. However, the one who engages in open debate is still, in some measure, responsible to deal with an opponent's attempt to distract from the actually point of adjudication. Aristotle writes regarding these types of rhetorical situations:

> Rhetoric is useful because things that are true and things that are just have a natural tendency to prevail over their opposites, so that if the decisions of judges are not what they ought to be, the defeat must be due to the speakers themselves, an they must be blamed accordingly (1355a 21-24).

In the same way that it is possible to step out of bounds in a debate, it is also possible to use good argumentation (which Aristotle argues is primary means of persuasion) to deal with those distractions actually merit being fully regarded as proof, and bring the discourse back into the bounds of the dialogue.

Second, Ricoeur does not interact on the level of the neuroscience literature, and, as a philosopher, he need not be blamed for this. Ricoeur's life of scholarly work proves him a man of enormous scholarly capacities, making noted contributions to the disciplines of philosophy, theology, history, and literature. In *Freud and philosophy* (1970) and *Hermeneutics and the social sciences* (1980b), Ricoeur proves himself competent in discoursing with the social sciences. In *The rule of metaphor* (Ricoeur 1977), he brings the theory of metaphor to terms with the theory of scientific models. But he still has difficulty engaging with neuroscience because he has not consciously assembled the hermeneutic phenomenology of complexity latent in his philosophy. It is the purpose of this dissertation to provide such a framework.

Finally, in *What makes us think?*, Ricoeur needs to bracket the application of the evolutionary model, which Changeux continually brings into the debate as a warrant for his thorough-going reductionism, by limiting his discussion to a synchronic analysis of the brain, not the diachronic redescription offered by the evolutionary model. It would be trivial to say that the Darwinian theory of evolution has been academically influential, so I will add to that observation Max Black's distinction between a theory and a model (1962, 223). A theory of something, like quantum theory or the theory of relativity, is an explanation that solves for a problem. In contrast, a model takes a story or structure, presented in one domain and

redescribes another subject or discipline in terms of it. While the *theory* of evolution may be helpful to solving many problems, its use as a diachronic *model* draws Ricoeur beyond the scope of his phenomenological study. The evolutionary theory is used to explain how one species (a particular system iteration) turns into another species (system iteration). Then uses as an interpretive model, this theory acts as a framework, a story of how one thing becomes another. But the phenomenology of non-human creatures is very difficult to reconstruct from cues. One may read into an animal's behavior certain human traits, as people often do with pet cats and dogs, but such our interpretations of animal behavior, of the behavior of other species do not conclusively prove that phenomenological reflection gives us insight into their consciousness. Humans do not have the knowledge to write a Merleau-Ponty-esque *Phenomenology of canine perception* that accurately engages lived canine experience. Humans are not dogs. Phenomenology occurs within the current iteration of human embodiment, which includes em-brain-ment. Humans have experience with human consciousness, but we do not have phenomenological access to "the experience" of consciousness for a mouse, cat, or macaque monkey, though there is much we can *infer*.

This chapter will address the second and third of Ricoeur's presentation problems (with the whole dissertation addressing the first). The chapter will close with a discussion of the debate between Steven Pinker and Jerry Fodor as a reason for focussing on a synchronic hermeneutic phenomenology of the current iteration of the brain/body as complex system.

3. THE POPULARITY OF BRAIN SCIENCE

Cognitive science appears, from the outside, to be a slam-dunk success. The popular scientific press presents "the science of the mind" as an ever-advancing endeavour, making clear headway toward scientific answers to the ancient philosophical questions: what is the mind? What is its relationship to the body? How do the mind and body interact? Cognitive science seems to have the answers, even if the answers may be disturbing to some traditionalists. An increasing number of popularisers are cashing in on this expectation by crafting engaging and well-written introductions to the discipline. For example, former MIT and now Harvard professor of cognitive science, Steven Pinker (1997), promises with his title to explain *How the mind works*, which he describes as "a bird's-eye view of the mind and how it enters into the human affairs" (x).[78] The popular appeal of cognitive science and the

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[78] It is beyond the scope of the present chapter to deal with whether Pinker (1997) explains how the mind works, in *How the mind works.* One of my supervisors asked me directly whether I think he accomplishes what his book sets out to do. In reply: no, I do not think he does for the reasons given

faith in its promised answers is evidenced in the financial commitment of the classic science journal *Scientific American*, which in January of 2004 began *Scientific American mind*, a cognitive science spin-off magazine that offers a quarterly update on advances in the scientific study of the mind. The popularity and prestige of brain science is also illustrated by the membership of the Society of Neuroscience which boasts more than 37,500 members, and boasts of a 30,000-person 2007 conference attendance.[79]

But cognitive science is no monolith. In the opening of their edited volume, *Cognitive modeling*, Thad A. Polk and Colleen M. Seifert defend their cacophonic anthology of cognitive science articles as follows: "The cutting edge of science in cognitive modeling involves controversy; that is, there is no single voice that represents 'the right' perspective regarding which approaches will succeed, which issues are the most important, in which articles will prove in the end to be the key to future developments in the field" (2002, xii). Polk and Seifert in *Cognitive modeling* represent the discipline more as it is – a battleground of warring theories and explanations.

Though it is impossible to offer an overview of brain science in a single dissertation chapter, it is important that I thematise and characterise the relevant current state of brain studies. This overview will introduce the study of the brain and the modeling of neural events to bring brain studies to terms with a hermeneutic phenomenology. In the remainder of this chapter, I will first organize the levels of physical complexity in the brain and show how each has a feature which I will call functional polysemy. Then I will outline the scientific attempts to study the mind according to three main approaches: rule-based (computational), connectionism, and Artificial Life. At the end of each outline I will present strengths and criticisms of each approach. Then I will clarify that the hermeneutic phenomenology of complex systems discussed in this dissertation aims at a synchronic analysis of the brain as a system, in a system. This synchronic study must be distinguished from a diachronic study, one that looks at the history of the systems formation, thus we will here not be analyzing the natural history of the human brain. I will give warrant for focussing on a synchronic study from the controversy engendered between Jerry Fodor and Steven Pinker on the subject. I

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by Fodor (2000, 2005). In my assessment, the computational theory of mind and natural selection are not adequate explanations, first because of the problems with the problems with the computational theory of mind discussed in this dissertation. Furthermore, natural selection offers an account for why certain organisms can survive and reproduce in their environment, but it does not account for the truth bearing nature of mental states. Natural selection does not necessarily select for knowledge, or knowledge capacities, but for survival ability. If a brain were to survive by self-deception, then it would be naturally selected to reproduce. Thus, natural selection could equally be used to explain the devolution of the brain.

[79] See the conference brochure produced for Neuroscience 2007 by the Society for Neuroscience (Society-for-Neuroscience 2007).

will then conclude with some initial steps at finding common ground between hermeneutic phenomenology and brain science.

4. NEUROSCIENCE AND THE POLYSEMY OF FUNCTION

A thorough presentation of neural anatomy is beyond the scope of this dissertation let alone a chapter in this dissertation[80], the application of a hermeneutic phenomenology of complex systems must be able to engage a particular systemic complexity. In order to accomplish this feat it will be necessary to briefly touch on the concept of polysemy which will developed more completely in chapter 4 and will be employed significantly in chapters 5 and 6. Polysemy is the quality of words that lets them mean more than one thing, depending on which sentence employs them. Ricoeur puts it more tersely: polysemy "signifies that there is more than one sense for one name" (Ricoeur 1977, 113). Natural language has polysemy, which can make natural language seem imprecise. Ricoeur however believes polysemy to be a good thing.

> That polysemy is not a pathological phenomena but a healthy feature of our language is shown by the failure of the opposite hypothesis. A language without polysemy would violate the principle of economy, for it would extend its vocabulary infinitely. Furthermore, it would violate the rule of communication, because it would multiply its designations as often as, in principle, the diversity of human experience and the plurality of subjects of experience demanded (Ricoeur 1977, 114).

Therefore, polysemy permits a conservation of language and the possibility of communication. Since language is able to accomplish more with fewer parts, it is an effective tool for communicating.

Ricoeur also makes clear that polysemy is a synchronic[81] quality of a system of *langue* (the system of a given natural language be it English, French, Chinese, etc.) and not a diachronic[82] quality, and that observation will bear on the development of our hermeneutic phenomenology of complex systems (this does not mean that there is no diachronic aspect

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[80] Several general works (Kandel 2000d, Gazzaniga 1995, Arbib 2003a, Squire 2003) were particularly helpful for organizing the sections that follow
[81] The term *synchronic* refers to the quality of system relationships at a given system state in time, not in the change of a system over time.
[82] The term diachronic refers to the quality of system relationships as the system changes through time, not at a given system state in time.

to polysemy, but that discussion must remain for chapter 6.) As I mentioned earlier, and will mention again later in this chapter, this study will engage whole system of the brain (and other systems) in synchronic study rather than diachronic study (through various evolving iterations of the same system). We will not be examining the brain as it may or may not develop throughout natural history. Instead we will examine the human brain as a system within systems in its current iteration.[83] Ricoeur observes that polysemy as a quality of natural language, is a quality of language on the synchronic level (1974, 68). He explains the importance of the synchronic definition of polysemy in *Conflict of Interpretations*:

> We will continue the description in Saussurean terms, distinguishing a "synchronic" definition from a "diachronic" definition of double meaning. The synchronic definition: in a given state or language, the same word has several meanings; strictly speaking, *polysemy is a synchronic concept*. In diachrony, multiple meaning is called a change of meaning, a transfer of meaning. Of course, the two approaches must be combined in order to take a global view of the problem of polysemy on the lexical level; for in polysemy, changes of meaning are considered in their synchronic dimension, that is to say, the old and the new are contemporaneous in the same system. Moreover, these changes of meaning are to be taken as guides in disentangling the synchronic skein. A semantic change, in turn, always appears as an alteration in a preceding system; if one does not know the place of a meaning in a system state, one has no notion of the nature of the change which affects the value of this meaning (1974, 68), *emphasis added*).

Ricoeur clarifies above that polysemy operates on the synchronic level, while he admits that the diachronic dynamic in language is important. It is important to point out here that Ricoeur is not referring to the diachronic progression of one system changing into another, say the transformation of the language of the Italian peninsula from Latin to Italian over several hundred years. Instead, he is referring to the diachronic change that one word may go through in relations to a previous meaning. A word can come to have *a new meaning*. However, that word still retains the old meaning as well because of the synchronic relationships that word has within a system. The word can go back to being used as it had been in the previous context, given the right situation. This quality of words multiplying meanings without losing past meanings is a systemic quality, not a quality rooted in some

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[83] For an explanation of why this is the case see the latter part of this chapter.

essence inside the original word. All the same, one cannot wholly remove the quality from the word itself, so it would be false to merely talk of the system of a language and evade the words themselves that make up that language.

Ricoeur's conception of polysemy and his careful parsing of the concept through the lens of a synchronic definition of it will prove incredibly helpful for bringing hermeneutic phenomenology to terms with brain science, an awesome task to be sure. Later in this dissertation I will develop an analogy between the model of the text and complex systems. But here the case will be made that the brain exhibits something I will call *functional polysemy*. I will develop this concept more in later chapters, but for now let me define *functional polysemy* as that quality of system parts or subsystems which lets them accomplish more than one function. Physical complex systems, as well as other systems, are comprised of parts with functional polysemy. This means that understanding them presents at least a small challenge, for a study of their function must always take into account the system in which their function has purpose. Within a different subsystem they may accomplish significantly different functions. However, it must be emphasized that polysemy of function would be understood by analysing the system on the synchronic level, rather than the diachronic level. A whole system change could alter the functioning of a part, even though the part remains unchanged. When a car engine designer redesigns a transmission and decides to use some of the same gears for a different purpose (to save tooling costs for manufacturing), the system is changing around a part that remains the same.[84]

I will now survey every major level of brain organization. Along the way it will be made clear that at every level functional polysemy is in play. Therefore this overview of neuroscience, like Ricoeur's detour through the theory of scientific modeling (in the sixth study of *The rule of metaphor*), represents the decisive point of this chapter.

4.1 CELLULAR LEVEL PLURALITY OF FUNCTION

The complex systemic quality of the brain can be seen at all five levels of brain structure: molecular, cellular, tissue, schema, and global.[85] For purposes of clarity, we will

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[84] Ricoeur does treat the question of the diachronic level in the relationship that develops the polysemy of words, namely metaphorical predication. In metaphorical predication the polysemy of a word is stretched through the act of predication, but that diachronic system activity happens at the level of discourse, not solely within *langue*. For discussion of the issues related to this, see chapters 4 and 6.

[85] I have only distinguished five levels. Patricia S. Churchland and Terrence J. Sejnowski (1996, 11) suggest that there are seven, namely, molecules, synapses, neurons, networks, maps, systems, and the central nervous system. However, it will be clear that my organization specifies functional

begin with the neuron, and then step down a level to the molecules which facilitate communication and even system changes. Then we will move up to the level above the neuron, to the level of tissue—the level of the neural network. Finally we will consider schemas and how the brain as a system participates in the body's other systems.

Cognitive neuroscience has assumed that the neuron is a fundamental conduit for information processing in the brain, and this assumption is probably right. Below is a diagram of a neuron, and in accordance with the definition given in chapter 1, in Brown's (2003b, 22-24) analysis this diagram is a model of a *neuron*, or if we apply the insights of Hesse (1966, 157), it is a *redescription* of the domain of explanation, a process Aristotle would call *mimesis*.

anatomy, and that a careful reading of what follows is not in conflict with the anatomical data they present.
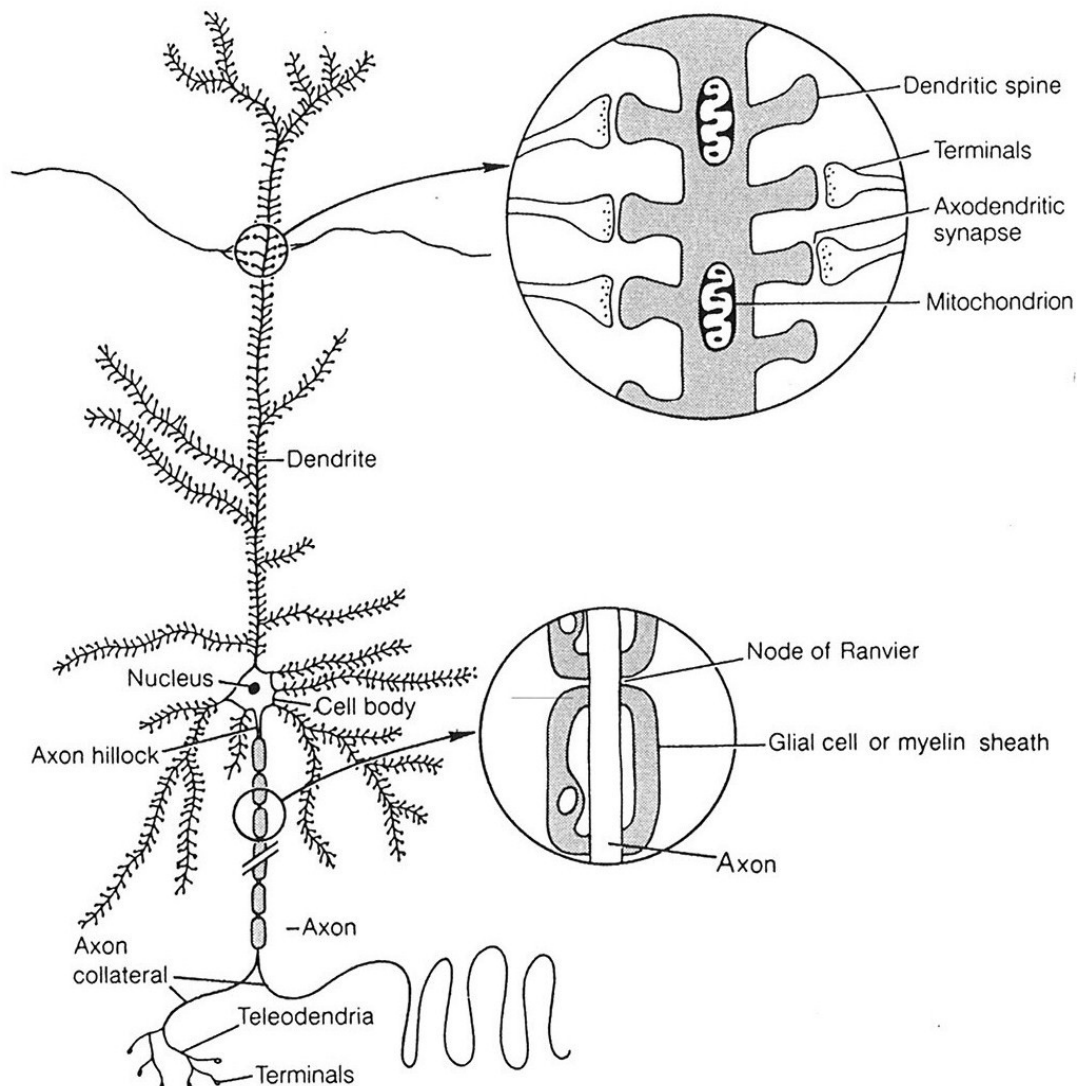
Figure 3.1. A diagram illustrating a typical neuron (from Goldblum 2001, 23)

Nerve cells, generally, have three main sections: the *cell body*, the *axon*, and the *dendrites* (see Eric R. Kandel 2000, 21-25). The cell body contains the cell nucleus and organelles that support the life of the cell. Nerve cells usually have one long tube-like axon that projects away from the cell body and is usually insulated by myelin, a fatty sheath with small gaps in between each myelin wrap. At the end of the axon's branches are swollen ends called *presynaptic terminals*, at the end of which are the *synapses*, the regions where nerve cells exchange electro-chemical information and where electro-chemical information is transferred. The dendrites extend out like tree branches away from the body of the cell, and they receive information through synaptic connections with other cells. Choosing the

synapse as one's point of reference, one can trace the progress of information from the *presynaptic cell* (the cell before the synapse), through the *synaptic cleft* (the intercellular space between synaptic ports where neurotransmitters passed), to the dendrite on the *postsynaptic cell* (the next nerve cell after the synapse. Thus one may see that the connection between dendrites and axons through the meeting of synaptic ports would naturally form a very complex network. Researchers have focused on the properties of these cells and the networks that arise from their interaction, in large part ignoring the cells surrounding neurons.

However, some research attention is now being directed at glia cells, which structurally support neurons, provide them with nutrients, and are instrumental in repairing damaged neurons (Arbib 2003a). These cells include those that make up blood vessels in the brain, macroglia, microglia, and the choroid plexus that secretes cerebral fluid (see Squire 2003, 7). Michael A. Arbib observes that "[n]eurons are intimately connected with glia cells, which provides support functions for neural networks. New empirical data shows the importance of glia in regeneration of neural networks after damage and in maintaining the neurochemical milieus during normal operation" (2003a). While glia may eventually turn out to play a more substantial role, I am purposefully leaving glia cells out of my discussion of brain anatomy, since neural modelers have generally ignored them in developing their models.[86]

Early efforts to model the neuronal structure of the brain were inhibited by the mathematical methods of research pioneers, who developed highly abstract networks made of simple parts. "The simplest units are two state binary units… such binary units do not resemble neurons, but they do have strong appeal for nerve net modelers…" (Rall 2003, 877). These units, being digital, are more easily modeled by computers, and thus are easier to work, but they do not behave as neurons do, which have, many more possible states than a two state binary unit. Real neurons are not even close to binary units; some neurons may have 10,000 synapses, and this diversity of possible inputs opens the potential in many neurons for a diversity, or polysemy, of function, be either individually or corporately (in pathways) able to accomplish multiple functions.

Neurons obtain a polysemy of function through at least two processes, that of neuromodulation and the regulation of ion channels. Neuromodulation occurs when the behavior of neurons is altered through the use molecules that on other occasions function as neurotransmitters (which will be discussed in detail below). Neuromodulation makes it possible for one neuron to perform multiple functions. Along with of the work of

neuromodulators in changing the behavior of neurons, ion channels also increase the functionality of the neuron (José Bargas 2003). Ion channels (see chapter 1, figure 1.1) are special proteins embedded within the membrane of the nerve cell. By opening and closing to particular stimuli they alter the conduct of the neuron and in fact change the *threshold* of the neuron.

The threshold of a neuron is the critical level during depolarization, the change in membrane voltage of a neuron due to a decrease in the absolute value of a neuron's membrane potential, which, when reached, "produces an all-or-none *action potential*" (John Koester 2000, 126). An action potential is the signal the brain uses as a means to receive, analyze, and convey the information it employs. They are all-or-none nerve impulses, initiated by a region at the beginning of the axon known as the *axon hillock*. These nerve impulses have a duration of roughly 1ms and an amplitude of 100 mV (see Kandel 2000c, 21-22). Ion channel regulation can change the threshold of the neuron, thus changing the point at which the action potential fires. This means that a neuron can deploy at least several different action potentials. This means that the neuron can perform multiple different tasks in the pathways in which it participates. Clearly we see here the quality of the polysemy of function.

Furthermore, recall Cilliers's 10-part definition of a complex system. Part nine of his definition required that a complex system have a history. It is noteworthy that the action potential firing points can be conditioned by their previous firing history. Neurons, in some way, learn from their working history, yet they can still accomplish multiple tasks. We see that Ricoeur's observation about the synchronic definition of polysemy applies also to the *functional polysemy* of neurons.[87] As I mentioned earlier, this study is not examining that natural history of the brain's development. This dissertation examines the brain on the synchronic level. However Ricoeur, as mentioned above, pointed out that on the diachronic level, words can change meanings, in one sense. A diachronic analysis of the neuron has been used Lyle J. Graham and Raymond T. Kado (2003) so as to take the neurophysiological data showing the neurotransmitters/neuromodulators swap (to be discussed in detail below) and the plurality of function resulting from ion channel regulation (discussed above) and argue that an accurate model of the neuron necessitates "a four-dimensional construct" (174) so that the biophysical properties that alter in different locations

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[86] But the approach developed in this dissertation would also be able to make use of new information from glia cell research, so this approach is not dependent on our current ignorance of glia cells.

in the brain and at different points *in time* can be fully accounted for. Thus to model the neuron accurately, one must model its different uses in time. It can have multiple behaviors. Again the analogy holds with Ricoeur; neurons, like words, have multiple uses.[88] However, since neurons retain a relationship to the system, the new use remains alongside the old, or perhaps several older uses. Thus, if my analogy holds true, the neuron on the synchronic level, like an individual word in Ricoeur's discussion, can have multiple potential uses at any point in time in the system. So the same quality of plurifunctionality found in words could conceivably be also present in the brain as system, on the cellular level. Thus the ion channels of the nerve cell permit a polysemy of function, which occurs within the framework of other acting cells that form a network.

So we see that the polysemy of function is present on the cellular level, we now will move below the level of the neuron, to the molecular level. After having treated the molecular level we will proceed on, past the level of the neuron, to greater levels of neural organization.

5.2 MOLECULAR PLURALITY OF FUNCTION

We will now step below the level of the neuron, to the level of the molecule. Even there, some molecules in the neural system exhibit the property of functional polysemy. While life's basic unit is the cell, the cells of the body must still communicate with one another. This communication sometimes occurs through other cells. In fact, the brain is a set (a vast multitude) of cells that allow for other systems of the body to, in a sense, communicate with one another. But inter-cellular communication does not necessarily occur through other cells. In fact, the cells of the brain also use intermediaries to communicate with one another. These intermediaries, depending on how and where they are used in various neural subsystems, can have a powerful system altering effect. As such, they help to illustrate the concept of functional polysemy. The complexity of the neural system can even be seen below the level of the neuron—the fundamental building block of the brain and nervous system—in the neuromodulators and neurotransmitters that condition and modulate synapses.

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[87] A more thorough discussion of the concept of polysemy may be found in chapters 4 and 6. This initial discussion is sufficient for introducing the concept of functional polysemy in the context neuroscience.

[88] The implications of this point will be applied at length to langue and discourse in chapters 4 and 6.

Synapses are the hubs of communication between neurons. They are spaces between neurons, we could even call them ports, where neurons communicate (LeDeux 2002, 2).
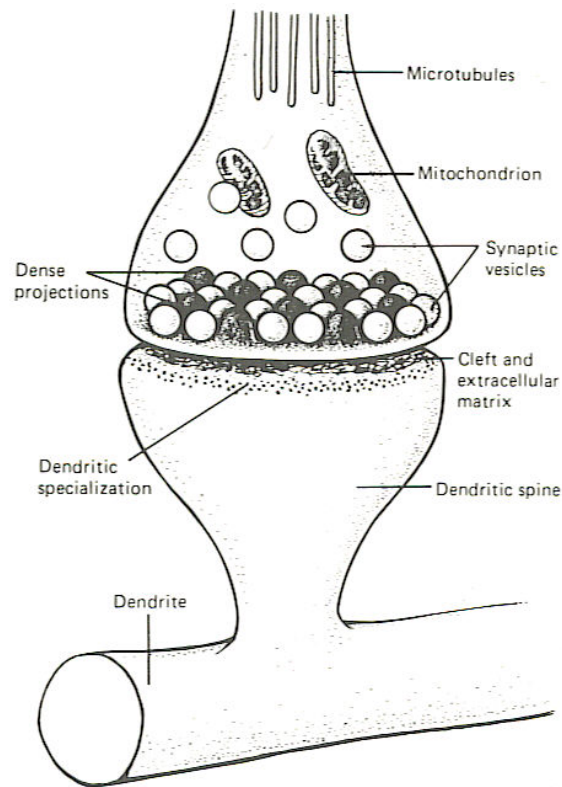
Figure 3.2. A diagram illustrating a three dimentional model of a synapse. (in Churchland 1996, 46, taken from Gershon 1985)

When an impulse travels down the membrane of the neuron it causes a chemical neurotransmitter to release from its terminal, pass across the synaptic space, and bind to the dendrite on the opposing neuron. (LeDeux 2002, 2)
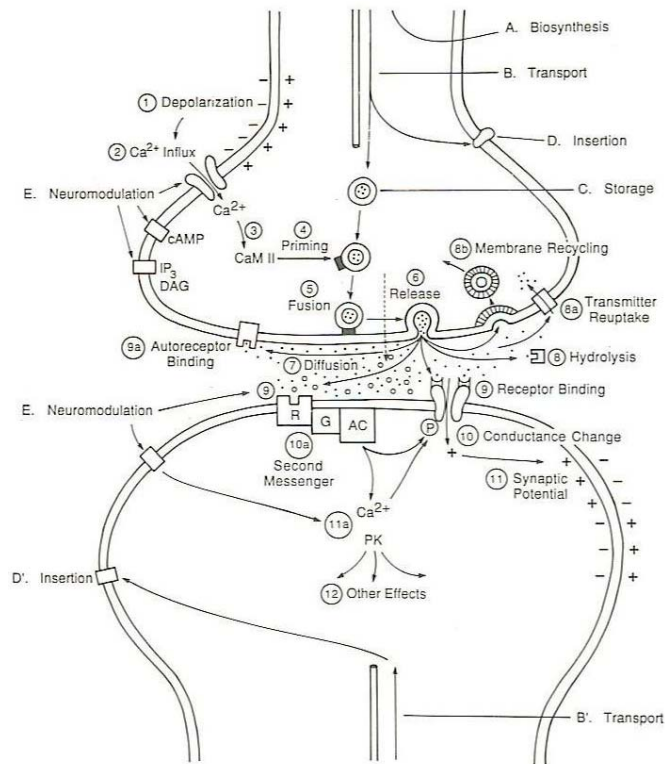
Figure 3.3. A diagram illustrating a schematic representation of a summary of some of the main chemical reactions that have been identified in the synapse. (in Churchland 1996, 49, taken from Shepherd 1988)

While neurotransmitters communicate between neurons, neuromodulators can change the function of the neurons that release the neurotransmitters. Neuromuscular junctures, neuronal membrane properties and synapses, and the properties of muscles can be modulated by locally released neuromodulators, or more systemically released hormones. The previous section discussed the functional polysemy of neurons. On the molecular level, it is important to observe that "the effect of a neurochemical is receptor-dependent: a single neuromodulator such as serotonin can have dramatically different effects on different neurons, depending on the type of receptor it activates. Indeed, *a chemical may function as a neurotransmitter for one receptor and as a neuromodulator for another*" (Arbib 2003b, 55, emphasis added). The body of knowledge on neuromodulators is limited, since extensive research has been conducted on only a few of the brain's neurotransmitters.
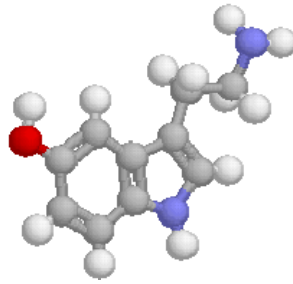
Figure 3.4.1 A ball and stick model of serotonin (University-of-Bristol).
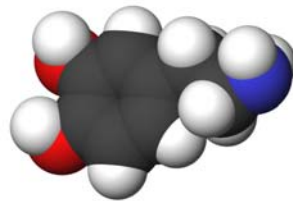
Figure 3.4.2 A space filling model of dopamine (Wikipedia 2007b).
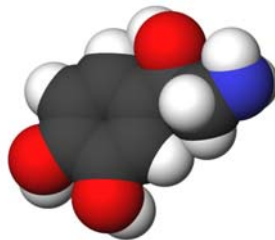
Figure 3.6. A space filling model of norepinephrine (Wikipedia 2007c).
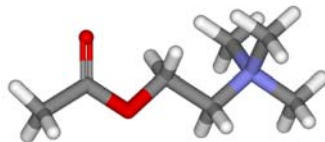
Figure 3.7. A stick model of acetylcholine (Wikipedia 2007a).

Figure 3.4.1-4 are models which illustrate the differing but similar structures of four neurotransmitters which are also neuromodulators.
Presented here are three types of models, the space filling model, the stick ball model and the stick model. While this figure helps to illustrate the material from this chapter, it also illustrates the points raised by Brown (2003b), with respect to how visual illustrations of molecular structures are models, not dicrect perceptions. All three of these types of models have their own strengths and weaknesses, for each of them highlights a particular aspect of the molecular structure of these molecules. The space filling model highlights the general shape if the molecule. The stick ball model highlights the structure of the molecule. And the stick model highlights the angles at which the various atoms are joined with one another.

Research on dopamine, norepinephrine, serotonin, and acetylcholine (modeled above) suggests that this plurality of use is a trait pervasive enough not to be ignored (see D. A.

McCornick 1993, J. M. Fellous 1998, Hasselmo 1995, Katz 1999). For our purposes, the dual function that neurotransmitters serve is another example of functional polysemy. On the synchronic level, each neurotransmitter can accomplish any one of a number of functions depending on the type of receptor it activates. It follows then that even on the molecular level, we see functional polysemy in action. In the way that a lexicon may catalogue the various uses of a given word, so it is possible to catalogue the various uses of each neurotransmitter within the system of the human brain. So functional polysemy also applies not only at the neural level but at the molecular level, which suggests that the hermeneutic phenomenology of complex systems to be developed in the last four chapters of this dissertation also applies at the molecular level.

4.3 TISSUE/NETWORK PLURALITY OF FUNCTION

We may now move past the molecular and cellular levels to look at assemblies of cells. Cells join together to make tissues. When neurons join together in tissue structures they make neural networks. Within such networks the action potential of neurons triggers other action potentials in other neurons, transferring information from one cell, or group of cells, to another. So far, I have made the case that neurons and the neurotransmitters they use have a functional polysemy, and it may seem obvious that if neurons have a plurality of uses, networks of neurons must as well. But this conclusion does not necessarily follow. Just because bricks have functional polysemy in that they can make chimneys, houses, libraries, and rubbish piles, it does not follow that chimneys and rubbish piles have a plurality of functions. To avoid the so-called fallacy of composition, one ought to ask if the network itself has a functional polysemy, and it turns out that it does, in and of its own right.

While it may be difficult to isolate a neural network in the human body and study its function, it has been possible to do this in animals. The crustacean somatogastric system is just such an isolated network. In the crustacean somatogastric system, research has shown neuromodulators considerably increased the number of functions performed by the neural network of the crustacean somatogastric system (see Harris-Warwick 1992). The crustacean somatogastric nervous system (STNS) has four networks, those in the crustacean oesophagus, cardiac sac, gastric mill and pylorus's network. Scott L. Hooper (2003) drew research together on all four networks and was able to identify common properties among all the networks. Among them, "[m]odulatory influences can induce individual STNS networks to produce multiple outputs, "switch" neurons between networks, or fuse individual networks into single larger networks. [Also,] modulatory neuron terminals receive network synaptic

input. Modulatory inputs can be sculpted by network feedback, and become integral parts of the networks they modulate" (304).

In other words, neuromodulators can alter networks to have *functional polysemy*. Furthermore, modulatory neuron terminals can be told to change the function of the network. So networks can then affect modulatory neuron terminals to change the function of other networks, achieving more functional polysemy within a system of systems. In this particular biological system one finds the development of a feedback loop (as per Cilliers' (1998) definition of the complex system) and strong support for functional polysemy in complex systems.

The STNS presents a paradigm example of how biological neural nets and networks of neural nets operate. The diachronic change of function is controlled by nerve cells that one network acts upon to then change the operation of itself or another network. This quality is trenchantly described by José Bargas, Lucia Cervantes, Elvira Galarraga, and Andres Fraguela:

> Accordingly, neuronal nets dynamically switch between different firing states and different configurations of synaptic weights: n thresholds and n firing levels due to n ion conductances activated at each level. A different pattern at each level will reach synaptic terminals differently (2003, 590).

These different patters, which reach synaptic terminals differently, account for the way in which a neural net alters its own functions or the functions of other nets. José Bargas et al., show that the regulation of the action potential threshold allows the neuron to perform multiple functions, and in doing so, it also can affect the surrounding network and networks. But notice that this diachronic change of an individual neuron, or network, is possible because of the system in which that network participates. Again, we find strong evidence of functional polysemy, and strong warrant for carrying over Ricoeur's insights about polysemy in language to the domain of functional polysemy in complex neural systems. This functional polysemy will be a critical joining element between complex systems and the model of the text.

4.4 SCHEMA THEORY AND THE PLURALITY OF FUNCTION IN CONNECTED REGIONS

One might also move up one level, from the level of the network, to look at the broad interaction between various structures in the brain, the domain of what Michael A. Arbib calls *schema theory* (2003c). A *schema* is a unit of functional analysis, that Arbib suggests should

as much as possible be examined in terms of structure. He also makes clear that, by using this terminology, he does not intend to commit schema theory to the framework of a particular sub-discipline of brain research; rather, he wants to provide terminological common ground for researchers from psychology, philosophy, linguistic, cognitive science, neuroscience, computer science, and medicine to interact with brain theory. It follows that schema theory may then be helpful for a hermeneutic phenomenology of complex systems, because schema theory represents an initial step towards a unified discourse which relates phenomenology to cognitive science. Schema theory recognizes the need for examining so-called "internal" states in terms of a system, or even a system of systems, rather than a particular set of neurons or neural pathways. Furthermore, it recognizes the multiple epistemological gestalts required to understand what is going on in the human organism when a human understands an object of knowledge, and thing from consciousness, to an apple, to another human being.

The idea of the "active organism" is at the heart of Arbib's approach (994). The term "schema" has been used in several ways: to denote the shape of the body, to describe the organization of experience in psychology, and even to account for motor-skill learning (994). Arbib suggests a more specific use of the term, "constrained by the need to explain the neural basis of behavior, stressing that schema expresses a function that need not be coextensive with the activity of the single neuronal circuit. [Put simply, a] schema is what is learned about some aspect of the world, combining knowledge with the process for applying it" (994). Take the example of an apple. An apple has a colour, texture, shape, taste, sound (when bitten), but there is also the story of how that knowledge is acquired: discovery of the apple, the first bite, the taste, the satisfaction after consumption, the memory of the apple, investing one's self in the labour of getting more apples. Cognitively, the getting of apple knowledge is a complex business. Schema theory act to unify the facets of the act of knowing and the knowing of the act regarding apples, and the many other objects that minds know and bodies act upon. He goes on to subdivide the schema into a *perceptual schema* and a *motor schema*, with attendant *activity levels*, adding to that *schema assemblages* and *coordinated control programs*.
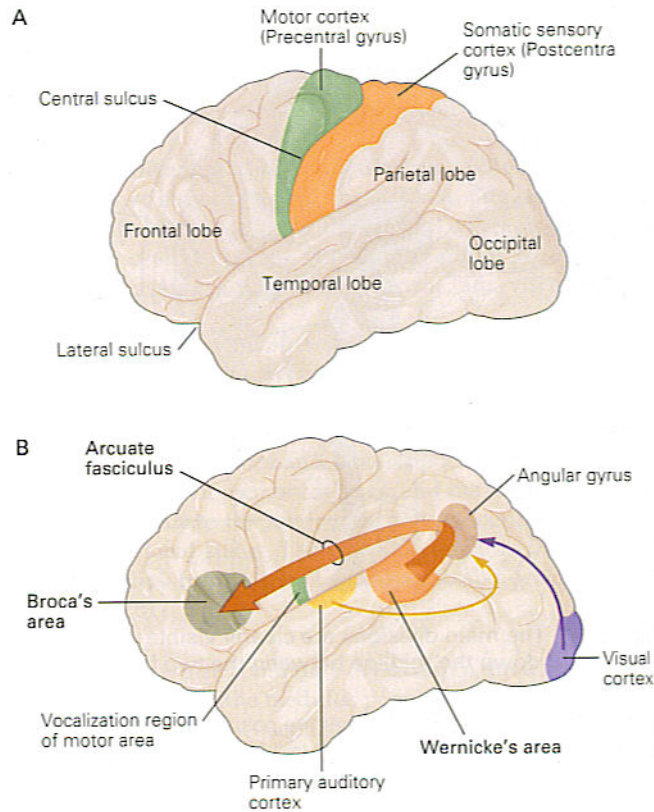
Figure 3.5. An illustration of the left hemisphere of the cerebral cortex.
A. An anatomical labeled diagram of the left hemisphere of the brain color highlighting the motor and somatic sensory cortexes.
B. A partial representation of the areas of the brain work together to achieve the human faculty of language. These areas would in part constitute what Michael A. Arbib would term a *schema*. (from Kandel 2000a, 10, adapted from Gershwind 1979)

Whether one accepts Arbib's terminology, or his multiplication of entities, the central idea of schema theory is important, for it aims to connect the vast unsorted findings of brain science into the beginnings of a cohesive theory. Arbib understands that it is not enough to report the behavior of the brain in relation to the observed behavior of the organism that a given brain inhabits. That kind of truncated explanation is an explanation on the cheap. Such a account tells *what*, without explaining *why*. Neural physiology, psychology, cognitive science[89], and even linguistics have a place in driving the effort of opening various schemas to human understanding. In Paul Ricoeur's terms, Arbib gives *schema theory* great polysemy, since it can be applied both to Artificial Intelligence and to brain study, both to the phenomenology of concepts and to the brain activity that serves the development of those concepts. Schema theory also allows us to see that the brain must draw together the

pluriform activities of its multiple networks, but like all the other levels of organization the schema itself is not ultimate. "[T]here is no one 'grand apple schema' that links all' "apple perception strategies' to 'every act that involves an apple'" (Arbib 2003c, 997). It is not as through each person has the same platonic apple schema (form) in the mind which a hyper accurate fMRI or PET camera could find.

Schema theory gives a theoretical space for the interpretation of PET and fMRI images that permit one to see the brain in action. Whether one has a term for it or not, when one attempts to interpret PET and fMRI images, one engages informally in an attempt to develop a kind schema theory. It is believed that these images indirectly evidence the brain summoning its parts to action. After neurons release action potentials, it is thought that increased oxidative metabolism and blood flow are necessary to refresh neuronal ionic concentrations. Functional brain imaging data points to this. But we have ample testimony, from the time of Homer and the dimmer past, that the life of the flesh is in the blood.

One need not stop with schema theory. The brain itself, situated within the nervous system, also has a plurality of functions. Like the parts and subsystems in the brain participate in the brain's activity, so also the system of the brain participates in the central nervous system, one of the nine systems of the human body (Barry Smith Forthcoming). Clearly one can identify a divide between the nervous system and the circulatory system, but it would be a mistake to divide the various systems as though they do not inter-penetrate one another. Neuroscientists often forget this. Some have even coined a discipline called *neuroethics*, on the assumption that the person and the nervous system are equivalent, and since ethics deals with what people do, it follows that ethics only deals with what neurons— not bodies—are doing (Gazzaniga 2005, xv). It is worth noting the great irony that a brilliant scientist, like Michael Gazzaniga, who rejects the existence of spirit, preach what the ancient Gnostics would approved on the basis of their ideological kinship with Plato's ontology of the soul. The similarity between Gazzaniga and Plato rests in the segregation of a component from the body, the nervous system and the soul respectively, and then following us this move by treating the part as though it is the full constitution of the person.

Both schema theory and the brain's own participation in the systems of the body support the conclusion I suggested at the beginning of this chapter, that all parts of the complex system of the brain, on every level of organization exhibit this feature of functional polysemy. It would seem then that the objects of neuroscientific study and Ricoeur's model of the text have at least this one point of common ground, and as we continue it will become more apparent how significant this point of common ground is.

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[89] I use *cognitive science* with reticence here, because the use of the term also associates with it

5. OVERVIEW TO THE MODELS OF COGNITIVE SCIENCE

We now move on to cognitive science and it three most generally popular and representative models, namely a rule-based model, a connectionist model and an Artificial Life model. I will develop the rule-based model as a context for discussing connectionism, rather than developing it as a sufficient account of cognitive activity. It has been substantially discredited as a complete solution to the problem of mind[90], and I will discuss some of its problems. The rule-based approach has an element of common ground with hermeneutic phenomenology because it takes symbols seriously, recognising that there must be some level of interaction between the symbols that is not in the symbols themselves. However the rule-based model segregates the symbols from the rules that govern their manipulation in computation (see below), and that move leads to substantial problems as we shall see.

I will then introduce the connectionist model, building on my previous introduction to neuroanatomy, and also present connectionism as a better solution to the problem of mind (if better means holding more promise to duplicate animal behaviors).[91] I will then present challenges to connectionism, which I believe can, in part, be overcome. The connectionist model has strong common ground with a hermeneutic phenomenology of complex systems, because both neural networks and language share an analogous complex structure. Paul Ricoeur's model of the text makes a detour through structuralism[92] to account for the

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theories which I argue in this dissertation are incomplete.

[90] Three classic problems with AI and symbol based cognitive science are (1) the frame problem, (2) the symbol-grounding problem, (3) and the problem of embodiment and situatedness. The framing problem arises from trying to have a formal symbolic representation adjust to model a complex changing environment. When formal systems attempt this, they end up quickly multiplying complex encoding schemes to manage relatively simple changes.

The symbol grounding problem is the name given to the challenge of identifying a specific state of affairs in the outside world with a particular symbol or symbol set in a computer (or mind). This situation creates no problem for computer program users, because a program user knows what the symbols, or output, means. In the context of a computer program, the question of correspondence is not an issue because the human mind, the mind of the user, has interpreted them. But outside of the user's choice to attribute a relationship, there is no reason in the symbols themselves, for them to designate anything in the outside world.

Finally, the problem of embodiment and situatedness refers the problem abstract algorithms have with interacting with the outside world. Again, if a human interpreter establishes the relationship then and algorithm can affect and change its environment. But in such cases it seems better to see the algorithm and is mechanical extension as a tool of a human user rather than an algorithm itself interacting with the world. For more see Pheifer and Scheier (1999, 59-78).

[91] Without citing a specific journal article, but rather appealing to what, after reading thousands of pages of neuroscience research, I have to believe is the common experience of brain science researchers. The literature of cognitive science (broadly categorized) is about understanding *functions*, leaving the question of the equivocal identity of the person and process in the cavernous shadows of a Skinner box.

[92] For a humorous anecdote on Ricoeur's detour through structuralism and Greimas (see Ricoeur 1998, 79)

polysemy of words with Saussure's observation that the meaning of an individual sign is defined by the difference in that sign from other signs.

Paul Cilliers finds a strong analogy between both Saussure's structuralism and Derrida's post-structuralism and the connectionist model of the neural network (1998, 37-47). Paul Ricoeur explains that his philosophy takes a constructive detour through structuralism. It is appropriate then for our development of a hermeneutic phenomenology of complex systems to take a constructive detour through the poststructural complexity theory of Paul Cilliers. Cilliers will be especially helpful in this regard, because he applies structural and poststructural semiotics as a model for understanding complex system. Cilliers work then acts as a Rosetta Stone to translate the discourse related to structuralism and poststructuralism to the categories of cognitive science, particularly neural network theory. Furthermore, Ricoeur brings together the contrasting positions of Saussure's structuralism and Aristotle's theory of discourse into an informative unity (see chapter 4), holding that meaning is not constituted in signs but in discourse. Later in this dissertation I will make a similar move. But in this chapter, Cilliers's post-structural complexity theory will be employed as a way of opening a channel for dialogue between the model of the text and the complex system of the brain. So, while a hermeneutic phenomenology of complexity does not settle in the land of post-structuralism, it certainly makes a hospitable visit and is thankful for the tea.

Finally, I will move on to an Artificial Life[93] model, and discuss it for two reasons. Firstly, the Artificial Life model recognises some of the problems of rule-based approaches and connectionism. It does not try to organise a system from the top down through the use of symbols and rules, as a rule-based approach would do, nor does it try to reverse engineer the connections between neurons as is the case with connectionism. The effort to duplicate these connections by computer generated models in artificial environments like NEURON[94] have merely highlighted the gap that exists between simulations and the real neurons they are intended to model. One important area of difference is the need to model neurons using compartments in a computer program embodiment space, which does not correspond to way distributed physical systems behave. But this problem may have more to do with the problem of using a digital computer to model something which is continuous in space and

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[93] Artificial Life should not be confused with Artificial Intelligence, or AI. AI aims by humanly manufactured means to reproduce thought, or at least behavior which humans interpret as being motivated by thought. Artificial Life aims not to create thought, but to create synthetic organisms, that live and interact with their environment. It is believed and hoped that this "ground up" approach will be more successful in achieving in the long term what AI failed to do.

[94] NEURON is a neural modeling program that runs on PC, Macintosh, and Linux platforms. For more information see http://neuron.duke.edu/.

time.[95] The paradigm of Artificial Life aims to build artificial living things from the inside out, part by part,cell by cell, without a particular agenda. Artificial Life, then, is less of a theory and more of a research program, and it is in this guise that I will not confront it. As with the rule-based model, and the connectionist model, I will raise issues that will bring Artificial Life to terms with a hermeneutic phenomenology of complex systems.

The strategy which I have outlined for surveying cognitive science seems consistent with Ricoeur's own understanding of the discipline, which he demonstrates in his own limited dialogue with brain science, Ricoeur recommends the work of A. Clark (1997), in a sympathetic context, as a support to his own attempt to bring phenomenology into dialogue with neuroscience (2004, 591). Curiously Clark organizes his own summary of cognitive science in an approximately similarly framework as he "distinguishes three styles of cognitive science explanation" (1997, 103-128). These three styles are the componential explanation, the "catch and toss" explanation, and the emergent explanation.

There is substantial overlap between his organization of the material, and mine. However, what he calls "emergent explanation" and later refines into what he calls a Dynamical Systems approach (where nonlinear, dynamical systems are the explanation for higher level emergent properties that cannot be reduced to the parts that make up the system) is not identical to the Artificial Life research program. Artificial Life researchers certainly do study dynamical systems, and indeed even, at times, try to "build" dynamical systems as part of their research, but the two positions cannot be partially or substantially equivocated without leading to confusion. Nevertheless, I draw attention to Ricoeur's reference to Clark (1997) as support for the relevance of examining these three models which find employment in Clark's three styles of cognitive science (2004, 591).

6. ARTIFICIAL INTELLIGENCE AND THE COMPUTATIONAL MIND

6.1 THE RULE-BASED MODEL

The rule-based approach to cognitive science finds its roots in Alan Turing's famous question, "Can machines think?" (Ince 1992, 133). Whether machines can think or not, Turing developed tests for how one could note that the machine is intelligent. He thought that if a human interacting with a machine can not tell that he was relating to a machine and not a human, then the machine is intelligent. Of course, Turing was not talking about the appearance of the machine, but about how it used symbols. The Artificial Intelligence

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[95] For more discussion on this point see Hines and Carnevale (2003).

research project assumes a certain view of what constitutes intelligence, namely, that human intelligence is, at least primarily, symbol manipulation and interpretation. If symbol manipulation is the essence of the intelligence game, it would appear that the answer to the question of whether a machine can think depends on computability; so, here I pick up where I left off in the last chapter's all to brief mention of mathematical complexity theory.

Independently, both Emil Post and Alan Turning suggested that computability can be defined through what has come to be known as the "Turing machine" (Mainzer 2005, 15-16). Imagine a machine with three parts. The first is a control box housing a program of finite length. The second is a long strip of tape—possibly of infinite length—divided into squares. The third, a kind of head that can scan or print on one square at time. On each square is printed either a single stroke or the square is left blank. According to Turing, any *computable problem* could be computed by a Turing machine given even if it took a billion years.

While the program of Artificial Intelligence does not represent the whole of cognitive science, the approach of Artificial Intelligence assumes that the mind is like Turing's control box, and that thought structures are symbols that can be manipulated by rules. The connection between the Turning machine thought experiment that birthed Artificial Intelligence and the computational theory of mind rests in the alleged isometric relationship between the symbol states in a computer, and those in the human mind. A Turing Machine, as a thought experiment, is supposed to be capable of performing any computation, since it can potentially perform any linear manipulation of symbols that can be done within a finite amount of time. If the states in the mind stand for other things, things in the outside world, then they must be symbols; and if computation is to account for the minds use of symbols then they must be "symbols" in the sense of symbolic logic, of course; they must be *univocal*. If they are symbols, and symbols can be manipulated by logical algorithms, then it follows that there can be human thought algorithms that can be studied like symbolic logic, or mathematical computation (for representative examples see Putnam 1975,Fodor 1983). Since computation is accomplished through the manipulation of symbols, and thought is accomplished through the manipulation of symbols (representations) it follows—if we except the *undistributed middle*[96]—that thought is a kind of computation.

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[96] Here's the thought is computation argument in syllogistic form:

> *Human cognition is the manipulation of symbols.*
> *Computation is the manipulation of symbols.*
> *Therefore: Human thought is computation.*

This is the argument with letters representing the terms:

In the 1960s, while early Artificial Intelligence researchers were trying to construct General Problem Solvers and "expert systems," which model human problem-solving abilities with rule-based systems, Hilary Putnam suggested the computer as a strong analogy for the mind by appropriating the model of the Turing machine, arguing for a new approach to the mind, called functionalism, the view that mental states are not identifiable themselves, but rather are what they are by way of what they do, what "function" they serve in the mind. The mind becomes a process. As Kim Sterelny explains, "The central thesis of all the many forms of functionalism is this: the essential feather of any mental state is its causal role" (1990, 3). For those early fathers of the computational approach to mind, this meant seeing mind in terms of a process, computation. Thus the functionalist thesis found a pillar of support in the work of Alan Turing. According to Putnam:

> To be specific, I would suggest that there are many considerations which point to the idea that a Turing machine plus random elements is a reasonable model for the human brain…. [I]t seems to me that we are in a fact committed (at least if we have the overall mechanistic view of the brain that I do) to viewing the classifier as simply a Turing machine (1975, 102-3).

If the early Putnam is correct[97], if the human brain is basically just a Turing machine, it follows that, since different machines, say a computer and an abacus[98], can carry to the same computations, the brain to the computer should be able to process similar symbolic

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    All A is B
    All C is B
    Thus: All A is C

Clearly B is not distributed because the predicate term is not distributed in "A" statements. This argument is clearly formally invalid. But can it be fixed?

The problem with the argument is that "the manipulation of symbols" is not distributed. There is a large set of things which fit into the class of *symbols*. For the argument to work, the middle term "the manipulation of symbols" would have to be distributed. But to distribute "the manipulation of symbols" one would have to know at least *the nature of all kinds of symbols* (not necessarily every last symbol). The problem is that we do not know if the kind of *symbols* which humans manipulate are anything like those used by computation. Nor do we know that the *manipulation* which humans employ on those symbols is anything like what occurs in computation. In fact the evidence seems to point to the contrary. So we find the argument linking human thought and computation rests on the formal fallacy of the undistributed middle, and that the evidence is insufficient to adequately distribute the middle term in favor of the conclusion that human thought is computation.

[97] It would take away from the direction of argument in this chapter to dwell on the controversy concerning Putnam's interpretation of Turing, for he seems to forget that the Turing machine is an imaginary construct. After all, it uses a tape of infinite length. For more on this point see DuPuy (2000) and Copeland (2000).

[98] This may need to be a Turing abacus… operated by someone with a lot of time on their hands, a computational Sisyphus.

structures. Jerry Fodor (1975), inspired by the work of Noam Chomsky (Putnam 1988, 4), extended Putnam's thesis in "a daring extension" (4) of Chomsky's linguistics. Fodor (1975, 55-64) argues, against Wittgenstein (see 1.258 in Wittgenstein 2002, 73) and Ryle (1949), that there must be a private language.[99] So Fodor takes Chomsky's "semantic representations" and transforms them into "a language of the mind" and draws an analogy between the Chomskian theory of language and computation of symbols in the manner of the Turing machine (Putnam 1988, 6). Though both Putnam (1988) and Fodor (2000) eventually reject functionalism, the model of the mind as Turing machine organises the research projects of both early cognitive science and Artificial Intelligence.

The early, computational, Fodor (1975) develops his computational theory of mind through distinguishing between the grammatical representations of a symbol system's syntax and its semantics. He holds that the level of semantics "affords identical representations for synonymous sentences" (Fodor 1975, 125).[100] The semantics of a sentence contrasts with its syntax. On the syntactical level, two semantically equivalent sentences may be starkly different in the symbols through which the sentence represents other sentences. An illustration will help us at this point. Consider the Roman numerals "VI, VII, and VIII." These numeral systems are semantically equivalent with "6, 7, and 8." However, following Fodor's distinction, these systems have a different syntax. This distinction between the syntactic and semantic levels of grammatical representation makes it possible to draw a computational analogy with mental events.

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[99] A private language is a language that one speaks to one's self, a language to which no one else necessarily has access. If cognition is symbolic, then it would seem to be a kind of private language. Something of a private language has been suggested by Augustin, William of Auvergne, Thomas Aquinas, and Jerry Fodor. Wittgenstein argued against such a private language in his *Philosophical Investigations*. Wittgenstein (see 1.258 in Wittgenstein 2002, 73) writes, "Let's imagine the following case. I want to keep a diary about the recurrence of a certain sensation. To this end I associate it with the sign "S" and write this sign in a calendar for every day on which I have the sensation.—I will remark first of all that a definition of the sign cannot be formulated.—But still I can give myself a kind of ostensive definition.—How? Can I point to the sensation? Not in the ordinary sense. But I speak, or write the sign down, and at the same time I concentrate my attention on the sensation—and so, as it were, point to it inwardly,--But what is this ceremony for? for that is all it seems to be! A definition surely serves to establish the meaning of a sign.—Well, that is done precisely by the concentrating of my attention; for in this way I impress on myself the connexion between the sign and the sensation.— But "I impress it on myself" can only mean: this process brings it about that I remember the connexion *right* in the future. But in the present case I have no criterion of correctness. One would like to say: whatever is going to seem right to me is right. And that only means that here we can't talk about 'right'." Wittgenstein makes the point that for a word to have a meaning, there must be some rule that the word follows, some criterion or standard that it must meet, for it to refer to something. For more discussion of private languages, and Wittgenstein's argument against them see R. M. Martin (1995, 45-52).
[100] Representation is used here in terms of grammar not necessarily referring to human thought, though Fodor is certainly heading in that direction in *The Language of Thought*.

The argument goes something like this: if the mind/brain contains representations, then that content is, by definition, symbolic. For the symbols to be employed in a logical structure, the mind/brain must organize them according to some pattern. Thus, the content of the mind/brain and the organization of that content are effectively separated. Also, one may infer that computational patterns that manipulate the symbols, much like the metalanguage of formal logic, are intended to describe the underlying patterns of reasoning used to logically manipulate words. It also follows that, while the mind/brain symbol system must have a different syntax from computers, the representations of machines like Turing machines may be semantically identical with mental computation. In this way, the early Fodor's detour through a Chomskian theory of language permits a strong analogy between artificial and human intelligence. Thus AI enters cognitive science as a way of explaining human thought.

6.2 PROBLEMS WITH A COMPUTATIONAL THEORY OF MIND

Marvin Minsky (1967), of MIT, foretold that "within a generation the problem of creating Artificial Intelligence could be substantially solved" (quoted in Devlin 1997, 167). But that prophecy never came true. Human intelligence never was duplicated, and the expert systems and problem solving programs which were developed, did increase knowledge in the domain of computer science, but not in a way that made good on the high hopes of Minsky and many others. The great research project of Artificial Intelligence over-promised and under-delivered. Rule-based systems are notoriously inflexible, and lost bits of data almost inevitably lead to a program shutdown. At best, if a portion of a rule is eroded, or lost, the system may behave differently than intended, and minor damage may have a significant effect on the system's overall operation. Rule-based systems also require a programmer who can predict the needs of the machine and write code sufficient for every need the machine will have. The more complicated the program, the more unlikely and unreasonable it is to expect this kind of foresight from a programmer. If the machine is to learn (a necessary part of intelligence), the programmer must plan how it will learn, what it will do to learn, how it will organise what it learns, and so on. Rule-based systems are helpful for humans who want machines to do something for them, but as a model of the mind, it seems that the rule-based, computational mind is found wanting. Admittedly though, technology may improve. But at present, rule-based systems have not met these challenges. While it is always dangerous to pronounce emphatically that computers will never achieve human intelligence, here are some reasons why it would seem a rule-based model of the mind cannot lead to the development of true Artificial Intelligence.

As discussed above a major aim of AI research focussed on the duplication of human facility understanding and using natural language. It stands to reason that an intelligent machine should be able to understand language and communicate with humans. In *Goodbye, Descartes: the end of logic and the search for a new cosmology of the mind*, Keith Devlin (1997) surveys the field of natural language study to show that the early Fodor's project in *The Language of thought* (1975) will never work. Natural language, it turns out, is hopelessly complex. Natural language does not submit to fixed rules like mathematics. When one tries to model all natural language using mathematically precise rules of syntax, a formal system that endeavours to model the contextual flexibility of language must be enormous, if it is possible at all. This situation is not dissimilar to that faced by astronomers on the eve of Kepler's discovery of elliptical orbits. According to Devlin, "[G]iven the complexity of even the simplest example of everyday human reasoning or human-human communication, too much mathematical precision simply swamps the analysis in pages of complex formulas. Then, far from increasing our understanding, the resulting analysis simply steers the issues of concern" (1997, 289).

A further argument raised against the rule-based model, and one which continues the line of criticisms regarding symbols and language, is John Searle's (1980) famous Chinese Room. Searle tells the story of a man trapped in a room and given a rulebook about how to manipulate Chinese symbols. The man is handed written symbols and must follow the rulebook in order to assemble these Chinese symbols. He then hands these assemblies of symbols to people outside the room, who themselves know Chinese and are able to read the sentences he assembles. He, though, is ignorant of what these assemblies of symbols mean. Searle compares this room to a computer. The computer assembles and arranges the symbols but does not "know" what the symbols mean. Thus computers are not intelligent in the way that humans are; computers do not know.

Searle applies the argument only to Artificial Intelligence, but R. van Gulick (1988) applied the Chinese room to the computational theory of mind, arguing that computers are not like human minds since they do not know what they are doing. Van Gulick extends Searle's case regarding Artificial Intelligence through the univocal symbols used in computational operations from the nature of the symbols. Searle's argument rests on the minds capacity to have intentionality regarding the symbols, to see past the symbol to what the symbol means. Thus, a man in the Chinese room may perform operations with Chinese, but not *understand* what those operations *mean.* This argument is also predicated on a particular definition of symbol. Searle is identifying that human intelligence uses symbols in a way that distinguishes them from the univocal symbols used by a computer. (The contrast between Ricoeur's definition of symbols and those used in computer programming and

symbolic logic will be addressed at the opening of chapter 6.) It follows that if computers perform operations with different types of symbols, from symbols which constitute human understanding, symbols with correlate with intentional mental states, then if follows that the computational theory of mind cannot work, nor can it account for human intentionality, since human intentionality requires both the symbol and the referent to be known in the same intentional act. Humans must have intentional states having "causal roles in mediating the system's interactions with its environment" (van Gulick 1988, 97).

Furthermore, symbols must have symbolic content outside the system itself, not just internal to the system. A computer needs no referent outside itself. Information is fed into the computer, and computer produces and output, but no knowledge of that information is needs. However there is no symbol content outside the system. A programmer may construct a mechanism by which one connects the internal behavior to the outside of the system, by that connection is "observer related" (van Gulick 1988, 98) not internally derived. (We will also notice this issue arise in a different guise with the question of distributed representation.)

Also, while it may be the case that computers may be said to "understand" their symbols because they can use them to accomplish specified tasks, the kind of intelligence which humans exhibit shows substantial semantic self-understanding. Humans possess semantic self-understanding in a high degree, an understanding internal to the system in conscious subjective experience. However, these symbols "in conscious experience have a high degree of transparency," semantic transparency being "the degree to which a system understands the semantic content of the symbols or representations it uses or processes" (van Gulick 1988, 98 and 94, respectively). In other words, rule-based models have no bridge with which to have the univocal symbols know themselves. The self-conscious knowledge of the semantic level of symbol understanding is not available in the computational model. This problem appears to be rooted in very nature of the univocal symbol developed by symbolic logic, but caused by the insistence that human intelligence must computational.

A substantial literature has formed around the Chinese room argument. I present the argument here to highlight the problem with computation as the mere mechanical manipulation of symbols.[101] However, one great asset of the rule-based model is its emphasis on symbols, though it defines those symbols in a way which undermines its project. We will find that the weaknesses which undermine the rule-based model correspond to the strengths of hermeneutic phenomenology. The model of the text which unites langue

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[101] For more detailed criticism of the argument see Dennett (1991, 435-40) and Cilliers (1998, 48-57).

and discourse would be very difficult to simulate with a computer, but it does illumine what is missing in the computational model, and that knowledge is helpful, at least for scoping more accurate ways to model both the mind and complex systems in general. Having covered the rule-based model, it is now appropriate to move on to the connectionist model.

7. CONNECTIONIST THEORY AND NEURAL NETS

7.1 THE CONNECTIONIST MODEL

Earlier, this chapter surveyed basic brain organization at all levels, highlighting that each level exhibited a plurality of function. Connectionism aims to explain brain function in terms of network operations and takes its cue from the basic organization of what seems to be the general organizational structure of neurons in the brain. Because the brain is so complicated, with a great many feedback loops[102], connectionist model builders must make some assumptions. In general, they have assumed that brain networks are only made up of neurons. For the purpose of modeling the brain/neural structures, each neuron is represented as a *node* of a network (see figure 3.6).
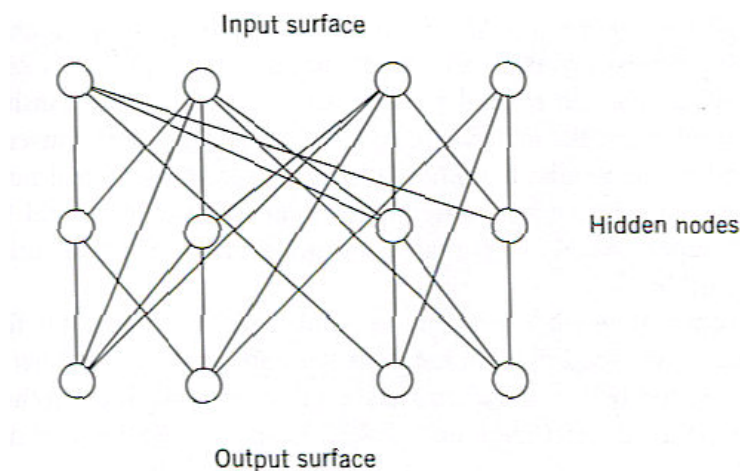
Figure 3.6. A diagram of a neural net. Neural nets characteristically have an input region, an output region. Often they will feature three layers of nodes, the ones in the middle layer being the hidden nodes. Figure from Harre (2002, 195)

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[102]For a discussion of feedback loops see sub-point 6 of Cilliers's definition of a complex system in chapter 2.

In the abstract model shown above (Fig. 3.9), each node has connections with other nodes, and each of these connections has a certain *weight*. Recall the discussion of a neuron's action potential earlier in this chapter. When a neuron depolarizes, the threshold is the point at which the neuron fires its action potential, hence affecting other neurons. In an artificial neural net, the threshold of a neuron which can be controlled by various factors which are analogous to ion channels and neuromodulators in living neural systems, represented by what is called the node's *weight*. The various weights of the different nodes guide the reorganizations of the input signal to shape in into a desired output signal.

Neural net modelers operate on the principle that a neuron averages the sum of its inputs, since a node can have input from more than one source. Each input has a particular "weight", and then they average the sum of all inputs and use them to determine what the neuron's output should be. Unlike real neural nets, which are found whole and complete in the organisms that posses them, neural net models have an input and output[103].

Neural nets have been used to model many brain functions: recognizing faces, recognizing words, perform curve fitting and automatic clustering and performing a variety of learning functions, among other things. But still, like the rule-based approach, they have an input and output. Data is "inputted" at one end. The network does its work, and on the other side of the network, the output side, an output is produced (see Figure 3.7). It is this relationship of input and output that makes it possible to program, or train them.[104] Consider the diagram below.

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[103] Real neurons do fire in a linear direction, but it is a mistake to conclude that naturally occurring network must fire in a linear direction. It could very well be the case that a neural net changes behavior retaining a signal inside itself without changing anything external to it, and still be functioning even though it has no "output." The language of inputs and outputs is useful, but its inherent reduction of the measure of behavior can be somewhat misleading. Assuming that a network must have an output because individual neurons have "inputs" and "outputs" would be an example of the informal fallacy of composition.

[104] It is beyond the scope of this dissertation for a detailed explanation of the ways in which neural networks are trained. Briefly, neural networks are given learning algorithms which use information transactions through the inputs and outputs and employ specific strategies such as unsupervised learning with global objective functions, Bayesian methods, modular and hierarchical learning, as well as free learning approaches which allow a network to dynamically interact with another network. There are multiple ways to train networks, but they depend on the relationships of input and output unless the network is placed within an embodiment. For discussion regarding embodied neural nets see the section on Artificial Life.
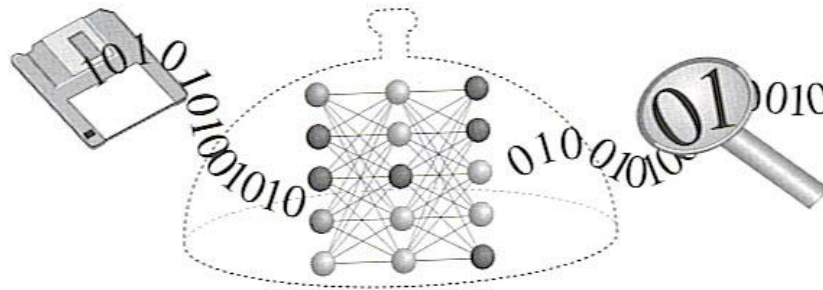
Figure 3.7. This diagram illustrates the principle behind a neural network model. They generally have three layers. The first layer has data "inputted" into the model. The network processes the data, and finally data is outputted on the other side of the network.

In this figure, data is being fed into a neural net by an experimenter. That data then is processed by the neural net and out the other side, another set of data outputs and is examined by a human who must then interpret the data to see if the neural net has successfully accomplished its task. If a neural net is to be *trained* to recognize faces, it must be taught by *someone* who already can. From Pheifer (1999, 110).

This relationship of input, process, and output has led some to ask whether the network represents what it outputs. If neural networks are to be used to model the actual mechanism underneath the human mind, a natural question that may be asked is whether it can account for mental representation states. In introducing this matter of representation Kim Sterelny writes:

> What is the function of our mental states? According to the representational theory of mind, while mental states differ, one from another, mental states are representational states, and menial activity is the acquisition, transformation and use of information and misinformation…. The scientific and the folk picture converge on the idea that representation is central to human minds (1990, 19).

Sterelny identifies representation as the *sine qua non* of mental states; and it is admittedly difficult to talk of the mind without thinking the folk notion that mental ideas *correspond* to things outside the mind and body. It should be no wonder that the connectionists feel it necessary to offer some account of representation, which what in fact develops in connectionist literature.

The topic of representation becomes a treacherous one when dealing with connectionist networks. For example, Patricia S. Churchland and Terrence J. Sejnowski clearly support a computational theory of mind in their book *The computational brain* (1996). Churchland *et al.,* struggle to define computation, because to claim the brain is

computational, they must come up with a definition of computation which applies both to computation machines (like computers) and the human brain. It must define something which encompasses the full compliment of what humans do cognitively and what computers do in their computational processing. To help develop a definition of computation, they write "We count something as a computer because, and only when, its inputs and outputs can usefully and systematically be interpreted as representing the ordered pairs of some function that interests us" (65). This definition seems to make whatever constitutes computation a subjective decision based on ones interest, an apparently weak definition, because it makes an aspect of the definition of computation subjective, but that part is the glue which maintains the cohesion of the whole nature of computation which makes its definition possible. But they seem to know its a weak definition because a page later they clarify that "A computer is a physical device with physical states and causal interactions resulting in transitions between the states" (66). But this definition is far too broad; it could even be referring to a cell (constantly changing states), or a door (digital, two positions, open and closed), or a toaster (input-bread, output-toast). They add "Basically, certain of its physical states are arranged such that they *represent* something, and its state transitions can be interpreted as computational operations on those representations" (66). What is absolutely critical to see here is that Churchland *et al.* are presenting a definition of a *computer* wherein the very definition requires that there be an *interpreter* to look at the output and *judge* the relationship between the input and the output to be a computational one.

This creates a significant problem. If the definition of computer necessitates and interpreter to look at the product to see if computation is occurring, then the human brain it would seem is not a computer, because it in some way knows itself. The authors of *The computational brain* are most certainly offering a complete account of the human person as situated in the brain which is basically a meat computer. However, the definition of computer requires a person, and interpreter, to be present to even know if something is, in fact, a computer, and it is very clear that *a judgment call* is involved.

Why would such a glaring mistake be present is such a competently written work? Because the authors understand the need for making a defensible definition, and they understand, likely from dialogue with colleagues, that the definition of computer will be attacked on the basis of just about everything being a computer because the natural world appears to closely follow mathematical principles. Thus, the epistemological constraints of argument necessitate that a computer be defined in terms of a human analyzing the product of the output and recognizing, through interpretation, that computing has happened.

This definition is inadequate though as a global explanation of computation. If *The computational brain* is aiming to give an account of computation as a final explanation if

what is happening in the human mind, the computational "outputs" of the human brain must be computational whether a person is around to interpret them or not. Churchland *et al.* unknowingly offer a definition which puts the whole brain back into Searle's Chinese room. After all, the brains output is a symbol which must be interpreted by a human (or something with at least human interpretive capacities) to know if it is in fact a computer. This all sounds as though Churchland *et al.* are following the rule-based model. Somehow physical states represent something else. This problem clearly fits within the problem domain discussed with the rule-based model.

Later they go on to explain the importance of distributed representation as a way for the brain to not run out of neurons. They equate distributed representation with vector coding—the use of a neural pathway to carry a representation, rather than local coding—the situation of using a single neuron or small collection of neurons for one single purpose, so they support connectionism. However, note their commitment to distributed representation, in light of their definition of computation. The physical states must represent, but how? Yes, we are told that distributed representation accounts for it, but we have no access to get into the computational brain to discover whether the brain is a computer without humans around to impose their own *interpretation* of the computer on the brain. Ricoeur may be willing to talk of interpreting the physical system of the brain, but he begins with the person. The computational brain must begin with the computer and work out. Computers may be built, but not stipulated.

Kim Sterelny (1990) separates computationalism and connectionism as rival views, and goes on to explain, or least try to explain, distributed representation. She points out that

> [T]here is no automatic commitment to the view that particular intermediate nodes in a network stand for any identifiable elements or feature of the environment… The representational properties are carried by the networks as a whole (or least some part of the network) rather than by individual nodes representing particular features of the environment.
>
> The behavior of the whole network is just a complex probabilistic sum of the behavior of its atoms. Hence there is no interesting intermediate layer of descriptions between an account of the behaviour of the network as a whole, and an account of the behaviour of its nodes. There is no control or executive orchestrating the network's behaviour. There is no homuncular breakdown of a connectionist network after the style of Lycan and Dennett (1990, 171).

Put another way, Sterelny summarizes the general connectionist picture of neural networks. A network of nodes has no hub, or central authoritative command centre where the information of the whole is somehow processed or understood. The brain's work is performed by the whole network. Though some regions are tasked with certain important duties, there is no homunculus (little man) inside the brain where "represents" the information it processes. Sterelny summarizes the general view of the relationship between nodes and the whole system they form. From this perspective, it is no wonder that later in the chapter she comments:

> It is not clear that a distributed representation [as distinct from the classical view of representation] is a representation *for the connectionist system* at all.... given that the influence of node on node is local, given that there is no processor that looks at groups of nodes as a whole, it seems that seeing a distributed representation in a network is just an outsider's perspective on the system. It is at most a useful heuristic. I am demanding to be told why I should regard distributed representations as states of the system at all (1990, 188).

When her exasperation is compared with her earlier discussion of "[t]he behaviour of the whole network" which she reports "is just a complex probabilistic sum of the behaviour of its atoms" (1990, 171). Thus, the situation of distributed representation is more a kin to the behaviorist view the mind, in which one can only look at the exterior behavior, and the mind is left a black box which cannot be understood, an observation made by the later Jerry Fodor (2000). Sterelny sees the problem of distributed representation very clearly. I mentioned above that neural nets have an input, a process (the network itself), and the output. The input may be an image of a face, or maybe a word to be recognized, or a curve to be averaged. The output may be a sign of recognition of that face, information that the string of letters shown to the network was in fact a word, or maybe it's the average of a curve. Refer back to Figure 3.10. Distributed representation requires that what the interpreter sees produced at the end of network's outputting process is somehow distributed over the network itself as a representation, but as Sterelny so pointedly asks, how is that actually a representation[105]? In what way is the output actually represented over the network? One might point out that if the output is represented by the network, then equally the input must be represented as well. If this holds then raw data and processed data are equivalent, which

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[105] See Sterelny's definition of representation mentioned earlier.

is absurd.[106] It seems as though the need to call the events that occur in a neural network a "distributed representation" is itself a human interpretation of the behavior of a network, but recall the problem which Churchland *et al*. faced when defining a computer. Is distributed representation actually representing something in a distributed fashion? If connectionism is to model cognitive function, is it permissible to create a category to describe network function, which really has little to do with what is known about the interior of the network, and more to do with a human hermeneutic process of reading the behavior of the network onto the network. Herein we have what will later (chapter 4) be called metaphorical predication. Chapter 1 gave a brief introduction to the relationship between metaphor and the scientific model. One feature which makes it possible to use metaphor as a scientific model is the correlation between aspect of the primary and secondary system. With distributed representation it is by no means clear that the output of the neural net can be mapped onto the interior of the neural net, such that the net can be said to provide a distributed representation. If there were such properties then such a hermeneutical process would be intelligible. But where are they? What are they?

  This is the matter which makes Sterelny so concerned. Sterelny wants to know the warrant for making such an interpretation of the network's behavior, beyond the simple need for representation to be occurring.[107] After all, if the neural net is the explanation for the human mind, it would be good to believe, that the human mind does have some clue about what is going on beyond its borders (a point I will touch on later). Sterelny wants some

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[106] One may argue its not clear here why output should be represented and not input, asking is the issue here one of the causal connection between input and output.

  As I see it, the problem with defining distributed representation in terms of the systems output is just that which the question expresses. Distributed representation must equally refer to the input on the same grounds as the output. But it cannot be that the network represents both the input and the output in the same logical space of argument. A can't be not-A. One may wish to make this kind of move to save the concept of distributed representation. But this cure will be more lethal than the disease. If a network represents both the input and the output, it seems that one must be using two different defintions of representation, or be quite confused. Even a computer, the base metaphor for the input/output terminology, does not represent both its input and output. Rather it transforms its input into its output. It processes it.

  Yet, it does seem that distributed representation is one of those concepts that is *mostly right*, even if connectionism is not the best way to get there. There must be some way in which representation has to be distributed over some substrate, in any account of mind which engages nature as a substrate for that mind. However, when the cognitive science model is solely that of connectionism, the input/output problem arises. When this is understood, the hermeneutic phenomenology of complex systems could be seen as a longer hermeneutical route to an account of distributed representation

[107] It should be noted that one or more neurons are removed the network is usually able to function, which points to redundancy in the system. Speaking in terms of the networks operation, network information does not seem to be stored in one place, like a single node. But this point does not change the point I am making here.

account of the terminology of "distributed representation" beyond the psychological need for it.

Those who defend distributed representation take the output and specify that it is in some way present in the network, but in a distributed way—in such a way that a "part" of the output cannot be located somewhere in the network. Thus, the representation of the output can be said to be distributed *over* the network. So what follows for connectionism?

7.2. CRITICISM OF CONNECTIONISM

The explanation of connectionism above concluded with a criticism of connectionism rooted in the apparent fiat definition of "distributed representation." However the problem may arise from using connectionism as an explanatory paradigm rather than a research methodology. Michael McCloskey distinguishes between the connection of neurons in the human brain and connectionist models on a computer (2002). McCloskey points out that virtual neural network models are helpful because they allow researchers to do things that cannot be done in the physical world: un-lesion a neural network and repair damage to see how the network functions when back at full strength, etc. However, he makes a distinction between *simulation* and *explanation*. For McClosky, a simulation is a reproduction of a system behavior, usually a very specific behavior. Explanation, on the other hand, is a theory of the faculty in question, an account of why the system can do what it does. To illustrate the difference he gives the example of a device that recognizes words as being either "word" or "not word" and then has another module that gives information on how the word is pronounced.

McCloskey then throws a wrench in the works: what if the word recognition was performed by a neural net trained to recognize those words, one educated over time? Is it now a simulation or an explanation? Though some aspects of human functionality have been duplicated, this by no means suggests that the human language faculty has in any way been modeled. "[T]he problem is that connectionist networks of any significant size are complex nonlinear systems, the dynamics of which are extremely difficult to analyze and apprehend" (McCloskey 2002, 1137). Because of his natural human finitude, the modeller cannot build the network; the modeller must grow it. "In connectionist modeling, on the other hand, the modeler may be able to proceed on the basis of vague and fragmentary theoretical notions, because much of the work is left to the learning algorithm. In a sense the modeler "grows" the network rather than building it" (1138). McCloskey suggests that a neural network model is more like an animal model, neither simulation nor theory, "but rather

an object of study" (McCloskey 2002, 1141), and he concludes with the possibility of the computational irreducibility of connectionist networks.

There is good reason to take the computational irreducibility of connectionist networks seriously. Even if all individual isolated actions were modeled, then all those modeled actions must be assimilated to operate with one another. Quickly one can see that all these separate networks are actually one great network. The input to the network comes from another part of the network, and the output flows into the input of another network, so one is forced to ask one's self: how many networks are there in the brain, or better, in the human body? Rather than seeing the neural networks of the body as separate, it may be more helpful to see the whole synchronically as a single system, that does not produce inputs and outputs, rather the body systems as all is alive. This will be a compelling approach for those who support the Artificial Life research program.

7.3. ANTICIPATION

I just discussed two approaches to distributed representation. Sterelny confronts the problem with frustration. She wants to know where the representation is in distributed representation. McCloskey takes the problem of representation in a different direction. He understands that one ought not equivocate between output and network processes.[108] For him neural networks are tools that can lead us to greater understanding. Neither of them is able to locate output, external meaningful behavior, inside the network, and both of them have different ways of responding to this problem. Another response to the problem of representation is that of Paul Cilliers. Cilliers assumes the basic view of system nodes that Sterelny holds, except that he is willing to deny at least classical representation, in the sense of something being represented by brain activity (1998, 72). According to Cilliers's definition, "Representation is process by which two levels of description – the symbol an its meaning – are related" (62). The fine tuning of this approach which is the back bone of functionalism constitutes the classical approach to representation which Cilliers rejects. However, he does

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[108] One may object that this point is unclear. Why must outputs be located "in the network"? An output can be any of the myriad reaction reactions triggered by input, whether neural firing or representation of some sort.

In reply, one must be careful not make the category of "output" too big. If one defines an input as any environmental change that affects an organism, and output is defined as any behavior which in some way responds to environment stimuli, it is possible to make the argument work. But to do so, one must apply the terms in ways which transcend the points of isometric relationship between the terms and their source model/metaphor.

support distributed representation on the connectionist model. For Cilliers, brain activity is a process in which poststructural semiosis.[109]

In imitation of Ricoeur's philosophical method, I would like to sketch some possible common ground for the symbol-based approach to cognitive modeling which is so important to both the rule-based model of human cognition and the problem of representation in connectionism. Both McCloskey and Sterelny recognize a boundary between the interior and exterior of the system. Both find it problematic to, without qualification; locate a quality of the system's exterior within the interior of the network. Cilliers, a poststructuralist, draws on the domain of semiotics to better understand the domain of cognitive science in terms of the interplay of signs (which will be discussed in greater detail later) to model the structure of the network in which the signs participate, because he rightly sees some analogy between neural network structure and the structure of structuralism and poststructuralism (1998, 37-47). Even though Cilliers uses the neural network analogy of connectionism, his use of sign theory gives more theoretical resources than either the rule-based model, or the input/output connectionist model considered in isolation. John Searle observes that signs must be known, be understood (1980). Cilliers work is certainly a movement in that direction, because he is in dialogue with the question of interpretation of signs in *more than a univocal sense*. The parts of the problem of distributed representation (as I have problematized it) can be itemized well through McCloskey's distinctions between the output of the system, its behavior, and the internal process. Representation would seem to require the internal process in some way stand for what is outside. The term naturally implies a separation of domains between the representation and what is represented, and this point is necessary if Sterelny's (1990, 19) definition (discussed above) of representation is to be intelligible. Phenomenologically there may be no boundary, since the mind has intentionality, and can *place* itself *in* the thing it knows. In some way consciousness permits the mind to be in and with and even be what it is coming to know, something which the talk of representation does not, at least prima facially designate. Even though there may be no boundary phenomenologically, physiologically there is. A brain resides inside a skull. It should also be observed that no matter where one wishes to designate a sign in the brain, that sign will always be made of something, be it code, or modules, or memes (see Dennett 1991, 1995), if it is in *the brain*.

While it is too early to deduce conclusion, one possible direction in which the *representation* may be made more intelligible is by showing the representation of the whole (network) requires the parts (of the network). Notice, earlier this reality led to the struggle

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[109] For more on post-structural semiosis see chapter 6.

represented in the discussions of distributed representation. However, there may be a different way of understanding representation which does not root it in univocal symbols, or connectionist distributed representation. If the network is irreducible to any part or collection of parts, like a homunculus, and brain-based, it would seem the network is informed by, and reaches through, the body to the world (Merleau-Ponty 2006), it is a hypothesis at least worth considering—one consistent with hermeneutic phenomenology—that the human, as human, in a pluriform aspect, is an irreducible representer. In other words one cannot reduce the representation work of the human mind to univocal symbols or to distributed representation without first beginning with the human who achieves events of discourse. When that agent of discourse is considered in his embodiment, signification is not something which occurs in the brain separate from the whole brain and full embodiment. Returning to the earlier topic, distributed representation requires that something have representation distributed across it. For now, I present it as an interrogative hypothesis: *why not distribute representation over the whole human being?* Why stop with the brain? Why must representation be found only in a region of the brain? It will require our extended discussion in chapter 6 to make sense of this hypothesis.

This suggested hypothesis would seem to unite both the data of neuroscience and the set of cognitive models discussed in this chapter. If we reconsider the outline of neural anatomy presented earlier in this chapter, brain anatomy would suggest that Sterelny's egalitarianism[110] of nodes within the network must be mistaken, since each aspect of the various networks in reality do interpenetrate one another, and influence one another, while at the same time retaining their multi-various "hierarchical" qualities. If Ricoeur is correct with respect to his approach to personhood in *Oneself as another* (1992), his analysis of relationship between the model of the text and human action in *From text to action* (1991), and his identification of the relationship between hermeneutics and the analogy of being in *The rule of metaphor* (1977), then the human neurological interior is most certainly "meaningful" in the strong sense, and might possibly be exegeted through a hermeneutic phenomenology of complex systems (see chapters 5-7).

8. ARTIFICIAL LIFE AS A RESPONSE TO CONNECTIONISM

Artificial Life is the final cognitive science model to be examined in this chapter. The Artificial Life movement holds that life is so complex that it requires us to try and reproduce it artificially, as a way of understanding its behavior. Traditional rule-based and connectionist

approaches to explaining animal behavior (via brain study) have had some success modeling behavior, but little success in modeling life as it interacts with its environment. With the advance of computer technology it is now possible to establish simple initial conditions or build simple artificial organisms and see how they develop over time. This allows Artificial Life researches to build organisms "from the inside out" so to speak. Artificial Life will be introduced here because later in this dissertation I will establish a connection between Ricoeur's model of the text and Aristotle's approach to complex systems which he introduces in *Parts of Animals* (2001). Aristotle's approach to complexity retains system information that Artificial Life removes, a point which will become more apparent in chapter 5. For now, it is of first importance to introduce Artificial Life.

According to Margaret Boden (1996), Christopher Langton's (1996) "Artificial Life" is the seminal paper of the field of Artificial Life. Langton briefly defines Artificial Life as "life made by man rather than by nature" (39). He goes on to clarify: "Artificial Life is simply a synthetic approach to biology, rather than take living things apart, Artificial Life attempts to put living things together" (40). Langton explains that biology has traditionally begun with the organism and then divided it into various subcategories: "organs, tissues, selves, or a mouse, and finally molecules and its pursuit of the mechanisms of life" (39). Instead he recommends considering each part in the presence of the whole, taking a cue from how nonlinear systems[111], in general, operate. Langton proposes a massive research project of making synthetic biological systems that develop "'virtually" in a computer. He argues that this is necessary because biological behavior results from many individual short range interactions, and without the calculating power and speed of computers it is impossible to synthesize all but the very simplest cases (51).

Langton advocates this approach, in part, because it gives us a way to model evolution. Whether one wishes to model the evolutionary development of a group of organisms or experiment with artificial breeding, Langton begins with the biological distinction of *genotype* and *phenotype*. In natural living systems, "[t]he *genotype* is the complete set of genetic instructions encoded in the linear sequence of nucleotide bases that make up an organism's DNA. The phenotype is the physical organism itself—the structures that emerge in space and time as a result of the interpretation of the genotype in the context of a particular environment" (55). Langton generalizes genotype and phenotype for non-biological situations. A GTYPE is a *generalized genotype*, or specification, for a set of machines. A PTYPE is a *generalized phenotype*, and Langton defines it as "the behaviour

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[110] Egalitarianism in this case refers to the way that no node in the network has hegemony over another. Instead each node's properties consist in its relationship of differences in the network.
[111] For more on nonlinear systems see chapter 2.

that results as the machines are run and interact with one another" (56). Therefore in its most basic construction, Artificial Life's three categories are necessary for the study of evolutionary development in synthetic organism populations are GTYPES, PTYPES, and their environment. Langton's intentionally simplistic three-part construction evidences the obvious fact that things which are alive are made of parts. Langton may skip from DNA to the full organism, since the goal of such simplistic constructions is to overcome the biological bureaucracy that seems to slow evolution to an amoeba's crawl in the natural world.[112]

The theme of parts and wholes may also be traced through the various research projects that compose the bulk of Artificial Life research. *Autonomous agent modeling* (see Maes 1995) seeks to synthetically build virtual adaptive autonomous agents that will interact with one another within a specified environment. Autonomous agents can be used to model stock traders, street traffic, ants working to build a hill. They can be made to learn from their experience and exploit specific strategies. We will find in chapters 5 and 6 that the theme of parts and wholes will be a major theme in the construction of a hermeneutic phenomenology of complex systems.

Another tool of Artificial Life is the use of cellular automata. A *cellular automaton* is "a lattice of sites, each of which can take on values" (Adami 1998, 27), and continues the theme of parts and wholes. These little abstract cells can be given assignments, dictated by simple rules . The behavior of these automaton cells can then be analyzed, and thus, the simplified scheme of cellular automata permit an environment for running Artificial Life experiments. Cellular automata are used in many different kinds of research studies, from population growth, to the study of fluid dynamics. In Artificial Life, they permit simplified experiments to be run which study the growth of pattern development among interrelated particular things (usually representing organisms or processes that may occur within organisms).

A cellular automaton usually begins with a simple initial pattern embodied in a computer simulation. Stephen Wolfram calls it a rule (Fig. 3.8). This rule or collection of rules will explain some sort of pattern that each cell should exhibit in relation to the other cells in the matrices. The rule specifies which cells will be switched on or off, depending on whether cells surrounding it are on or off.

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[112] Langton's distinctions are foundational to *genetic algorithms* that allow computers to model natural selection, for they close the gap between the genes of the modeled organism to the expression of those genes, which then can face the selective pressure of the virtual environment.

If a cell and its neighbors look like this at one step

(rule 254)

then the cell will look like this on the next row
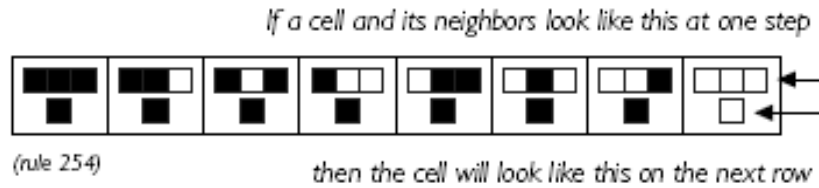
Figure 3.8. An example of a simple program for cellular automata, combined with instructions describing how the program works. (Wolfram 2002a)

Now let us take a different program (one that Stephen Wolfram thinks is special, almost too special). Below is the simple program he describes as Rule 30.

(rule 30)

Figure 3.9. Wolfram's simple program which he calls Rule 30. (Wolfram 2002a)

The program is then run in successive iterations, generating a pattern on the basis of the following the program. In this case, the execution of this program will look like this.
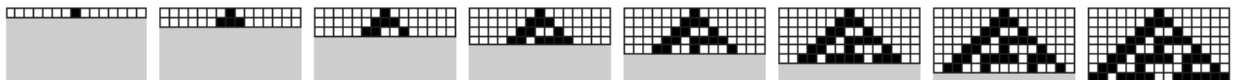
Figure 3.10. The progressive iterations of Rule 30 being applied seven times from an initial black square. (Wolfram 2002a)

It turns out that very complicated pattern can be generated from simple rules. If the program continues to run it will develop a very complicated pattern that would not be expected to have followed from a simple rule.
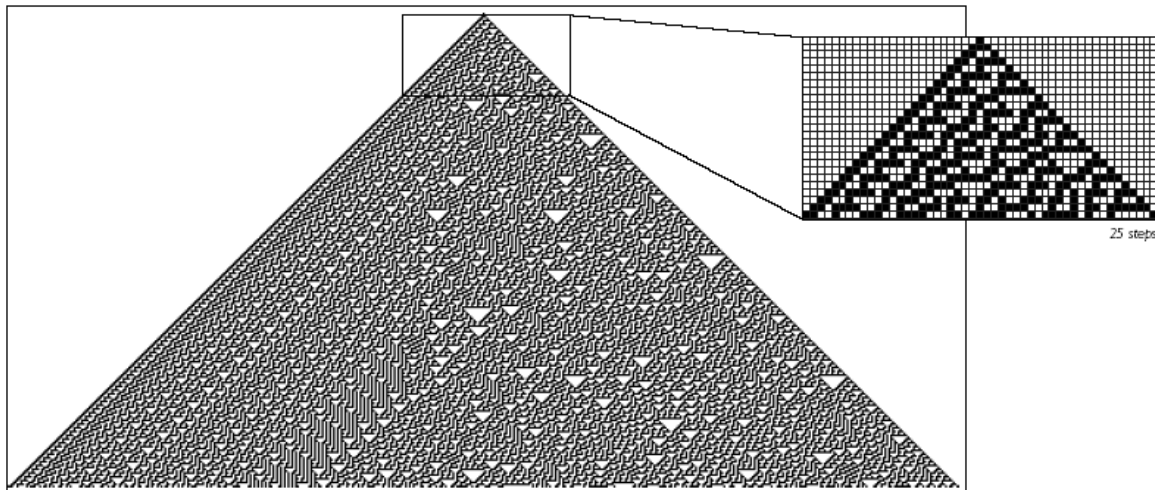
Figure 3.11. The smaller illustration to the right, shows the first 25 lines which have employed simple Rule 30, and even the first twenty five lines show the beginnings of a pattern, but by 250 lines the pattern is clearer. (Wolfram 2002a)

After 25 steps a very distinct pattern is beginning to develop. After 250 steps, the pattern is even clearer. These diagrams help to explain what cellular automata are, and how they permit a very focused study of complex patterns, since each site in the lattice can have very simple rules applied to it, and yet remarkably complex patterns can flow from very simple rules (see Wolfram 2002b). Artificial Life research focuses on experiments and research projects, like Wolframs work with automata, with the goal of observing what happens, and from those observations, developing understanding of the abstract principles which govern all life (not just the biological life familiar to humans). As in the case with Wolfram's research, Artificial Life research projects have the potential to reveal some surprises.

What we see in the Artificial Life project is a respect for the unity between parts and wholes of organisms, and the way part and whole act upon the environment. Where the rule-based approach begins with behavior and tries to come up with rules to explain and duplicate it, the Artificial Life program begins with the artificial organism in its environment, and uses the actual working out of rules and patterns to inform the researcher about what general principles explain a given behavior. Likewise, where the connectionist approach must use the output of the network to then train the network to behave a certain way, Artificial Life researchers use the artificial organism's interaction with its environment as a tool to learn general principles of guiding the development of organisms (breeding them as it were). In both comparisons, the unity between the interior behavior, exterior behavior, and environment are each reinforced. Thus, the theme of unity between parts and wholes in Artificial Life is sufficiently established.

Though an Artificial Life model clearly shares some overlap with a connectionist model (discussed above), its approach of examining the parts in the context of the whole alters the Artificial Life approach to neural networks. Michael Dyer (1995) points out that the neural net modeling of intelligent animal behavior requires the modeller to define individual behavior within social organizations. Neural net modeling requires significant ingenuity to get right. This social-interaction approach which Dyer describes gives some direction toward an explanation of how neural networks become conditioned to maturity. It's a team effort.

Some Artificial Life theorists take this emphasis on social organization in what amounts to the opposite direction of cognitive science. In *Swarm Intelligence*, James Kennedy and Russell C. Eberhart argue that,

> Cognitivist reductionism has provided a great wealth of understanding about how brains work, and even about the relationships between some mental activities and the physical infrastructure that supports them, but it has not given us what we need in terms of explanation of mind in its ordinary sense... [W]e have not required that minds be human and have not even required that they do any profound information processing, as cognitive science and human vanity tend to presume. Our assumption is that individuals are components of the system that thrives on their participation and nurtures it, too (2001, 422).

As seen above, Kennedy and Eberhart continue the emphases of the Artificial Life research project by emphasizing the development of the organism in its environment. In this case, Artificial Life research paradigm is being applied to the nature of the mind. Kennedy and Eberhart boldly attack the latent Cartesian egocentric methodology of cognitive science, and advocate a provocative thesis that mind, while being individual, develops out of community. Using research on particle swarms, which are extended, and more complicated types of cellular automata (see above) experiments in a computer simulation embodiment, they draw the conclusion that the human mind is less inside the brain, as it is a product of social interaction, analogous to the way that an individual particle's behavior can develop in relationship to the other particles of the swarm in which it participates. But let us not deceive ourselves. By mind, they do not mean "person." A community could equally be a particle swarm. A particle swarm, like a network, is a mechanism that offers an account for behavior, not a mind—in the sense of a *personal* mind.

Be that as it may, one may generalize regarding the Artificial Life research program that, while the connectionist modeller focuses on duplicating the operation of parts in the

brain, the Artificial Life modeller focuses on modeling animal behavior. In this way it is a promising, more well-rounded, research program. Since Artificial Life is less of a position and more of a research program, it would be imprudent at this stage to offer major criticisms about the approach. The research project is still in infancy. Frankly, the research work of the Artificial Life community is quite interesting. But one glaring area of potential refinement is the theme in the various research procedures that I have drawn out, namely the relationship between part and whole. For example, recall the definitions of GTYPE and PTYPE, and compare them with the biological definition of genotype and phenotype. A GTYPE is a rough virtual equivalent to a genotype--it is the synthetic genetic material. However, PTYPE and phenotype are quite different. A phenotype is the organism, its full bodily shape and power to act. The PTYPE on the other hand is "is the behaviour that results as the machines are run and interact with one another" (56). PTYPE is "behaviour." Langton jumps all the way from DNA to an organism's actions. But what connects an organism's genotype to its actions is its organism, its full embodiment, and all the intricate complications that make its behavior possible. Thus, Artificial Life further extends the classic problem of modeling complex systems described in chapter 2, namely that when one simplifies complexity, one destroys the very thing one attempts to model, namely *the complexity* of life. It would seem then that Artificial Life could benefit from a theory of the relationship between parts and wholes, an approach which adds the complexities of the organism rather than stripping down life to the relationship between genes and the external behavior of the artificial organism, something potentially included in a hermeneutic phenomenology of complex systems.

9. THE LIMIT OF A SYNCHRONIC STUDY

Earlier in this chapter I introduced the concept of *functional polysemy*, and showed that all levels of organization in the brain seem to exhibit this quality, namely that of having multiple functions within a system. I also showed how this quality is defined in terms of a synchronic level of analysis rather than a diachronic level of analysis. Ricoeur (1974, 68, see quotation above) makes a similar point when initially defining the concept of polysemy in relation to language. Following the Saussurian categories of the synchronic and the diachronic, Ricoeur clarifies that polysemy understood diachronically does involve the change in meaning of a word. However, words, to be words, must be part of a system, and in relationship to the language, the *langue*, in which they participate, they retain previous meanings. Thus, polysemy, to be polysemy, must be defined in terms of the synchronic level of analysis.

The hermeneutic phenomenology of complex systems which I am developing will also remain within the same framework Ricoeur establishes for the model of the text. This move is very important in light of the Ricoeur's interchange with Jean-Pierre Changeux (Changeux 2000). Changeux raises his neuroscientific polemic under the banners of evolutionary theory. For example, here is the close of chapter 6, the transition to his chapter on ethical universality:

> The interlocking patterns, or successful relays, of evolution lead us from biological history to human history—keeping in mind that human history corresponds to a much higher level of organization than that which governs evolution from protozoa to vertebrates; and also that it occurs a quite different biological context since it involves the human brain as well as to the representations that it produces and transmits (Changeux 2000, 256).

Why does Changeux bring up evolution here? We have no example of a fossilized pre-human brain. Everything allegedly known about the evolution of the brain is conjecture, perhaps warranted conjecture, but conjecture none the less. A daily-growing body of research opens the brain, in its current iteration to human understanding. However, an evolutionary account of human brain function must be established on less directly empirical ground and this need has led to some controversy in the field of cognitive science. I will offer a brief introduction to the controversy through the lens of the mildly heated interchange between Steven Pinker and Jerry Fodor.

Thus based on the controversy, and upon Ricoeur's Saussurian analysis of polysemy, I will bracket the evolutionary issue for the purposes of the present work, on the grounds that, for our work here, as the ancient author of *Rhetorica ad Herennium* ([Cicero] 1989) warns us, it would "trace things to far back" ([Cicero] 119). This move will benefit hermeneutic phenomenology by focussing the attention of study to that which *can* be known regarding the "internal" states of the conscious subject, rather than conjecturing what extinct brains might or might not have been able to do. By limiting the study, this present research project aims to focus on what *is* instead of what *might have been*. Furthermore, there is warrant for making this move as demonstrated by the Fodor/Pinker controversy within contemporary cognitive science.

The *later* Jerry Fodor (2000), in *The mind doesn't work that way* takes aim against what Fodor calls "the new synthesis," which Pinker eloquently articulates in *How the mind works* (1997). The new synthesis joins together the computational theory of mind with Darwin's theory of natural selection. For Pinker, the computational theory of mind explains

how humans got smarter, and then the environment's Darwinian natural selective pressures weeded out those humans who could not compute as successfully and survive. Natural selection then becomes the mechanism that accounts for the complexity of mind and its success in a hostile world.[113] Pinker explains his own project as weaving together two major ideas: "the computational theory of mind and the theory of the natural selection of replicators" (Pinker 1997, ix). He goes on to explain "the big picture: that the mind is a system of organs of computation [along the lines of Fodor's modular hypothesis] designed by natural selection to solve the problems faced by our evolutionary ancestors in their foraging way of life" (x). Briefly put, Pinker argues that human cognitive evolution was guided by natural selection, so that those individuals that could think in useful ways were able to gain a survival advantage.   Using the work of John Tooby and Irven DeVore, Pinker argues that, in an analogous way to how animals may fit an ecological niche, humans filled a "cognitive niche" (188f). He defines intelligence as "using knowledge of how things work to gain goals in the face of obstacles" (188).   Early hominids survived by hunting and gathering. Our ancestors needed wits to survive, therefore the activities of survival provided selective pressure to promote the reproduction of phenotypes that could perform competitive behaviors and, because phenotypes are expressions of genotypes, their DNA continued to reproduce. "The stepwise growth of the brain, propelled by hands and feet, and invested in tools, butchered bones, and increased range, is good evidence, if evidence were needed, that intelligence is a product of natural selection for exploitation of the cognitive niche...

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[113] It is curious that writers supporting the evolutionary development of mind do not interact with Fodor's later work. For example Kim Sterelny (2003) cites Fodor's early work in support of a computational view of the mind, but does not reply to his criticisms of the philosophical project of a computational mind as a viable yoke fellow with an evolutionary theory of cognition.

Pinker (2002) offers Fodor no reply in his next book, *The blank slate: the modern denial of human nature*, published after Fodor's *The mind doesn't work that way*, but he does find a way to work in this unfavorable anecdote against Fodor regarding the origin of the East Pole-West Pole debate. "Fans locate the first extreme, which originated at the Massachusetts Institute of technology, at the East Pole, the mythical place from which all directions are west. They locate the second extreme, which originated at the University of California, San Diego, as though West Pole, the mythical place from which all directions are east. (The names were suggested by Fodor during an MIT seminar at which he was fulminating against a 'West Coast theorist' and someone pointed out that the theorist worked at Yale, which is technically on the East Coast.)" (Pinker 2002, 35).

Pinker (2005) finally did get around to replying to Fodor's short book. His review characterizes Fodor as having departed from "the generic characterization of computation in his previous writings and assumes a far more specific and far less psychologically plausible version. He now defines the Computational Theory of Mind as 'whether the architecture of (human) cognition is interestingly like the architecture of Turing's kind of computer (p. 105, note 3). Similarly, he evaluates the idea that 'cognitive architecture is Classical Turing architecture; that is, that the mind is interestingly like a Turing machine' (p. 30). (For more on the Turing machine, see discussion of the computational theory of mind in this chapter.)
Pinker's reading is impressive because the main text and the footnotes do not argue for a mere analogy to a Turing computer. Rather Fodor is recounting the case that he made previously in The language of thought, that "Turing machines can compute *anything* that's syntactic" (Fodor 2000, 30).

Moreover, the bigger brains were no mere ornaments but allowed their owners to make finer tools and infest more of the planet" (200).

Jerry Fodor (2000) does not take issue with evolutionary theory per se, but rather criticizes the use of it as the global model that explains all of human cognitive psychology; the idea that drives Pinker to write "psychologists have to look outside psychology if they want to explain what the parts of the mind are for" (Pinker 1997, 38). Fodor raises four lines of argument against Pinker's use of evolutionary theory as a model for interpreting the data of brain science. Pinker's (2005) reply to Fodor organizes them under the headings *fitness and truth*, *consilience*, *teleology*, and *complexity*.

First, Fodor attacks Pinker's pragmatism. If cognition was shaped by evolutionary pressures, the question of truth is overshadowed by functional adaptation. The contents of the mind need not be true, but they merely need to support survival. Against this pragmatic strain in psychological Darwinism Fodor (2005) writes in his reply to Pinker's reply:

> The claim at issue is about what cognition aims at; it's about what cognition contributes to the overall process of choosing and integrating actions. But there's a lot to more to deciding how to act than what cognition contributes; it has to be sensitive to considerations of prudence, relevance, computational cost, probable pay off and so forth. It is, to be sure, possible to imagine a kind of architecture in which the mechanisms that find out how things are aren't distinct from the ones that decide what to do; that's precisely how a reflex works. Quite possibly, distinguishing thought from action is the cost of a mind's doing better than a reflex…. Truth alone doesn't determine the course of action; how could it? But that doesn't deny that cognition per se is interested in truth per se. That man does not live by bread alone isn't a reason to doubt that there are bakers (Fodor 2005, 30).

Evolutionary biology is a truth-seeking field, in that it aims to understand how life grew on this planet. However, an evolutionary biology of mind does not in itself account[114] for the

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[114] Keith Lehrer addresses an analogous point in *Theory of Knowledge*, when he addresses the question of whether natural selection can be trusted as an account for why human minds have truth bearing beliefs. His argument can be readily applied to "Yet another way of saving observation statements, by appeal to the theory of natural selection, is equally faulty for similar reasons. To argue that beliefs about what we observe must be completely justified because they have survival value in the process of natural selection will leave one epistemologically bankrupt. First, the form of survival theory that currently appears most tenable is one recognizing that many factors bear little weight in the struggle for survival and consequently, may be retained even though they have almost no survival value. Hence, one cannot argue from the existence of beliefs to their survival value. Second, and

truth-oriented nature of the mind.[115] Open minds seek truth like open mouths seek food. Truth may be difficult for people to define, but that difficulty in no way diminishes how it is evidently so. In fact, the many books and remarkable ingenuity[116] shown in the labour to understand truth demonstrate that the cognition of the human mind (as Fodor uses the term above, referring to real human minds) does aim at truth. Maybe there is no truth. If so, the fact has done little to deter us from the search for it.[117]

Secondly, Fodor argues from *consilience*, when the data from two inductively studied domains happens to agree. The various subdisciplines of science are not all "mutually *explanatorily* relevant" (Fodor 2000, 83). Psychology does study the mind, and biology does study the brain, but it is a mistake to suppose "that the mere *consistency* of the psychological sciences with biology somehow requires that cognitive architecture should be a Darwinian adaptation"[118] (Fodor 2000, 82-83). The *requirement* that evolutionary theory *must* be used is a strong sign evolutionary theory is being used as an interpretive *model* rather than a theory (see the distinction between *model* and *theory* in chapter 1).

On this point, Pinker's rebuttal of Fodor is strong:

The subject matter of psychology is the functioning of the brain. The subject matter of botany is plants. The brain is not a plant. Now, the subject matter of evolutionary biology is living things. The brain is a living thing. Therefore, the relationship between psychology and evolution is not the same as the relationship between psychology and botany (or the relationship between

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more important, even if this inference is allowed, the epistemic leap to the conclusion that such beliefs are completely justified is totally unwarranted. Beliefs that are neither true nor completely justified may have considerable survival value. Perhaps the truth would destroy us" (1990, 101-102).

Lehrer's argument can equally be applied to cognitive science which I will illustrate by repeating the salient parts of the paragraph with the appropriate edits.

"To argue that the [brain's cognitive architecture] must be completely [trustworthy] because [it has] survival value in the process of natural selection will leave one epistemologically bankrupt. First, the form of survival theory that currently appears most tenable is one recognizing that many factors bear little weight in the struggle for survival and consequently, may be retained even though they have almost no survival value. Hence, one cannot argue from the existence of [the brain's cognitive architecture] to [its] survival value. Second, and more important, even if this inference is allowed, the epistemic leap to the conclusion that such [cognitive architecture] is completely [trustworthy] is totally unwarranted. [Cognitive architecture] that [is] neither [truth preserving] nor completely [trustworthy] may have considerable survival value. Perhaps the truth would destroy us."

[115] This is not to say that the mind is *only* truth oriented. Some humans love to lie. In fact one could call them lie oriented. Perhaps there are people who are for all intents and purposes "lie-oriented". But consider, there's a way in which a really good liar *needs* to be truth oriented to be successful, perhaps even more than those who tell the truth.

[116] For an excellent survey of truth theory literature see Kirkham (1997).

[117] Here in context, this comment suggesting the possibility that that truth might not in fact exist, is meant to highlight the evident human interest (on the part of a good many humans) in the search for truth.

[118] For the details of Fodor's case against Darwinian adaptation see Fodor (2000, 79-100).

lunar geography and cellular mitosis, and so on). If anything is 'a little odd', it is Fodor's failure to distinguish pairs of disciplines whose subject matters are in a superset-subset relation from pairs of disciplines whose subject matters are disjoint (2005).

This powerfully argued passage is also helpful in that it reveals Pinker's blind spot. After clearly showing that the brain is a living thing, he makes the wild jump (of which Fodor accuses him), even using the word "Therefore" to suggest that he thinks there is a connection between something being alive and the necessity that it be studied through the lens of evolutionary biology. Pinker is *not* saying that it would be helpful to study the mind through evolutionary biology, but rather that it *must* be studied through that lens. *But what if there is more to the mind than what theories based on evolutionary biology can show us? Because* the brain is a living thing, "the relationship between psychology and evolution is not the same as the relationship between psychology and botany" (Pinker 2005). If one replaces evolution with anatomy or physiology, this sentence makes perfect sense, and Fodor agrees that psychology is related to brain physiology; such a study is in Ricoeur's terms a synchronic study of the brain as a complex system. The point of adjudication between Pinker and Fodor is whether evolutionary history is necessary to understand the functioning of an organism. And Fodor emphatically answers, "No," on the basis of the brain's relationship to biology. Because the heart is a biological item, and so is the brain, and because we don't need evolutionary history to know that the heart pumps blood (Fodor 2005, 30), we do not *need* evolutionary history to reinterpret experimental observations of brain science.[119] This is

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[119] One may argue that the brain is so much more complex that the heart, therefore its natural history must be studied for it to be understood. However, since a non-conjectural knowledge of the natural history of brain development is not available to us, only its present iteration is available to us as an object of study. Since understanding a complex system in part depends on understanding the close range interactions within the system, it is important to get as close to that information as possible, which, at least at present, is only available to us through direct study of the human brain. Ricoeur's notion of the polysemy opens up a history of the system, which is itself not diachronic. Polysemy of the meroi is a diachronic process, though it depends upon synchronic relationship. Words retain previous meanings while gaining new ones. Thus it is possible to study the history of the system without the system going through changes. This principle applies to brain science in the notion of functional polysemy, particularly in the plasticity of cells, and in the memory of past firing thresholds in neurons, which was discussed earlier in this chapter.
    One may also want to argue that animals provide an evolutionary context in which the human brain may be studied. While it is true that they provide a window into the operations of the human brain, the study of comparative anatomy is a synchronic study, in that we are only able to study the living animals that exist now. We can conjecture what an *Australopithicus*'s brain must have been like. We may wonder what the difference between a *Robustus* brain and an *Afarensis,* and knowing that that the chimpanzee is most likely related to the *Australopithicus* may tempt some into thinking that the brain of the chimp is basically that of the *Australopithicus*, but what is being forgotten in that leap of reasoning is that the chimp is a current iteration, not a past transitional form. To use McCloskey's

not to say that the work of comparative anatomy (which today part and parcel with evolutionary biology) does not helpful and interesting.

Third, Fodor argues from *teleology*. Fodor observes the continual refrain that science seeks a rationale for the arrangement of the material it studies (2000, 84-85). No problem here. But Fodor is critical of the following step of the new synthesis: the claim that immediate application of an evolutionary model is required to make teleology intelligible. He rejects that there must be some intrinsic connection between an organ and its selection history such that the organs function is unintelligible without knowing the history. Fodor has great faith in the human ability to guess at the purposes for which the hands, feet, nose, and brain are used.

Finally, Fodor argues from *complexity*. Fodor criticizes the constant refrain in new synthesis literature that adaptive cognitive development is by definition naturally selected development:

> Since nothing is known at all about how the architecture of our cognition supervenes on our brains' structure, it's entirely possible that quite small neurological reorganizations could have affected wild psychological discontinuities between our brains and the ancestral apes. This really is entirely possible; we know nothing about the mind/brain relation with which it's incompatible (2000, 88).

Fodor strongly advocates that his reader takes seriously that in complex nonlinear systems small changes can have drastic effects (93). Fodor affirms that he supports a modest modularity of mind consistent with his earlier work, and consistent with a hermeneutic phenomenology of complex systems.

While the controversy between Fodor and Pinker may be interesting, it does highlight one important point, which will be of help as we develop a hermeneutic phenomenology of complex systems. The debate shows that evolutionary biology cannot possibly come up with *all* the answers on *how the mind works*, even if one combines it with the computational theory of mind. There is more to the mind, and if we use Pinker's restrictive strategy strongly, we may miss something important, perhaps things that a hermeneutic phenomenology of complex systems could show us.

Later in this dissertation I will examine Aristotle's approach to understanding complex systems in his work *Parts of animals* (2001). It is worth pointing out here Jerry Fodor has done with Steven Pinker what Aristotle did with the reductionist physicalist, Empedocles.

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terminology, the brain of the chimp or the macaque is an object of study, a useful object of study, but

Aristotle, who loved biology, would not allow biology to be collapsed into mere physicalism.[120] Empedocles wanted to allow only physical descriptions of material to constitute explanation. Aristotle's interaction with Empedocles, like Fodor's with Pinker, illustrates Aristotle's strong desire not to go beyond what is known. When confronted with the issue of where biological organisms come from, Aristotle admits that they were formed, but he does not want to make the story of how they were formed central to the inter-operational causes of their parts.[121] Instead he sticks to what is empirically given. Plants and horses come from seeds. Rather than seeking a full account of the historic origin of the species, he looks at what is before him, considering the observable teleology of the parts he is studying. Thus Aristotle's approach to biology is consistent with Ricoeur's notion of synchronic level of analysis. In *Parts of Animals*, Aristotle studies the causes of the parts of animals as they act upon one another, bringing about internal change within the organism.

So as it stands we have three reasons to delimit the development of a hermeneutic phenomenology of complex systems to the synchronic level. Firstly: considering the initial scope of the research, it fits with our initial methodology in that Ricoeur defines polysemy in terms of the synchronic level of analysis. Following the direction I established in the introduction, I assume that for the most part Ricoeur is basically right. Secondly, the complications that arise from the issues debated by Pinker and Fodor give warrant for focussing on the current iteration of the human brain, and the concrete study opportunities that it avails. Finally, Aristotle (who is both inspiration to Ricoeur's model of the text, and is

not an answer.

[120] *On the parts of animals*, 642a 16-23 (Aristotle 2001): "For nature is an origin more than matter. Even Empedocles occasionally stumbles upon this, led by the truth itself, and is forced to say that these substantial being in the nature is the account [for more on substantial being see chapter 5], e.g. when he says that bone is. He does not say that it is some one of the elements, or two or three, or all of them, but rather that it is an account of their mixture. Accordingly, it is clear that flashed to, and each of the other such parts, is what it is in the same way."

[121] *On the parts of animals*, 641b 11-37(Aristotle 2001): "[I]t is apparent that, just as in artifacts there is the art, so in things in themselves there is another sort of origin and cost, which we have as we do the hot and cold—from the entire universe. This is why it is more likely that the heaven has been brought into being by such a cause—if it has come to be—and is to such a cause, that immortal animals have been... Yet some people say that each of the animals is and came to be by nature, while the heaven, in which there is not the slightest appearance of chance and disorder, with constituted in that way by chance and the spontaneous.

"We say 'this for the sake of that' whenever there appears to be some end towards which the change proceeds if nothing impedes it. So it is apparent that there is something of the sort, which is precisely what we call a nature. Surely it is not any chance they that comes to be from each see, nor a chance seed which comes from a chance body; rather, *this* one comes from *that* one. Therefore the seed is an origin and is productive of what comes from it. For these things are by nature; at least they grow from seed. But prior even to this is what the seed is the seed of; for while the seed is becoming, the end is being. And prior again to both of these is what the seed is from. For the seed is a seed in two ways, *from* which and *of* which; that is, it is a seed both of what it came from, e.g. from a horse, and it is a seed of what will be from it, e.g. of a mule, though not in the same way, but at each into

once again, now in the age of nonlinear science, proving helpful in his own development of a way of understanding complex systems) is careful in his own methodology to study an organism as it is now. This study of the organism as it is now, in its current iteration, permits a study of the history of the individual organism, its beginning, middle, and end, in which the organism is not lost amidst the other processes in which it participates. For these three reasons, the move to focus this study on the synchronic level of system analysis seems quite warranted.

10. CONCLUSION

This chapter addressed two of Paul Ricoeur's presentation mistakes in *What makes us think?*: Ricoeur's lack of a hermeneutic phenomenology of complex systems, and his failure to bracket the question of evolution. In preparation for a reply to Changeux on behalf of Paul Ricoeur, this chapter reoriented and reorganized the data and models of brain science to bring them to terms with hermeneutic phenomenology. Finally, I showed why this study would develop a hermeneutic phenomenology of complex systems for the synchronic level of system analysis.

The survey of brain science data demonstrated that all levels of brain architecture exhibit a functional polysemy through their participation in a complex system. This feature of neural architecture, and other complex systems, permits an analogy with the linguistic feature of *polysemy*. Polysemy is the property of the possible plurality of use that a word could have in discourse. In this chapter, I referred to the parts of a complex system as having a functional polysemy. When the parts become systematized, properties emerge from them that cannot be wholly separated from the system. They have a systemic identity. In the same way that discourse subdues and reconfigures polysemy of words in hermeneutic phenomenology, so it is that complex systems subdue and reconfigure the functional polysemy of that system's parts, both structurally irreducible parts (like neurotransmitters and neuromodulators) and subsystems (like neurons and networks of neurons).

In terms of neural anatomy, we also find a strong analogy between that reconfiguring power of discourse, and the reconfiguring power of systemic action within a complex system. When a part participates in a complex system, that system, through its action, configures the expressive power of that part within the system. This is exactly what we see in discourse. Predication appropriates words from the structure of interrelated possible meanings,

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way mentioned. Further, the seed is in potentiality; and we know how potentiality is related to

resulting from the history of the words used, and may quite possibly reconfigure the use of that word within the sentence, so that the sentence has a meaning that ascribes a different use to that word (for more discussion on this point, see chapter 4). Discourse can do this without disrupting the structure of the word internally or preventing that word from being used as it was before. It should be observed though that since words are conventional, and are more flexible than physical systems, it is remarkable that similar properties apply to both.

I went on to discuss the three types of models used in cognitive science: a rule-based model, a connectionist model, and an Artificial Life model. Though I raised problems with each kind of model, I also showed how each model appreciates an important feature or set of features that serve the project of modeling complex systems. The rule-based model, built around the manipulation of symbols, takes symbols seriously. Symbols, to be symbols, must symbolize something. Therefore, the rule-based model carries with it the necessity for representation. The person must in some way represent a world, out there.

Any successful approach to modeling complex systems must take symbols seriously. The Austrian economist Ludwig von Mises observes two epistemological problems (discussed in the previous chapter) that come with interpreting economic phenomena (or for our purposes the relations within a complex system): the problem of correctly interpreting the causes of an event when multiple causes are in play, and the epistemological problem of being ignorant of at least some, and possibly much, of the system (1998, 30-32).[122] This means that at some points, likely at many points in the labour of interpreting complex systems the interpreter is presented with things or events with unknown causes. These things and events have *symbol-like* qualities, though they are not necessarily symbols. Because the rule-based model appreciates symbols there is some common ground between it and a hermeneutic phenomenology of complex systems.

The rule-based model also has some serious problems. Paul Cilliers and John Searle together observe that the rule-based model has no resources for the interpretation of the symbols that it uses. Michael McCloskey showed that the same input/output relationship in the rule-based model also holds with the connectionist model, therefore there is at least a functional equivalence between the two. What one may call a symbol in the end is simply a component in a mechanism, not a mind, which Searle's Chinese room illustrates. It follows that the rule-based model cannot be appropriated and synthesized into a hermeneutic

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complete actuality (Aristotle 2001).

[122] These are important epistemological problems, and at least in an economic system, though I expect this applies to all natural complex systems, the indeterminacy of human actions (and another natural systems there are components which accomplish the same epistemologically limiting functions that human actions to an economy) make a total solution to these epistemological problems inscrutable.

phenomenology of complex systems, because the notion of symbol in hermeneutic phenomenology, and the univocal symbol of symbolic logic and computer languages in not the same. However, the rule-based approach recognizes the value of symbols, and that cognition somehow works with symbols.

A connectionist model also displays areas of sympathy with hermeneutic phenomenology, but also exhibits at points its incompletes as a global cognitive model. It shows sympathy in that it appreciates the systemic relationships of the parts to the whole. Neural nets summon a collection of parts to accomplish a task, often a variety of tasks. Parts of neural nets can essentially be a "broken off" through neuromodulation used to accomplish different tasks, which we observed to be the case in the example of stomatogastric nervous system. Here again we find common ground with the hermeneutic phenomenology of Paul Ricoeur. Discourse systematizes polysemic parts, subduing their potential and actualizing them to serve the creation of meaning in discourse. However, the connectionist model as-such appears to be incomplete, because its operation fits a similar input/output definition that also applies to the rule-based model. This definition holds, with the noteworthy exception that neural networks do not necessarily need their inputs translated into symbols. Connectionist modelers may define the work of the network as "distributed representation," but the only basis for this definition is that the network's output was produced by the network. Thus it is somehow functionally "distributed" through the network, but making this notion of distributed representation intelligible was found to be difficult. Jerry Fodor rightly sees the strong analogy between connectionist modeling and behaviorism, as mentioned above (2000).

In his scholarly work, Paul Ricoeur often takes a problem in one philosophical approach, and then charitably recognizes how to remove the cause of a problem. Ricoeur then removes the situation from its offending philosophical setting and placed in a more beneficial context. I will apply Ricoeur's method here. Connectionist modelers label the work of the network as "distributed representation" because they want to appreciate that what is happening on the *inside* of the system is not the same thing as what is happening on the *outside* of the system. The behaviors that one sees on the outside are labelled as so-called *emergent properties.* If, for a moment, we set aside the input/output functions of the neural network, and focus on emergent properties as properties of the whole that cannot be reduced to the parts, though they may be affected by the parts, we have an insight that approximates Ricoeur's defence of the irreducibility of personhood in *Oneself as another*, and of discourse itself.

Hermeneutic phenomenology may also find common ground with Artificial Life. The new discipline of Artificial Life is too young to criticize, since it is less a theory or model than

a research project. Researchers of Artificial Life recognize some of the problems faced by rule-based models and connectionist models. A good portion of Artificial Life computer modeling leans in the direction of evolutionary research, since computer models can remove the natural stopgaps that seem to make evolution flow like window glass in the natural world. Because Artificial Life studies fictional organisms in the midst of rapid change, it faces the challenge of identifying parts and wholes, which I illustrated with Langton's use of GTYPE and PTYPE. As we have seen, researchers struggle to distinguish between emergent behavior and internal system events. Once again, Ricoeur's dialectic of language and discourse may be brought to the service of modeling complex systems but toward a different application. The structural system of language, in which words exhibit a multi-valued but limited polysemy, is inextricably bound to the *possibility* of sentence inscription. This partnership is so strong that there is no polysemy without discourse. Words allow for sentences while sentences organize and activate words. This distinction between parts and wholes seems also to be a common theme in Artificial Life research program, which aims to construct or better *grow*, an artificial organism and its capacities. It is also telling that the same criticisms raised by Artificial Life theorists about rule-based models and connectionist models could equally be advocated from the platform of hermeneutic phenomenology.

This chapter concluded by making a brief case for focusing a hermeneutic phenomenology of complex systems on the synchronic level. A review of the Pinker/Fodor controversy showed that evolutionary biology could not possibly answer all the questions about how the mind works. Whether Fodor or Pinker wins their rhetorical rumble is irrelevant for our purposes. Aristotle took a similar position to that of Fodor against his Pinker-like contemporary, Empedocles. Therefore through Ricoeur's analysis of polysemy, and the approaches of Fodor and Aristotle, we find warrant for a synchronic hermeneutical phenomenological approach that preserves the unity of the system while understanding how the parts affect one another and the whole.

If I have sorted the data of neuroscience for the needs of a hermeneutic phenomenology of complex systems, and brought rule-based, connectionist, and Artificial Life models of brain science to terms with hermeneutic phenomenology; and if I have given warrant for a synchronic approach to the brain as a systems, then this chapter has met the goal of reorienting and restructuring the data of neuroscience to circumvent Changeux's contentions in *What makes us think?*.

Let's press on. The next chapter will conjure the central themes in Ricoeur's work that will embolden a hermeneutic phenomenology of complex systems.

CHAPTER 4

Model and text: the hermeneutic phenomenology of Paul Ricoeur

"The symbol gives rise to thought."
Paul Ricoeur, The Symbolism of Evil *(1967, 352)*

1. Introduction

The intention of this dissertation is to situate brain science within hermeneutic phenomenology and to develop a hermeneutic phenomenology of complex systems in order to accomplish that task. By situating brain science within hermeneutic phenomenology, my strategy is to close the ground between the respective positions held by Paul Ricoeur and Jean-Pierre Changeux in their book length debate entitled *What makes us think?* (Changeux 2000). Not only am I to bring the positions of Ricoeur and Changeux to terms with one another, I also intend to take up Ricoeur's side of the debate and argue in favour of Ricoeur's hermeneutic phenomenology over and against the reductionist neuroscience of Changeux, which I outlined in chapter 3.

To accomplish this task, I began first pointing out the strong relationship between metaphor and scientific modeling, for both neuroscience and cognitive science are disciplines that aim to model complex systems. Since Ricoeur develops a significant aspect of his hermeneutic phenomenology through his own study of metaphor, it seemed an inquiry into the relationship between the metaphor and the scientific model was both an appropriate

and necessary starting point for developing a hermeneutic phenomenology of complex systems. The first two chapters developed a definition of both the *model* and the *complex system*. In chapter 1, "model" was defined, drawing on the work of Black, Hesse, Ricoeur and Brown, "as metaphorical redescription of the domain of the explanandum" (Hesse 1966, 157). Chapter 2 defined "complex system" in accordance with Paul Cilliers's 10-part definition of a complex system. Chapter 3 then examined the domain of brain science, looking at the levels of brain organisation, surveying the three main models that are used to account for cognitions and finally explaining why the hermeneutic phenomenology of complex systems should engage systems primarily on the synchronic level.

Regarding the subject of this chapter, before I begin to develop a hermeneutic phenomenology of complex systems that can be applied to neuroscience, it is first necessary to draw from Ricoeur's works the insights that best inform this task. In the present chapter, I intend to characterise hermeneutic phenomenology, giving the necessary backcloth for developing a Ricoeurian approach to modeling complex systems. To avoid prolixity, I will touch on the facets of his work that promise only the most helpful insights, but I will save their application to modeling complex systems for the three chapters following the present chapter. In this chapter, I will offer a more developed introduction to hermeneutic phenomenology, situating it within the broader tradition of phenomenology. I will then proceed to the development of Ricoeur's theories of symbol, polysemy, discourse and text.

2. WHAT IS HERMENEUTIC PHENOMENOLOGY?

Phenomenology, as a tradition, aims to accurately describe the objects of experience. One can take this mission, in its barest formulation, as a description of human experience alone. This bare effort assumes a notorious Cartesian insinuation as Husserl's *Cartesian Meditations* make evident (1977).[123] Paul Ricoeur does appropriate Husserl's method of the *epoche*[124], but he transcends the bare formulation of the project of phenomenology, that of limiting phenomenology to descriptions of experience only, not

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[123] The initial stage of Husserl's project examined phenomena, approaching it as though the objects of experience could only be studied as presented in the phenomena of experience, with no relationship to a world beyond that of the individual's available perceptions. However, this initial approach to phenomenology also adopted the latent ego-centric predicament that Descartes's *Meditations* (1993) inspires.

[124] Husserl's *epoche* is a philosophical method whereby an item is separated from other factors or concerns for the purpose of analysis. Husserl placed experience into the *epoche* so as to consider the objects of experience as separated from the objects that cause experience in themselves.

through obscene metaphysics[125], but through expanding the class of *objects of experience* one can submit to phenomenological description. Ricoeur expands this class to include objects of culture, and especially written texts, a move instigated by Husserl's latter work emphasizing the *lebenswelt*[126].

In his essay "Existence and hermeneutics," Ricoeur distinguishes his own philosophy from Heidegger's "short route" to an ontology of understanding and instead seeks inspiration from the later Husserl (1974, 21). Ricoeur turns "against the early Husserl, against the alternately Platonizing and idealising tendencies of his theory of meaning and intentionality" and instead seeks at a notion of *understanding* (9). The project of the early Husserl aimed at reducing being, or better, to close off phenomena from the very things that make them intelligible. In other words, he aimed at showing that there is something underneath appearances that humans come to *understand.* However, in Ricoeur's eyes, that project failed (9). It is this failure that allowed phenomenology to escape the confines of the initial project, which focused the attention of the researcher on climbing inside the mind as separate from the world. After this failure, phenomenology is free to seek understanding *into* the lived world. Phenomenology can now dive in! Ricoeur judges this pursuit of understanding to be the common ground between Husserl and Heidegger. Drawing inspiration from his own work on Freud, he reverses the *cogito*[127] by pursuing an *archaeology of the subject* that moves toward a teleology of the subject were the subject "returns to himself" through the movement of interpretation (21). In other words, the subject is not some solid, steel pith inside human experience; it must be excavated, uncovered, and studied. The hermeneutics of the subject is at least one stated aim of psychology. But the archaeology of the subject is more than just psychology; it is fundamentally the work of

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[125] By "obscene metaphysics" I am referring to the metaphysics of Martin Heidegger (1962) who took a direct approach to metaphysics in his development of *Dasein.* How does Heidegger do this? In *Being and Time,* Heidegger begins his project by presuming the phenomenological reduction as a precursor to his research. In contrast with this short route to metaphysics, which quickly engages the lived world as being accessible to our consciousness, as I will explain in the paragraphs that follow, Ricoeur will develop a "long route" to metaphysics, one that I am in fact trying to follow as a method for my own philosophical work here.
[126] The *lebenswelt* is the concept of the life-world which Husserl (1970) introduces in *The crisis of the european sciences and transcendental phenomenology.* This life-world, in contrast to the Cartesian direction of Husserl's earlier work, approached the idea of a public lived human cultural framework in which there is a shared world of experience that is open to phenomenological study. Much of Ricoeur's philosophical work can be seen as an exploration of this world.
[127] The cogito refers to the unassailable self which Descartes discovers in his famous second meditation. In his second meditation, Descartes deduces from the fact of his own doubting, that he must be thinking. Consequently, if he is thinking, he must exist. Upon the foundation of the *cogito* (Latin for "I think") Descartes believes he has discovered the one irrefutable fact of existence, and aims to build upon its foundation all of human knowledge. I will go on to point out that Ricoeur reverses this approach. Rather than climbing inside the mind in order to come to know the self, one

understanding, wherein the human goes out into the world, so to speak, in order to return to himself and situate himself within his world (21). As Ricoeur explains, "It is behind itself that the *cogito* discovers, through the work of interpretation, something like an *archaeology of the subject.* Existence is glimpsed in this archaeology, but it remains entangled in the movement of deciphering to which it gives rise" (21). This observation guides Ricoeur's philosophical project:

> This is why philosophy remains a hermeneutics, that is, a reading of the
> hidden meaning inside the text of the apparent meaning. It is the task of this
> hermeneutics to show that existence arrives at expression, at meaning, and
> at reflection only through the continual exegesis of all the significations that
> come to light in the world of culture (Ricoeur 1974, 22).

"[E]xistence arrives at expression, at meaning, and at reflection," Ricoeur tells us, but he is quick to remind us we can only come to know existence through continued exegesis. Human understanding requires a relentless pursuit of wisdom, of discovery. But Ricoeur is quick to clarify that when it comes to meaning he is an ontological realist: "[R]ival hermeneutics are not 'language games,' as would be the case if their absolutist pretensions continued to oppose one another on the sole level of language" (23). By grounding interpretation of what in "an existential function" he employs the lived world to arbitrate between rival language games,[128] without leaving a hermeneutical path. One cannot stop the inquiry at any point and say "I have arrived." The being of the world does not present itself to our minds like a Platonic chair form. For Ricoeur, the many facets of reality must be approached on a journey, a quest.

Thus Ricoeur contends that humans come to understand through the detour of symbolic thought, as he famously puts it, "The symbol gives rise to thought" (1967, 352). Ricoeur defines *symbol* after carefully studying the way in which cultures develop and employ their own symbols (1-56). Based on that study, Ricoeur carefully defines 'symbol' as the middle between two extremes. On the one hand he wants to avoid an extreme which he attributes to Ernst Cassirer, who uses 'symbol' as a universal framework holding human conception together (1957, 3, 93, in Hamburg 1956, 59). Ricoeur is concerned that

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ought to leave the interior of the self, and go out into the world, into cultural works, into public discourse, in order to find the self.
[128] Ricoeur does not deny that there are "language games" (he uses the term discourse, and refers to other ways of speaking about things as "discourses"). However, hermeneutics permits one ones interpretation to enter into existence, to interpret past appearance, but he strongly encourages

Cassirer's analysis establishes no bounds for symbols, because, in Cassirer's view, symbols become the unifying mediators of all knowledge (1970, 10-13). For Ricoeur, this universal definition of 'symbol', by its scope, limits the possibilities for the analysis of the symbol. To use a metaphor, to Ricoeur's mind, Cassirer's analysis turns humans into fish swimming in a boundless sea of symbols, which account for every aspect of the ecosystem of their understanding. Cassirer cannot explain "[h]ow man gives meaning by filling sensory content with meaning" (11). For Ricoeur, Cassirer's account of symbols never permits symbols to point at objects except other symbols, thus Cassirer implicitly denies the referential quality of symbolic discourse, which Ricoeur is concerned to protect.

On the other hand, Ricoeur wants to steer clear of the definition of symbol used by symbolic logic.[129] Symbolic logic aims to reduce logic to universal forms that need not take into account context or subtlety, only validity. The polysemy of symbols only gets in the way of the symbolic logicians logical operations.[130] In Ricoeur's view, which will be treated in greater detail in chapter 6, the univocal symbol of symbolic logic is the opposite of what he finds so necessary about symbols. The univocal symbol has no interior, and no way of being explored. It simply operated in relation to other rules and other symbols. If one brackets this type of symbol, nothing is added or taken away, and that is why these symbols were developed by humans. This symbol lacks the polysemy of meaning common to human symbols which opens it to philosophical (hermeneutical) reflection. Thus, there is no way to *understand* it, or understand the world and ourselves through it.

Ricoeur turns away from these two extremes; however, he recognizes that they both see valuable sides to the debate. Cassirer sees the ubiquity of symbols in human understanding. The view of symbols in symbolic logic recognizes that symbols can have specific values, and that they can be used to accomplish specific tasks. For Ricoeur "the word 'symbol' seems well suited to designate the cultural instruments of our apprehension of reality: language, religion, art, science" (1970, 10). Ricoeur also distinguishes between two aspects of a symbol, its sensible quality and its significance. Symbols are sensible in someway, either through sight, hearing, smell… somehow we sense them. However, the symbol also has a second aspect, its significance, its meaning. A symbol can have multiple significances; it can have polysemy.   Symbols are dangerous things. One can read a symbolic meaning into everything, as the ancient Christian theologian Origin was later accused of doing. There is often told story of a two Babylonian wise men:

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epistemic and hermeneutical caution, because—following Aristotle's analogy of being—being rarely reveals itself in one moment. Coming to know the world is a process, a never ending journey.
[129] For a more detailed discussion see chapter 6.

While discussing the curvature of the earth, younger one asked the older one, "Why is the earth curved?"

The older one replied, "Because it's on the back of a turtle."

The younger wise man thought a moment and asked, "What is that turtle standing on."

The older one quickly replied, "Another turtle."

The younger was about to ask a follow up question but the elder wise man knew what he would ask, and answered, "It's turtles all the way down."

The peril of symbols is it could be symbols all the way down, what Umberto Eco calls *unlimited semiosis* (1990, 28). Ricoeur avoids the peril of an endless moving through symbols by demonstrating that in the interpretive act one does not move from ignorance to knowledge, but from one kind of acquisition to another. Both moves acquire knowledge, but interpretation leaves one kind of acquisition and uses the resources earned to gain something new. When a lawyer exegetes the law in order to apply it to his client's situation, he does not ignorant of his client's circumstances or the law. Yet his work of interpretation must move through both. He must seek to understand his client, having understood the law; then he must seek to understand what issues the text of the law raises for the circumstances of his client. This creates a hermeneutical circle, and one that is ethically treacherous. Since the lawyer is in the process of acquisition of knowledge, moving from one kind of acquisition to another, he must be careful not to bring a third dimension to the circles movement to throw it off course. Often money and power can tempt a lawyer to turn the alternating acquisitions of knowledge into a movement from ignorance to knowledge. What is so noteworthy about this corrupt state of affairs is that its successful prosecution (success measured for the lot of the "blood sucking" lawyer) requires *knowledge*. Money and power are black holes in the moral universe whose gravitational pull twists the orbit of the hermeneutical circle, pulling belief and understanding out of their normal orbit into another which ends only with their own destruction.[131] Returning to Ricoeur, this two-fold acquisition of belief and understanding permits Ricoeur to distinguish between *believing* something and *understanding* it, without subordinating one to the other. Echoing Augustine he writes, "We must understand in order to believe, and we must believe in order to understand" (Ricoeur 1967, 351).

Ricoeur is careful to protect the open inquiry of hermeneutics, which the Cartesian *cogito* and Heideggerian ontology seem to stifle, for he wagers that the long road of

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[130] Incidentally, the definition of symbol found in symbolic logic is the source of the view of symbol employed by the computational theory of mind.
[131] Could this happen in science too?

hermeneutic ontology opens the world to being understood and believed. To avoid the direct appeal to foundationalism, or some ontological given, Ricoeur makes this hermeneutical wager:

> I shall have a better understanding of man and of the bond between the being of man and the being of all beings if I follow the *indication* of symbolic thought. That wager then becomes the task of *verifying* my wager and saturating it, so to speak, with intelligibility. In return the task transforms my wager: in betting *on* the significance of the symbolic world, I bet at the same time that my wager will be restored to me in power of reflection, in coherent discourse. (Ricoeur 1967, 355)

In other words, Ricoeur bets his time and philosophical energies on the project of symbolic thought in the hopes of yielding clarity and insight, expecting on the other side to be wise and better equipped with prudence and copiousness of mind. The task of philosophical reflection on symbols becomes a quest to invest his wager with the wisdom and intellect, which opens the field of symbolic thought toward the eschatology of a thoughtful and articulate philosophical maturity. Symbolic thought makes the rich wisdom of understanding possible, because the polysemy of symbols, and the domains in which they operate, open a world of understanding. Ricoeur, therefore, remains within the frame of phenomenology by identifying the symbols of texts as the kind of phenomena that phenomenology can describe. This frees Ricoeur to bracket[132] the question of authorial meaning and instead uncover the meaning of the symbols themselves. Ricoeur wants to be careful not to obscure the meaning of the text by approaching it as some cipher for the intent of its author. As I will explain later, Ricoeur is no opponent of authorial intent. Rather he wants to study the text with the text's intent in mind. In other words, in the same way that an object of experience can be analysed (for purposes of clarity) separately from the material qualities of the object itself, so the text can, for purposes of analysis, be separated from the intent of its author. In this way, the human world opens before Ricoeur as a world of signs and symbols. However, the human world is still more that signs and symbols.

Throughout his voluminous writings, Ricoeur increases the scope of this hermeneutical circle to engage not only symbols, but discourse, text, and the full,

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[132] By "bracketing," I'm referring to the application of the *epoche* referred to earlier, the procedure used in phenomenology of isolating a particular phenomenon for study.

epistemologically complex, human life world. Ricoeur uses the term *hermeneutical circle*[133] to designate the implications of the abovementioned maxim which he draws from Augustine, namely, "We must understand in order to believe, and we must believe in order to understand" (Ricoeur 1967, 351). However Ricoeur (1974, 381-401), in explaining the hermeneutical circle while in dialogue with Bultmann's theology in the context of the discipline of biblical hermeneutics, is critical even of this traditional formulation of the circle, because

> This formulation is still too psychological. For behind believing there is the primacy of the object of faith over faith; and behind understanding there is the primacy of exegesis and its method over the naïve reading of the text. This means that the genuine hermeneutic circle is not psychological but methodological. It is the circle constituted by the object that regulates faith and the method that regulates understanding. There is a circle because the exegete is not his own master. What he wants to understand is what the text says; the task of understanding is therefore governed by what is at issue in the text itself. (Ricoeur 1974, 389)

Though Ricoeur may be discussing the exegesis of a religious text, the context of his discussion actually makes his points about the nature of the hermeneutical circle all the more clear. The circle does not keep us from knowledge, as though we are trapped in it. Rather it is how we come to understand the domain of our study, and it is that domain, what we come to know, that checks our understanding.[134]

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[133] The hermeneutical circle is the relationship between belief and understanding, in which one of the pair interprets and informs the other. Thus, there is no absolute pole. Belief cannot be absolute over understanding, neither can understanding be absolute over belief. As one understands a cultural system, one moves deeper into symbolic exegesis through the iterative process of moving from the one type of acquisition to the other. Even if one does not believe, one must play *as if* one believed, in order to know. At turn on the circle, the human mind better orients itself in the system.

[134] The hermeneutical circle can seem to remove the interpreter from reality he or she wishes to understand, and move the question of interpretation further into the shifting nether-maze of literary theory. Two examples may help here that take us beyond the bounds of written symbols. Col. John Boyd (summarized in Bunker 2002, 136) outlines a hermeneutical circle that behaves like circle Ricoeur describes. Boyd analyzed the warfighting process and discovered that the opposing forces in a war go through a four-part hermeneutical circle. First, they observe the situation. Second, they orient themselves to the situation. Third, they decide what they will do. Finally, they act. These four stages are then followed by observation and then orientation, then another decision and finally an action. Each circle on the loop opens the system of both the opponent to being better understood, which is a problem for the warfighter. But a hermeneutical circle is exactly what is happening in this cycle, called the OODA loop. The difference in a warfighting situation is that one does not usually want more iterations of the loop to continue.

Ricoeur uses the question of a theory of history as an apt nexus of discussion for the issues related to textual hermeneutics and the lived world, and the debate requires him to stand against a positivist view of science which influenced some of Ricoeur's conversation partners[135]. To accomplish this feat he punctures holes in the would-be watertight compartment that separates *explanation* and *understanding* in positivistic science, and chastises the epistemological hegemony of the natural sciences. His points here are a critical starting point for a hermeneutic phenomenology of complex systems.

> At the start, the question is whether the sciences, be they natural or human sciences, constitute a continuous, homogeneous, and ultimately unitary ensemble, or whether there is necessarily an epistemological break between the natural and the human sciences. At the first level of the problem, the terms *explanation* and *understanding* are the emblems of the two camps confronting one another. In this duel, the term *explanation* denotes the claim of non-differentiation, of the epistemological continuity between the natural sciences and the human sciences, while the term *understanding* proclaims the insistence on the irreducibility and specificity of the human sciences. But what, in the final analysis, could found this epistemological dualism if not the presupposition that, in the things themselves, the order of signs and institutions is not reducible to the other order of facts governed by laws? It would then be the task of philosophy to ground the pluralism of methods and the epistemological discontinuity between the science of nature and the human sciences in the ultimate difference between the mode of being of nature and the mode of being of mind (1991, 125-6).

Ricoeur shows that explanation alone is methodological, while

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An example from the business sector comes from the work Jim Collins (2005) who argues convincingly from empirical research that the top eleven highest-performing companies that transitioned from merely producing acceptable results to eventually producing and sustaining stellar results for fifteen years, successfully practiced a hermeneutical circle to gain understanding. Each company that produced such stellar results on the New York Stock Exchange had an informal group of executives that worked, wrestled and debated with one another to gain *understanding* about the situation of the company and discover that at which the company could be the best in the world. Collins calls this group "the Council." And he repeatedly makes clear that the goal of such an effort is not to make some bold strategy and pursue it. Rather it is to pursue an iterative circle of inquiry, which is continually informed and checked by the real answers and insights uncovered by the Council.

[135] For an example see Carl Hempel (1942) and Ricoeur's (1991, 40-43) analysis.

[u]nderstanding is instead the non-methodological moment that, in the sciences of interpretation combines with the methodological moment of explanation. This moment proceeds, accompanies, concludes, and thus *envelops* explanation. Explanation, in turn, *develops* understanding analytically. This dialectical tie between explanation and understanding results in a very complex relationship between the human sciences and the natural sciences. Neither duality nor monism, I should say. To the extent that the explanatory procedures of the human sciences are homogeneous with those of the natural sciences, the continuity of the sciences is assured. However to the extent that understanding contributes a specific component… the discontinuity between the two regions of knowledge is insurmountable (1991, 142-3).

Why is the discontinuity between natural sciences and the human sciences allegedly insurmountable? If I understand Ricoeur correctly, it seems the formal procedures of *explanation* strip the informed counsel of the hermeneutical circle of human understanding, when scientific knowledge is narrowly defined by formal procedures of explanation (like those developed by Francis Bacon, see chapter 7). Instead, Ricoeur is responding to those who would suggest that one arrives at scientific knowledge only when the formal procedures of explanation are met. Thus, so called "scientific knowledge" is significantly limited by the formal procedures of explanation championed by the positivist approach, which advocates the view that scientific knowledge is limited to what could be deduced from observational statements. Clearly, for Ricoeur, science is not the enemy. On the contrary, he objects to what the positivist approach does to natural science – it renders it into a truncated epistemology of mere explanation, as defined by a set of procedures.[136] He disagrees with such a limited epistemology and explains that "discontinuity and continuity are constituted *between* the sciences just as understanding and explanation are *within* the sciences"(143). If we follow Ricoeur's reasoning, it is also fair to say that *the human sciences proceed, accompany, conclude and envelop the natural sciences*.[137] Ricoeur, again, is applying his notion of the hermeneutical circle to the relationship between explanation and understanding. The one leads to and informs the other, and vice versa.

It should be clear then that the comments he makes in reply to Bultmann also apply here (Ricoeur 1974, 389). Far from being some strange subsuming of the objective realm of

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[136] Chapters 6 and 7 will make much of this point.
[137] To explain how this is the case is one impetus for this dissertation. Chapter 7 will deal with this topic directly.

science into the subjective realm of the human perspective, Ricoeur is taking a long road to metaphysics[138] through the patience of this hermeneutical circle, which I am now applying to the relationship between human understanding as delineated by Ricoeur and the explanatory procedural approach of natural science.

Also, the natural sciences develop the human sciences analytically, procedurally, in a very complex relationship.[139] In this way Ricoeur maintains the character of the human and natural sciences while bring each into communion with the other, without one becoming the other. Ricoeur is careful not to reduce *people* into what is not *personal*. For Ricoeur, people do not become just physical processes.

Ricoeur does not fear letting the natural sciences develop the human sciences because for him understanding is more than getting a set of "facts" to meet a set of "rules." Understanding denotes something "genuinely truth-centred" (Ricoeur 1991, 143) but not methodological in the sense of following some specific procedure, as a positivist might designate a formal procedure. Rather it points to "an apprehension, on a level other than scientific[140], of *our belonging to the whole of what is*" (143, emphasis added). Rather than seeing the "whole of what is" as a homogeneous, monistic mush, Ricoeur gives a substantially qualified affirmation of Aristotle's analogy of being—a point that I will discuss at some length later in this dissertation. But here it is appropriate to mention that the mechanisms to get at the pluriform modes of being will find their root in Ricoeur's notion of *distanciation* which he borrows from Gadamer, but develops in a more positive and cheerful direction.

Distanciation is the quality of discourse that gives it meaning separate from its author. While it may seem that meaning is what the author intends, Ricoeur affirms that the meaning of a text is autonomous from the author. As mentioned previously, Ricoeur does this to prevent the discourse in the text from being lost, from being collapsed in to the subjective state of the author, in the quest for authorial intent. By saying this, he is not denying that authorial intent is important; rather, he employs the method of phenomenology

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[138] "A long road to metaphysics" here alludes back to the discussion of Ricoeur's intention to avoid the direct approach of Heideggerian ontology.

[139] The natural sciences develop the human sciences analytically by an iterative increase in knowledge which develops human understanding. It would be a book project to explain this point in detail. Briefly, knowledge of the natural world increases human effectiveness in living within the environment and within human embodiment. As this knowledge increases, it becomes one of the texts before which human experience is read and interpreted. This process of interpretation re-informs a human's understanding of him or herself. Thus, the body of scientific knowledge is a cultural artifact which informs a human's understanding of himself, along with art, history, literature, etc.

[140] Here Ricoeur's brief definition of symbol (though there is certainly more to his notion) is helpful. "[T]he word 'symbol' seems well suited to designate the cultural instruments of our apprehension of reality: language, religion, art, science" (1970, 10). For Ricoeur, reality is more that what positivist science would suggest.

which "brackets" a particular subject for more concentrated study. Thus he is sealing off the meaning of the text from the meaning of the author and is considering it and its component parts in relation to one another, to the whole of the text, and to other texts, and their parts. In fact, distanciation[141] weighs on the mind of a writer when he puts his words on the page, for when he asks if his words will *intend* what he *means* to say he performs an act which presupposes the truth of Ricoeur's observation. He must choose the language of the recipient, in Saussurian terms, the portion of *langue* they have available to them, whether he were writing to them or not.

Since distanciation requires a text to be considered in terms of its component parts, we now turn to Ricoeur's theory of the text, which will move us from a theory of symbols to a theory of the text as a model for understanding human action. Hermeneutic phenomenology then wagers that more will be known through the use of symbolic thought. Also, Ricoeur's notion of symbol can be characterised between the extremes of Cassirer or symbolic logic. Hermeneutic phenomenology uses a circle of explanation and understanding that build one another, and the great medium through which the knowledge of this process is gained is language, and particularly textual exegesis. Ricoeur applies this approach to symbols to language, religion and art in the corpus of his written works, and also suggests ways in which his approach further applies to knowledge in science. Hermeneutic phenomenology then seeks to know the world through the model of the text.

3. SYMBOLS AND POLYSEMY: A DETOUR THROUGH STRUCTURALISM

In the previous chapter we found that the property of polysemy could be usefully employed in understanding complex systems like the brain. I will know re-introduce the concept of polysemy within the context of Ricoeur's philosophy.

Ricoeur brackets *the word* from *syntax* to consider it as *symbol*, and as such it becomes an object for phenomenological study. To accomplish this task he employs structuralism as framework for orienting the symbol in context with other symbols, and in doing so he identifies five presuppositions of structuralism:

> 1. Language is an object that can be studied through empirical science; empirical here is understood in the modern sense – it does not solely designate the role and primacy of observation but also the subordination of inductive operations to deduction and the calculus.

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[141] For more on *distanciation*, see below.

2. Within language itself we must still distinguish between a science of the states of system, or synchronic linguistics, and a science of changes within language, or diachronic linguistics.

3. In a state of the system there are no absolute terms, only relations of mutual dependence.

4. The collection of signs must be maintained as a closed system[142] in order to submit it to analysis.

5. The definition of the sign which satisfies these four propositions breaks entirely with the naïve idea that the sign is made to stand for a thing. (Ricoeur 1974, 81-83)

In Ricoeur's assessment, structuralism presents a view in which *signs* no longer stand for *things*, but rather position themselves—or better, are positioned—by other signs. The meaning of a sign is constituted in its *difference* from other signs in a system of signs, which necessarily implies that the work of a sign does not escape from the system of which it is a part. For this reason, Ricoeur believes that while structuralism turns language into an object of scientific study, it also obscures the very purpose of language, which is to say something about something. For structuralism, linguistic signs do not point out to a referent beyond the system of which they are a part.

However, linguistic signs do seem to relate to one another on some level through the contrasting relationships of difference. At the same time, linguistic signs are summoned by human speakers to say some thing about something. How can both be true? Ricoeur recognises this tension and appropriates the comparative architecture of structuralism to better define the polysemy of a word, not as the relationship "between a name and a meaning" but as between it and other signs (Ricoeur 1974, 68).

Recall in the previous chapter, I introduced the concept of polysemy. Words, considered individually, have the interesting property of polysemy, or "the possibility for a name to have two [or more] meanings" (68). This meaning may be some reality out in the world, or more tangibly, may be the collection of words that supply its definition in a lexicon, a fixed record of the language (presupposition 4).[143] Structuralism brackets the ambiguity of reference in the world to analyse language in itself, or *langue* (the French term for a specific

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[142] A "closed system" is a system has a fixed impenetrable boundary such that nothing new can enter the system. The system cannot be changed by way of putting new things in or taking things out.
[143] Presupposition 4 states "The collection of signs must be maintained as a closed system in order to submit it to analysis." The tangible application of this presupposition is the writing of a dictionary or lexicon, which records the relationship between words.

language like French or English). *Langue* then can be understood in itself, separate from the world to which a speaker may refer.

This move provides a system context for specifying how "polysemy is a synchronic concept" relating words to one another in a system of relations (68).[144] Polysemy is not mere ambiguity, or a process that can continue infinitely. "Words have more than one meaning, but they do not have an infinity of meanings," because, as we shall see, the development of the polysemy of a word depends on use in a sentence in discourse within a community (93). Though the quality of polysemy may render a contextless word ambiguous, a quality which at times has led to the maligning of natural language as imperfect or imprecise, polysemy does make language practical, for without it we would need an infinite lexicon to speak about the cosmos. While some may have accused natural language of being imprecise, the polysemy of natural language is actually a practical device which makes language possible.

Ricoeur's hermeneutical circle necessitates that language actually point beyond itself to some kind of meaning. Ricoeur's analysis of the five presuppositions of structuralism, as shown above, shows his awareness that structuralism is designed to study the signs and system, while affirming that all relationship are only those of mutual dependence. Since the system of structuralism is a closed system, Ricoeur needs a way of getting out of the system of *langue* to the referent about which a speaker or writer discourses. If he cannot do this, then the project of using the model of the text as a way of understanding the world is hamstrung from the start, and hermeneutic phenomenology will stumble at the starting blocks. Ricoeur enlists the help of Aristotle to do bridge the distance between the system of *langue* and the realm of referents.

4. ARISTOTLE AND PREDICATION: A THEORY OF DISCOURSE

The rule of metaphor (Ricoeur 1977) and *Interpretation Theory: Discourse and the Surplus of Meaning* (Ricoeur 1976) articulate Ricoeur's resuscitation of the theory of discourse found in Aristotle's *On Interpretation*, to the end of giving an account of how the symbols of the symbol system of *langue* can be employed to point outside the system of

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[144] In chapter 6, I will carefully define and develop the notions of diachronic and synchronic system change. For now, it is appropriate to understand the term "synchronic" as referring to system relationships together at a particular temporal system state, wherein the relationships of particular parts of the system can be understood with respect to one another. This is a contrast with a "diachronic" system change, which refers to the change of a system through time, such that the system itself changes as a whole. Polysemic relations are the multiple different uses of a word in specific sentences. But these different meanings would be nonsense if they were not able to hold intelligently within the system of relationships already established. Below we will find that the

langue. In contrast with Saussure, Aristotle specifies the primary unit of meaning as the *sentence* (16b, 26-28, see Aristotle 1949, 121). Put simply, while sentences may have particular signs, like nouns and verbs, it is necessary to bring the signs together so that one not only knows the subject, but also *what* is being predicated about that subject, and *when*. Words, outside the warmth of a sentence, shiver with potential meanings. Placement in a sentence subdues the polysemy of words and summons their unified number to relatively univocal expression (Ricoeur 1991, 55). It is the sentence which makes possible to summon the resources of *langue* for the predication of discourse.

By re-instigating Aristotle's dictum that the sentence is the smallest unit of meaning, he meets structuralism, and by extension post-structuralism, at the semiotic root, for it is the sentence that makes *words* from mere signs into a system of signs. "Words are signs in speech position. Words are the point of articulation between semiology and semantics, in every speech event. Thus the word is, as it were, a trader between the system and the act, between the structure and the event" (Ricoeur 1974, 92). It follows then that the polysemy becomes "incomprehensible if we do not introduce a dialectic between sign and use, between structure and event" (93). The sentence gives rise to the polysemy of its parts, precisely because they can be used in many different ways, in an almost infinite number of possible sentences. These polysemic parts muster themselves in units of meaning that are substantially univocal. Sentences permit the increase of the polysemy of words, new and creative uses, without the loss of clarity. After all, in discourse, the smallest unit of signification is the sentence, not the world. Thus, the integrity of discourse in not injured by creative increase in the polysemy of the words available in the language. Shakespeare did the *langue* of English no loss by stretching the polysemy by coining so many words through his many impertinent predications.

Predication occurs in time, in history, in such a way that the creative augmenting of language, especially metaphors and poetic language, can be used without distorting language—rather creating through it:

> There is a process of naming, a history of use, which has its synchronic projection in the form of polysemy. Now this process of the transfer of meaning—of metaphor—supposes that the word is a cumulative entity, capable of acquiring new dimensions of meaning without loosing the old ones. It is this cumulative metaphorical process which is projected over the surface of the system as polysemy (93).

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synchronic nature of the system of *langue* is the precondition for metaphorical predication which

Ricoeur maintains that the creation of polysemy is the product of meaning predicated in events of discourse. Metaphor is instrumental in shaping the polysemy of language, because of its creative power. Metaphor is the force that most extends the polysemy of words, thus it is appropriate to follow the preceding chapter which introduced the concept of polysemy to draw a connection between complex systems and Ricoeur's model of the text, to now examine this significant multiplier of polysemy in language.[145] While a full development of Ricoeur's theory of metaphor is beyond the scope of this dissertation, it is fitting to draw attention to four points: (1) that metaphor is more than trope, (2) that metaphor cannot be reduced to a "literal" meaning for it both states that a thing "is" and "is not" its partner in the metaphorical expression, (3) that scientific modeling is closely akin to metaphor, (4) and that metaphor points to a certain ontology.

First, metaphor is more than a trope. Ricoeur begins *The rule of metaphor* with a history of metaphor, from Aristotle through the modern classifications of metaphor as trope, in which Ricoeur establishes that Aristotle is the source for the view that metaphor's use of language deviates from the natural use of language. Informally, Ricoeur traces Aristotle's bias to Plato who viewed the ornamental theory of tropes as "among the 'cosmetic arts'", likely an allusion to Plato's (1971) *Gorgias* (Ricoeur 1977, 45). This view sees metaphor as the substitution of one word for another, in a kind of deviant predication, a predication which does not attribute to the subject of a sentence what common word use would speak of it. For this reason Plato viewed it as a kind of flattery, and ultimately deception (1971). But metaphor cannot be a mere word swap if Aristotle is correct that the sentence is the smallest unit of meaning that expresses judgment (16b 26-36). For Aristotle, truth is a function of the sentence.[146] Ricoeur overcomes this dilemma through his distinction between the semiotic and the semantic. Following from the theory of discourse discussed above, Ricoeur agrees with Ullmann's claim that *the theory of metaphor as a word* depends first upon that word's placement in a sentence (1957). A metaphor requires a subject and a predicate, which predicates something about that subject. Subject and predicate, in a sentence, involve the use of at least one word, a noun, for the subject, and also a verb, at least one, for the predicate. In metaphor, a noun has a verb (likely a verb and several other words as well) related to it in such a way that the noun has a different word applied to it than the noun normally would. Take the over-used example, "A man is a wolf." In this bleak metaphor,

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stretches the polysemic situation of a term in the *langue* system.
[145] Metaphor will prove quite fruitful in the chapters to come.
[146] Of course, the next few chapters will develop the significance of placing unexpected words into the sentence, and how metaphor influences the sentence.

"wolf" is substituted for "man." Therefore, metaphor is both a substitution and a tension resulting from the impertinent predication of the "tensive use of such language that resists assimilation to the meanings of ordinary language" (Hahn 1995, 217).

The second point develops the first: metaphor *cannot be reduced* to a "literal" meaning. It cannot be reduced because it both states that a thing "is" and "is not" its partner in the metaphorical expression. I will develop this one point in Ricoeur while at the same time adding to it. I will first introduce an illustrative example, and then develop something I will call the Square of Metaphorical Opposition.

A silly example will suffice. Suppose for a moment that in a middle-aged American woman named Ronda has fallen in love with a local man named Johnny. Ronda's best friend Darlene is concerned, and so one day she comes over to Ronda's trailer when Johnny isn't there, interrupting Ronda's soap operas. She explains that Ronda should stop seeing Johnny because "Johnny is a wolf." Ronda, being greatly offended, raises her voice to Johnny's defence. "Johnny is not a wolf. He's the most thoughtful man I've ever met." Ronda volleys her return, "He's just trying to get close enough to move in for the kill."

This inane example points to an obvious feature of metaphor that becomes obscured when one insists that meaning is a quality of univocal language only. Metaphors do mean something, but univocal language in this instance would imply that either the sentence literally means Johnny is a wolf or it must be meaningless gibberish. And that meaning is particularly pointed. Ronda takes offense when Johnny is called "a wolf" because she knows the qualities of a wolf, and she does not want Johnny to be labelled with those qualities. Moreover, wolf-like qualities are base because they belong to *wolves*, and wolves are filthy, predatory animals. If Darlene had called Johnny a lion who meant to devour her, that might have some charm. Lions do have some nobility. But a wolf?!

Even Darlene's defence of her thesis unpacks her metaphor. She turns Ronda's defence of Johnny into a proof of her case. Wolves do stalk their prey, hiding their intentions, waiting for a time to strike. Of course, they want to lull their victims into a vulnerable position. While a metaphor may be ambiguous in one way, somehow, even the most unsophisticated speakers are well attuned to the very specific meanings implicit within a metaphor, even if the women in question have never had a course in the philosophy of language. Why is this?

I suggest it is because a metaphor *contains* multiple univocal propositions, or if that thesis is too offensive (because the reader may be an Anglo-American philosopher who feels unsteady in the presence of the word *proposition*), I will posit that the metaphor is a sentence that suggest at least four implicit premises, or statements, that one infers in the act of interpreting a metaphor in a similar way that an enthymeme summons one missing

sentence to fill in the full logical meaning of a syllogism. These four statements form the corners of Aristotle's Square of Opposition, A, E, I, and O.

Clearly (A) "[All] Johnny is a wolf." Darlene is not saying that there is some good in Johnny, and thus we might be able to turn him around. That would not be so offensive. Ronda is offended because Darlene has said that Johnny, in fact, is *a wolf* and is therefore dangerous. Thus Johnny is being fully characterized as a wolf. Ronda and most people who hear a metaphor are struck by multiple attributes that characterize the subject with its metaphorical predicate, but not as though the attributes were just a list of qualities which could aneseptically be specified apart from the bold implications of the A statement. The subject (Johnny) is the predicate (a wolf). "Johnny" is a unity. The "wolf" is a unity. Somehow one unity is the other unity. The full "wolf-ness" of the impertinent predication leads to the offense felt by Ronda.

However (E), clearly "Johnny is not a wolf." He does not howl at the moon, have grey fur, or a predilection for catching rabies. He is not a member of *Canis lupis*. This point is not in dispute.

Certainly (I) "Some of Johnny is a wolf," or the accusation would be groundless. Some of the attributes of a wolf are shared by Johnny. The (A) statement associated with the metaphor rests upon (I) some characteristics that are the same. In Darlene's eyes, Johnny hunts for weakness, vulnerability. He looks for sheep. Maybe she thinks Johnny wants to take Ronda's money, or rob her of her virtue, or take from her in some other way. But it is clear from Darlene's response to Ronda that she does think that her statement certainly means that some of Johnny is a wolf. Ronda defends her Johnny by saying (E) Johnny is not a wolf. (O) He's the most thoughtful man I've ever met." Darlene responds with an (E) statement "He's just trying to get close enough to move in for the kill." In other words, in his character/will (the thing that "tries") he is a wolf.

Finally, (O) some of Johnny is clearly not a wolf, namely all those parts of Johnny that make him a man. Since Johnny really is a man, then all of him is not a wolf, as we established earlier. When Ronda and Darlene argue, they draw from the (I) and (O) meanings of the metaphor "Johnny is a wolf" to make their respective cases.

In summary, "Johnny is a wolf" means:

> A: "Johnny is a wolf"—Johnny is a creature who hunts the weak, covers
>   himself in darkness, and waits to pounce.
> E: "Johnny is not a wolf"—Johnny is a human being.
> I: "Some of Johnny is a wolf"—Johnny has enumerable wolf-like attributes.

O: "Some of Johnny is not a wolf"-- Johnny has enumerable non wolf-like attributes, due to being a human being.

When a metaphor's meaning is disputed, these four meanings of a metaphorical statement come into play. Ricoeur's theory of metaphor gives an account for why this is the case. Because words have polysemy, metaphorical predication summons a greater richness from the words used. It is *because* a metaphor has at least four meanings that it stretches the polysemy of words in the lexicon, because it permits them a use that is multiple uses in the same event. So, although it is true that sentences can fix the meaning of their words to near univocal expression, this is most certainly not true of all sentences.

This theory of the fourfold meaning of a metaphor [147] also accounts for why metaphors are so powerful in terms of persuasion. Since they mean at least four propositions with the sentence, they partake in the same kind of persuasive effect as the enthymeme. Metaphors overwhelm the interpreter with content. While analysis can look at the individual gestalts of the meaning of a metaphor, the first impression of a metaphor overwhelms the imagination. As Aristotle himself observed, metaphor requires one to "see[148] [Greek: *theoreo*, to look at, view, behold] the similarity in dissimilars" (1459a 6-7). The first comprehension of a metaphor is not its four separate propositions, but the subject of the metaphorical sentence being presented clearly as the metaphorical predicate to the mind's eye, as Aristotle observes.[149]

Third, returning to Ricoeur's development of a theory of metaphor, Ricoeur shows that scientific modeling is closely akin to metaphor. Through the work of Max Black (1962) and Mary Hesse (1966), Ricoeur argues that "with respect to the nature of the relation to reality, metaphor is to poetic language what the model is to scientific language" (Ricoeur 1977, 240). Ricoeur points to the development of the connection between scientific modeling and poetic metaphor as a "decisive stage" in the development of his philosophy of metaphor, because Ricoeur then uses the scientific model as a ground for arguing for metaphorical truth (1977, 239). Mary Hesse suggests that "the deductive model of scientific explanation be should be modified and *supplemented* by a view of theoretical explanation as

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[147] This idea is so simple that someone must a have thought of it before, but I developed this on my own without reference to any source.
[148] This quality of metaphor that it involves "seeing" resemblances, also applies to narrative. Chapter 7 will discuss the way in which spatial embodiment affects the understanding of narrative.
[149] Incidentally this is what makes metaphor so rhetorically effective. Aristotle anchored persuasion in the enthymeme, the argument with a missing statement (be it a premise or a conclusion) which a hearer or reader can comprehend and then insert the missing statement themselves, thus persuading himself or herself. Metaphor is especially affective because, according to the Metaphorical Square of Opposition, it does the work of four enthymemes.

metaphorical redescription of the explanandum" [emphasis hers] (1966, 171). Ricoeur finds two great benefits in this connection. First metaphor, like the scientific model, becomes more than an explanatory aid but an integral part of the process of coming to know the system of the world, since scientific models open up nature to our understanding (1977, 243-6). Metaphor then is more than a tool for ornament; it is a way of knowing the nature of things. The strong connection between metaphor and model is not the single sentence metaphor; rather, it is in the extended metaphor of the epic simile or a story. The other benefit is that metaphor draws together the concepts of heuristic function and description, understanding and explanation (see chapter 1). As we saw in chapter 1, metaphor has a peculiar quality of taking the complex and making it simple, all the while not loosing the complex, which we learned was a critical need in modeling complex systems.

Fourth, and finally, Ricoeur sees that metaphor points to a certain ontology. In the eighth study of *The rule of metaphor*, Ricoeur convincingly argues that the translation from the structurally polysemic potentiality of the subject to the actualised reconfiguration of the predicate in a single event of discourse points to *something like* Aristotle's metaphysics (1977, 257-313). Ricoeur sees in the subject a potentiality and in the predicate and time-located actuality, which then sets the stage for further potentialities by the way the sentence reconfigures the *langue* necessary for predication. However, Ricoeur takes almost tedious care to not commit himself fully to all the particulars of Aristotle's full ontology, for the division between the initial metaphysical framework of Aristotle and its application to the rudimentary scientific observations available to Aristotle at his period in history, make a full acceptance of every aspect of Aristotle's metaphysics a complicated and compromising matter for one committed to dialogue with the contemporary state of natural science. Through careful dialogue with the views of metaphor in Aristotle, St. Thomas, Heidegger, and Derrida, Ricoeur concludes that each of these approaches is incomplete (1977, 259-295).[150]

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[150] Ricoeur takes issue with Aristotle for his limitation of metaphor and his inability to account for the unity of various forms of discourse, for example, ontology and theology. Thus, the mistake that leads Aristotle to define metaphor as he does also leads him to realise and assume an analogy of being without being able to develop an account of the unity of the discourses within that analogy.

Ricoeur takes issue with Aquinas for developing an onto-theology, because of the challenge of making the analogy between God and his creation. Since God is not like his creation, onto-theology is a risky venture, since at its core appears to be the very lack of analogy which it purports to support. However, Aquinas does recognise the need for the analogy of being in accounting for the intelligibility of metaphor.

Ricoeur takes issue with Heidegger for the obvious shortcut he takes in developing an ontology to support hermeneutical inquiry. However, Heidegger does see the need for a correlation between hermeneutics and ontology.

Ricoeur takes issue with Derrida over Derrida's deconstruction of metaphor, since one needs metaphorical discourse to talk about metaphor itself. Ricoeur accuses Derrida of Platonising

Ricoeur does affirm that Aristotle and Heidegger together come nearest to an ontology that makes the phenomenology of metaphor possible, without robbing it of the possibility of being about *something*. With Aristotle's notion of substance, it necessarily follows that a thing can be analysed in terms of multiple implications, causes, parts, wholes, teleologies, etc. There is reason for similarity and dissimilarity, for verbalising both qualities in logically related statements that predicate: "is" and "is not." Heidegger's presupposed phenomenological reduction appropriates the human encounter with being, the perceptiveness that permits both the predication of metaphor and the locatedness of metaphor that is difficult to describe abstractly, yet seems so viscerally experienced in the encounter with good literature. Homer ranks among the best in literary history for his remarkable command of metaphor, and he has stood the test of time because so many have "seen" and "been there" on the plains of the great citadel of Ilium. Ricoeur draws together both Aristotle and Heidegger, so that through Aristotle's notion of the "analogy of being" the world is redescribed upon itself, which "makes World appear in all things" (Ricoeur 1977, 284). In other words, the redescribing of the world by predicating it upon itself is the application of the analogy of being to predication, to discourse. As such, it is referential; it speaks *to* being and to the being of the world, the human world. This cognitive activity maps the world onto itself, but it is the human, within his life experience, not cut off from *Dasein* which metaphorises (see chapter 1). When Ricoeur phrases his point this way, he is drawing his reader's attention back to Heidegger, but Ricoeur, by his longer hermeneutical route, gives warrant for finding the unity of a World presented to the subject, by way of a hermeneutic phenomenology of metaphor, through the approach I have here described.

5. FROM TEXT TO ACTION: A PHENOMENOLOGY OF HUMAN ACTION

Ricoeur's theory of symbol, discourse, and metaphor may now be summoned to establish a critical foundational pillar of a Ricoeurian approach to modeling complex systems—namely *the model of the text*. Ricoeur (1991, 144-167) does employ the text as a model for human action, but I will extend the model of the text to other kinds of complex systems through the post-structural complexity theory of South African philosopher Paul Cilliers, and also Aristotle's (2001) account of the causes of the parts of animals in *On the parts of animals.* As we conclude this salient recapitulation of Ricoeur, I promise that model

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metaphor, and misconstruing it with ontological baggage at variance with the nature of metaphor itself. For Ricoeur's more copious treatment of these four philosophers of metaphor see Ricoeur (1977, 259-295).

of the text will bring the nominalism of post-structuralism to terms with the realism of Aristotle.

Ricoeur uses his philosophy of models and metaphors to develop the model of the text into a model of human action (1991, 144-167). A metaphor, according to Ricoeur, is the result of an actualized potentiality in the subject that is impertinently predicated. Returning to our metaphor "Johnny is a wolf," notice that in the rhetorical situation, namely the Johnny involved, the person making the metaphor was actualizing the potential available in the subject, and then predicating a metaphor on the basis of the available potential. In predicating "wolfness" of Johnny she was modeling his human actions. Her model may be wrong or right, but Darlene is very clear that a redescription of her Johnny and his actions is being made, and she knows she doesn't like it. The modeling is accomplished with a sentence. Thus it follows that the sentence is a model of action, and Ricoeur builds upon this observation that the model of the text can be used as a model of human action, through Aristotle's observation that *muthos* is a mimesis of human action[151] (1991, 168-187). However, if Ricoeur's reasons hold for extending the model of the text to human action, we will also find that one may be able to model complex systems on the model of the text (see below).[152] If so, the model of the text forms a decisive step toward a hermeneutic phenomenology of complex systems. The model of the text will be discussed in three movements. We shall first consider discourse, then written text, and finally the model of the text applied to human action.

Ricoeur (1991, 145ff) builds his model of the text around four essential qualities that distinguish discourse from language: (1) discourse is an event, but language is "virtual and outside of time" (145); (2) discourse refers back to a speaking subject, but language lacks a subject; (3) discourse refers to the world symbolically, whereas linguistic signs *per se* distinguish themselves only in contrast to other signs; and finally, (4) discourse speaks to someone, while the system of *langue* only offers the potential for communication, a shared lexicon. Ricoeur can distinguish between discourse and language by recognizing structuralism's observations regarding the system of *langue* (see above), but using Aristotle's theory of discourse to redeem the poverty (see earlier in this chapter) of the structuralist account of predication.

Written text may be distinguished from discourse by developing the four contrasts of discourse and language in the direction of the written word. Firstly, where the event of discourse occurs and is lost in the changing stream of the past, writing fixes that discourse event, so that the interpreter may return to it and possibly its context.

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[151] See chapter 1.

Secondly, whereas the event of discourse refers back to a speaking subject, the act of writing distanciates the message from the writer. Ricoeur is not claiming that a written text has nothing to do with authorial intention. Rather, he is saying that a text, by virtue of physical inscription, cannot be rescued from itself by gesture or the intonation of deliver; it says what is written. Interpretation does play a role in understanding what a text says, but that work of interpretation depends upon the distanciation of the text from the author, otherwise the text is unnecessary, a mere barrier between the reader and the mind of the author. It is the distanciated text that opens the world of the text (which may include the world of the mind of the author) to interpretation and understanding. In relationship to the author, the text is another, a co-labourer. A text may allude to a world beyond it, but it does so being self-enclosed, and this fact guides the proficient writer to choose her words carefully. She must make sure that, as much as it falls on her, her co-labourer requires guidance to be faithful to the author's message, because once the text leaves the author, it will be a thing unto itself, for better or worse. Ricoeur goes on to argue that a text can escape its immediate situation and can mean things in new contexts that the author did not necessarily intend. It would be fair to say, when a reader, who is neither a slanderer, nor a liar, nor a sluggard, reads a text in a way that the author did not intend, and did not want, it is the authors failure, for he was not careful to make a text that accomplishes what he intended.

Thirdly, while discourse reveals a particular situation in which it is spoken, inscribed discourse reveals *its own world.* It follows that a text distanciated from its author by a thousand years can reveal its world, and thus gives those far removed from its authoring strong clues about the world that made it, e.g. *Beowulf*.[153]

Finally, while discourse is addressed to a conversation partner present in the discourse situation, written text is addressed to anyone who can read: "In escaping the momentary character of the event, the bounds lived by the author, and the narrowness of ostensive reference, discourse escapes the limits of being face to face…. An unknown, invisible reader has become the unprivileged addressee of the discourse." (150)

Ricoeur develops his theory of the text into a model of human action by extending each of the four contrasts between discourse and written text, showing that the four unique

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[152] Also, this point will be developed in detail in chapter 6.
[153] *Beowulf* is a great example of this principle, because there are almost no documents to give us a cultural context for interpreting the work. We are presented only by the values of the characters in the epic itself. We have their actions, in word, in deed, in decision to tell us the worldview of the characters, and to some degree, the poet and his audience. The poem carries their culture with it in some sense.

textual properties apply to human action.[154] Firstly, like the inscription of discourse in text, human action inscribes what is done in time. Before the event of action there are multiple possibilities of action, multiple things which can be acted upon, etc. But a human action delimits these possibilities in an event in which an agent performs an action in time. Once the action is completed, it is in the past, and it becomes an item that can be studied, parsed, examined—or more broadly, interpreted. Ricoeur (1991, 151-2) uses Anthony Kenny (1963), J. L. Austin (1962), and John Searle (1969) to make the case that the properties that make speech acts act-like, also make acts speech-like. They can be exegeted. They communicate something. But Ricoeur goes on to point out that the fixation of an action in time also makes action text-like. According to Ricoeur, human actions have propositional content. They have *noema*. They mean something. Ricoeur points out the obvious (or perhaps not so obvious) fact of this aspect of human action in the operations of human history. Human actions mean something to those around them, and to future generations. It may be that actions are written down, but more to the point, it is the nature of those actions, the meaning of them (or at least the question of their meaning) that so urges people to know the deeds of others, to understand them. People study the actions of Jesus of Nazareth, Mohammed and Siddhartha because their respective actions promise a world of understanding for those in the traditions established by them.

Secondly, when an agent performs an action, that action goes outside the agent. While it may be that the action was subjectively contemplated before its performance, the action cannot be retrieved once performed. A man who cheats on his wife cannot take it back after the adultery. The actions we perform escape us. This quality also makes us subject to them. Actions can be recorded and blamed, and one need look no further than the discipline of history to find overwhelming evidence for this reality. Over time, actions even become institutionalised, in that the actions have meanings that may be different than what the actor intended by them. Consider the tragic example of Louis XVI. In an effort to please the peasants, Louis invited the Third Estate of France to meet in their townships and pen the grievances that poured forth in the heat of those meetings, and then have each region send a representative to the Estates General to represent the cause of the people to the king. Then, when these rabblerousing representatives arrived, Louis, in an effort to please the French nobility, chose not to meet with the Third Estate, to make them wait. In a misguided attempt to please everyone, Louis acted in ways that easily distanciated themselves to purposes his naïve mind could neither understand nor foresee. His misguided attempt to please everyone and the dreadful meanings that were imputed to those foolish actions are

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[154] Later we will examine how this model of the text can also be used to model complex systems, like

stark monuments to this truth, more so than the gold obelisk that now stands in the great square in Paris, across from the National Assembly where France punished her foolish king.

Thirdly, like a text's revelation of its own world, a human act reveals a world of itself. Ricoeur explains, "Not only does a work mirror its time, but it opens up world that it bears within itself" (Ricoeur 1991, 155). Plutarch records that on the eve of the tragedy of the Sicilian Expedition "[Athenian] youth in their training-schools and the old men in their work-shops and lounging-places would sit in clusters drawing maps of Sicily, charts of the sea about it, and plans of the harbours and districts of the island which look toward Libya" (Nicias 12). While their drawing in the sand may mirror their culture, it also tells us something more tangible about the city's hopes than a transcript of Athenian Assembly debate could ever convey. The Athenian expedition against Sicily, more than the mere hubris of Alcibiades, tragically depicts the lofty, greedy ambition of a great city. Again, the famed rebellion of Corcyra reveals more than the causes of its won revolution. Thucydides presents its portraiture (3.81-85) because he recognizes something of Ricoeur's point, that the importance of meaningful action goes beyond their relevance at a given time (Ricoeur 1991, 154). It would not be too amiss to say that Thucydides' faith in this third observation gave him the motivation to write his great history in the first place (cf. 1.21-22, especially 1.22.4).

Finally, like text, human action is an open work with meaning "in suspense." "Human action, too, is opened to anybody who can read. In the same way that the meaning of an event is the sense of its forthcoming interpretations, the interpretations by contemporaries has no particular privilege in this process" (Ricoeur 1991, 155). We will find that the open work of human action will itself open the parts and the wholes of complex systems, but the full discussion of how this will apply to complex systems must wait for chapter 6. The understanding of parts and wholes is critical for understanding the way in which elements interact with one another, per Cilliers's definition. Also an understanding of the interrelationship between parts and wholes is critical for understanding how the model of the text meets the exegesis of complex systems.

6. CONCLUSION

This chapter introduced and surveyed the foundational concepts for developing a hermeneutic phenomenology of complex systems. It was appropriate to begin the introduction at this point after having first defined both a *model* and a *complex system*, and

the brain.

surveying the disciplines of neuroscience and cognitive science. This chapter gave an overview of Ricoeur's hermeneutic phenomenology, while making reference to models, complex systems and brain science. It was shown that Ricoeur develops hermeneutic phenomenology in dialogue with both the natural sciences and human science. Ricoeur also distinguishes his own approach from that of Heidegger, which skipped over the extended process of discovery to a direct hermeneutics of being. Ricoeur instead emphasises a hermeneutical circle, in which understanding is developed iteratively through philosophical reflection on symbolic thought.

Ricoeur's appropriation of structuralism helps him give an account for the development of polysemy in language, and polysemy will be an important concept when it comes down to modeling complex systems with natural language. However, he is able to limit the danger of unlimited semiosis by employing Aristotle's theory of discourse, a theory that points to the sentence as the smallest unit of discourse. We saw that this move is significant because it distinguishes predication, which has a referent, from the presence of single word or sentence fragment which can be used in many different sentences, to potentially mean many different things.

This chapter also introduced the Square of Metaphorical Opposition, a tool which helps to show how metaphor actually implies four different univocal propositions at once. This Square shows metaphorical predication is information rich and in itself acts as both a heuristic for the development of understanding and as a collection of univocal descriptions which lead to explanation. I do not say that this set of four univocal propositions constitute explanation, because without the Metaphorical Square of Opposition, the traditional Square of Opposition would only find contradictions between the A and O, and also the E and I corners. Thus metaphorical predication must be a different kind of predication, yet it still operates within logical space. So the Metaphorical Square of Opposition confirms that metaphor, while not being univocal, does inhabit the same space as logical discourse.

Furthermore, Ricoeur's application of the model of the text was applied to human action. It was shown that human action could be interpreted like a text. Such an application of the model of the text would seem to open the possibility of applying the model of the text to complex systems, if it is possible to do so through arguing that complex systems have strong points of similarities with human action. These similarities will be explored carefully in chapter 6 of this dissertation.

The following chapter will bridge hermeneutic phenomenology and physical systems by explaining the approach to complex systems found in Aristotle's *On the parts of animals*, and showing its unity with tragic mimesis and the definition of *model* introduced in the first

chapter. Aristotle's approach to complex systems will help to further bring the model of the text and complex systems into a closer hermeneutical relationship.

CHAPTER 5

Mimesis and complex systems

Twenty-four centuries ago, Aristotle described four types of cause
(material, efficient, formal, and final), which overlap and intermingle
in ways that were often overlooked in 20th century thought but are now under scrutiny.
Alwyn Scott, introduction to Encyclopaedia of nonlinear science *(2005c, vii)*

1. INTRODUCTION

The task of situating brain science within Ricoeur's hermeneutic phenomenology required me to first define *model* (chapter 1) and *complex system* (chapter 2), and then work through the key aspects of brain science (chapter 3) and hermeneutic phenomenology (chapter 4) which are most instrumental to that task. Both chapter 1 and chapter 4 illustrated the significant role of Aristotle's philosophy as a significant source of inspiration for Ricoeur's hermeneutic phenomenology. This chapter will pursue Aristotle's own development of systems theory beyond the scope of Ricoeur's work. The locus of discussion in this chapter will be Aristotle's *On the parts of animals*[155], which presents a remarkably well-developed approach to understanding causal relationships in complex systems. I will first critique the view of causality popular at the beginning of the 20th century, because it so starkly opposes Aristotle and has strongly influenced 20th century philosophy of science. Then I will explain Aristotle's system theory from *Parts of Animals*, and then show how his systems theory and the view of modeling presented in the first chapter are related to one another.

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[155] All citations of *Parts of animals* are from the James Lennox translation (Aristotle 2001).

In the first chapter, I identified both a relationship between scientific modeling and metaphor and between metaphor and narrative. At the end of this dissertation narrative will prove helpful for the modeling of complex systems, and Ricoeur's hermeneutic phenomenology shows a strong component of narrative theory. Ricoeur recognizes that in narrative "plot 'grasps together' and integrates into one whole and complete story multiple and scattered events, thereby schematizing the intelligible signification attached to the narrative as taken as a whole" (Ricoeur 1984). Narrative then seems filled with the potential to model complex systems. But this power has not been sufficiently exploited by the complex systems research done over the past twenty years, which focused on developing powerful mathematical tools for modeling complex systems (see chapter 2). While these tools are good and useful for modeling some of the behavior of complex physical systems, a narrative approach would be more helpful to those disciplines where non-mathematical models would be more useful for work that requires quick human decisions, for example, business administration or strategic operations planning in a military context. A non-mathematical approach may also provide helpful information for more accurately tuning and evaluating mathematical modeling approaches thus increasing the possibility for success in mathematical modeling. It stands to reason that a non-mathematical approach to complex systems ought to also have connection points with mathematical modeling, if the approach used to model the system is reliable, for, at least broadly speaking, nature has shown itself to be significantly if not substantially quantifiable, as the modern and contemporary application of mathematics in the natural sciences has demonstrated. However this quality is limited as evidenced by the Three Body Problem[156] (see chapter 2). As we will find later (chapter 7) narrative is rich both quantifiable and qualifiable.

In this chapter I will argue for a connection between the physical world and narrative through an Aristotelian Systems Theory (hereafter AST). To develop this systems theory I will use the hermeneutic phenomenology of Paul Ricoeur to join the enterprise of scientific modeling with that of narrative construction. By making this move, this chapter does not constitute knowledge as mere narrative or metanarrative. Rather, it supports Ricoeur's thesis that scientific modeling and poetic art meet in metaphor.

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[156] The Three Body Problem and its relation to quantification meet in the notion of distanciation which I will discuss in chapter 6. Events caused by a *meros* internal to a substance can distanciate to the surface of the substance. The substance then may be qualified but the *meroi* internal to the substance may not be precisely quantifiable. This is what happens in the discourse of the price. See chapters 2 and 6.

2. A POSITIVIST PREAMBLE

Bertrand Russell opens his essay "On the notion of cause," originally delivered in 1912 to the Aristotelian Society, with these provocative words:

> All philosophers, of every school, imagine that causation is one of the fundamental axioms or postulates of science, yet, oddly enough, in advanced sciences such as gravitational astronomy, the word "cause" never appears. Dr. James Ward, in his *Naturalism and Agnosticism,* makes this a ground of complaint against physics: the business of those who wish to ascertain the ultimate truth about the world, he apparently thinks, should be the discovery of causes, yet physics never even seeks them. To me it seems that philosophy ought not to assume such legislative functions, and that the reason why physics has ceased to look for causes is that, in fact, there are no such things. The law of causality[157], I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm. (1918, 180)

Bertrand Russell's words depict the zeitgeist of philosophy of science during the first half of the 20th century. The confident brashness of Russell's move to deliver this paper to the face of the Aristotelian Society is telling. Two centuries before Russell, the followers of Newton killed three of the causes in Aristotle's four-causal model[158], leaving only a monolithic *efficient cause* to govern the behavior of the universe. The other causes seemed irrelevant, especially when they seemed bound to many the Medieval world's geocentric view of the world. It is no wonder Newton was inspired by Galileo's successful case against the geocentric view of the planetary system which brought with it a quantitative approach to nature and a deductive approach to universal laws of nature (see Kline 1964, 182-213). The reduction of science to the study of efficient cause in action appeared to clarify a relationship between mathematics and the behavior of nature, wherein matter and motion were stripped of all encumbrances that would prohibit the quantification of their properties. But the philosophy of science by Russell's time had even stepped beyond Newton and Galileo. By the time Russell speaks to the Aristotelian Society even this one *cause* is under dispute.

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[157] Russell goes on to explain that by law of causality he is referring to the notion that if event A can be said to cause event B, that a necessary relationship exists between B and A such that hypothetically, every time that event A occurs, event B must follow it. Russell goes on to attack this notion of necessity as being unfounded (1918, 180-181).
[158] The suggestion that Aristotle's four causes be seen as a model comes from (Wallace 1996).

Karl Pearson[159] (1957), disciple of Auguste Comte, contemporary of Russell, and a lecturer in mathematics and eugenics at the University of London, staunchly rejects the doctrine of cause. Not to put too fine a point on it, Pearson reckons that "[f]orce as cause of motion is exactly on the same footing as a tree-god as the cause of growth—both are but names which hide our ignorance of the *why* in the routine of our perceptions" (Pearson 1957, 119-20). This scepticism grew slowly out of the great philosophical debates between the rationalists and the empiricists of the 1600s and 1700s in which both sides assume a more or less nominalist epistemology in which the world must be justified based on clear ideas, whether they be "clear and distinct" *ideas* in the Cartesian formulation or the *ideas* in the mind which result from sense impressions. Kant widened the chasm between the human mind and causal relations in the external world by making causality a construct of the phenomenal world, a necessary one to be sure, but, for Kant, whether causality belongs to the noumenal world is a question humans cannot answer. Pearson's comments should be no surprise to us, considering the three centuries that preceded him.

Between Bertrand Russell's caustic words and Pearson's positivist magisterium science appears to be stripped of any appeal to cause as the explanation of physical phenomena. It follows from both Russell and Pearson that science only describes but does not explain. Pearson distinguishes above between the prima facie appearance in "the routine of our perceptions" and the *why* underneath that routine of which we are ignorant. Rather than seeking a good interpretation of the physical phenomena of nature, Pearson asks his reader to give up the search, and settle for "science" as the organization of sense perceptions. Since one cannot get beyond one's senses, and all knowledge to which one has access comes through the senses, cause and its underlying mechanisms are inaccessible. For this reason, Pearson suggests, along with Bertrand Russell himself, that the pursuit of causes, as such, be abandoned.

But their hostility seems dated in the face of nonlinear science and the study of complex systems. The revelation that many physical systems apply the same dynamical nonlinear equations (see discussion of mathematical complexity theory in chapter 2) begs one to ask: Why do so many different systems (ecosystems, economic systems, neural systems, etc.) behave with similar properties? Through the development of complexity theory, chaos theory, and nonlinear science, the problem of identifying causes now seems much more complicated than it did to Newton and his followers. The Newtonian vision of linear causality has been augmented by the increased knowledge of physical systems' dynamics and the increased computational power available in the dramatic advances in

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[159] Pearson's book, *The Grammar of Science*, was first published in 1892, and was revised in 1900.

computer modeling of physical phenomena. This increase of knowledge and computing power (see discussion of Edward Lorenz in chapter 2) show that nature operates according to consistent patterns of behavior; however, it is thought to be impossible to establish with any complete certainty all the factors for the initial conditions. Nature consistently remains dependable to do what faithful descriptions of it predict it will do, within a short time horizon, as Lorenz's work demonstrates.

This remarkable consistency in the observable physical world has put causation back on the table. Alwyn Scott, in his Introduction to *Encyclopedia of Nonlinear Science*, after surveying the broad range of scientific fields touched by this new field, reintroduces Aristotle to contemporary science: "Twenty-four centuries ago, Aristotle described four types of cause (material, efficient, formal and final), which overlap and intermingle in ways that were often overlooked in 20th century thought but are now under scrutiny" (2005c, vii). Scott gives an example for how these causes interrelate in discerning a complex situation's cause:

> The sad disintegration of space shuttle Columbia on the morning of February 1, 2003, set off a search for "the cause of the accident," ignoring Aristotelian insights into the difficulty of defining such a concept, never mind sorting out the pieces. Did the mishap occur because the heat-resistant tiles were timeworn (a material cause)? Or because 1.67 pounds of debris hit the left-wing at 750 ft/s during takeoff (an efficient cause)? Perhaps a management culture that discounted the importance of safety measures (a formal cause) should shoulder some of the blame. (2005, vii)

Scott's report of research and his well-chosen but sobering example make Pearson's assertions that science only deals with sense perceptions seem at least overly simplified, if not mistaken. This would suggest that scientific study can never know causes. However, Scott's comments point to a weakness in the apparent antinomy between the pragmatic approach to understanding causation (wherein the apparent cause of something is accepted to be the real cause based on probability) and the philosophical/scientific sense of causality (an "absolute" or determinate notion of cause). We may now draw in Ricoeur's discussion regarding the relation between explanation and understanding, which featured prominently in the previous chapter (1991, 125-143). Both the pragmatic approach (represented by Pearson) and formal approach (represented in Russell's explanation of what constitutes a necessary causal relationship, which he then criticizes) to causality fall into Ricoeur's category of explanation, not understanding. The pragmatic approach uses a procedural approach of probability to make an educated guess into causal relations (if there indeed are

such things). The formal approach aims to establish necessary relationships between events with a certainty fitting valid logical forms.

When considered in light of Ricoeur's analysis of the difference between explanation and understanding, both the pragmatic and formal approaches can be useful (1991, 125-143). In that they can lead to understanding, following Ricoeur's use of a hermeneutic circle of explanation and understanding (see chapter 4). However, as discussed in chapter 4, understanding can be informed by explanation, but it is not the same thing as explanation. Explanation focuses on examining a given phenomenon in terms of a set of procedures. Whether a formal, deductive causal relationship can be established between two events, or probability is used to approach some apparent cause as if it were the real cause to expedite some human purpose, a procedure is in view. Both approaches require a procedure. Certainly, each approach can be competently defended. Each proves useful in addressing particular problems. But as I showed in chapter 4, reiterating Ricoeur, explanation is not *understanding*. For Ricoeur, understanding, in part, involves a journey. The interpreter comes to understand himself and his world through a kind of interpretive entrance into the world, followed by a return to himself. This journey never ends, yet every circle brings new insight. Understanding does not end with a lab report, or some fixed procedure that finalizes and closes the case. Understanding is always in dialogue, always growing. Understanding continually opens the world to being known. But explanation which establishes itself as such by meeting the demands of a formal set of procedures will not, as such, come to understand the underlying causal relationships. If Ricoeur is correct, those who champion explanation alone greatly limit what can be known about our world. They halt the hermeneutical circle of investigation, in this case, causal investigation. In contrast, Aristotle's causal model focuses on *understanding* causality in its multiple senses. In contrast with the procedures of explanation, it is a hermeneutical tool of interpretation and understanding.

One might reasonably be led to ask: what led many scientists and philosophers of the early 20th century to abandon the possibility of understanding causal relations? The answer to that question is closely related to the development of logical positivism and the hostility of that school of thought to the traditional pursuit of hermeneutics, with all its subtle complexity. I raise the spectres of both scientific and logical positivism because, it seems to me, the same outlook leads both to the abandonment of any hope to discover both underlying causes and the underlying meaning of a text, the kind of messy problems A. J. Ayer (1936) thought he had cleaned up with his verificationism.[160]

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[160] Verificationism characterizes the meaning of sentences only in terms of what content is empirically verifiable. If a sentence cannot be directly empirically verified, then that sentence is *meaningless*. Since my immediate subject in this chapter is the hermeneutics of causality, it is significant to observe

Both scientific and logical positivism can be traced back to David Hume's attacks on the epistemic support of one's knowledge of causation.[161] According to Hume the only knowledge one can posses is what one can perceive through one's senses (1977, 1935). Thus, all knowledge is ultimately not about the world outside the self, but the relationships between sense impressions that come from objects in the world beyond the self. Hume was, of course, not Berkeley. Once knowledge has been truncated to these anaemic restrictions, Hume points out, there can be three, and only three, relationships between sense impressions, namely *resemblance*, *contiguity* and *cause and effect* (1935). Hume gives examples to explain each category (see sect. III, 19, in 1935). When a picture draws one's mind to the original, *resemblance* is being recognised. *Contiguity* is employed when one mentions one's apartment, and a discussion begins with ones interlocutor about the other apartments in the building. Finally, the relation of *cause and effect* is drawn upon when we think of a wound and cannot help ourselves but think of the pain that followed receiving the wound. Since I am only discussing cause and effect, I will merely explain that Hume argues that we never see the cause underlying our perceptions occurring (1977, 1935). One's sense impressions do not reveal causes to one's mind.

Hume uses the famed billiard ball example to make his point. Just because one ball moves to impact another, and the next ball moves when the first ball stops, does not mean that the motion and impact of one ball caused the other to move. It only appears to because the two motions are *constantly conjoined* in our experience. Since Hume has restricted the only possible relations to namely *resemblance, contiguity,* and *cause and effect*, the only possible conclusion, given his restrictions, is that one ball appears to cause the other to move, but the inference to causation is one that appears in the mind of the observer, not *necessarily* in reality. Hume gets to this observation by pointing out that cause and effect are

here that verificationism leads to behaviorism. Since sentences about the human person are not directly empirically verifiable, they are not acceptable; hence, one may only make meaningful sentences about one's behavior. Regarding this connection Roger Scruton observes, "Verificationist were also behaviourists. Since the only evidence I can have for my statements about your mind are observations of your behaviour, that is all I could mean by referring to your mental processes. But what about my own mind? Surely I don't mean to refer to my *behaviour* when I say that I am in pain or thinking. If that is what I meant, then I could be mistaken! Here lies one of the many difficulties that verificationism has encountered. Indeed, verificationism is studied now largely for these difficulties. The verificationists, like Berkeley, made the mistake of being honest. They fell victim to their own naïveté, by making it possible to refute every single thing they said, including the verification principle itself. How, after all, would you verify the principle? There seems to be no answer. In which case, the principle, by its own reckoning, is meaningless." (1994, 26)

[161] The argument I present here could be worked out into a full book, or at least a journal article, (A spin off project that I will take up after this research). Regarding the historical question of whether Hume is the source of these ideas, the literature criticizing causality cites Hume's work as presenting the core arguments upon which later writers embellish. See Russel (1929, 235, 240). Also see W. V. O. Quine's short history of Hume's bold identification of bodies with sense impressions, which betrays an employment of the causal hermeneutical circle (1969, 71-75).

really just a reiteration of resemblance and constant conjunction. One can postulate something happening underneath sense impressions, but whatever that speculation comes up with—it is just metaphysical speculation.[162]

David Hume's attack on the necessity of causal relationships presents this discussion with an apt opportunity; for, if it can be shown that Hume's entire case depends first on the existence of necessary causal relations, it will be possible to demonstrate that something like the hermeneutical circle of textual interpretation (see chapter 4) is also in play in human knowledge about why events occur as they do.

The fundamental failure of Hume's sagacious criticism is that he misses that the whole criticism depends upon causation between the object that impresses itself upon us through making a sense impression, and the sense impression itself.[163] In fact, his view depends on this relationship; for, if there is no such causation, then there are no sense impressions. No one *sees* causal relationships; if Hume has taught us anything it is this. This blind spot[164] lets Hume posture as though there is no evidence for causal uniformity, and then stand on absolute causal uniformity against the phenomenon of miracles, asking if his reader has ever *seen* the universe behave any other way. But Hume cannot have it both ways. He cannot deny the empirical knowledge of causation and complete absence of the knowledge of causal relations from the a priori consideration of causal objects[165] while assuming causality at the outset of his attack, as I will illustrate below. One could point to a contradiction here, like some freshman philosophy student, but that would be unhelpful.

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[162] If causal relationships cannot be known, only inferred on the basis of probability, then Hume's further criticisms of probability, which he builds upon his reduction of cause and effect to resemblance and contiguity destroy confidence in any claim to knowledge that the future will be like the past. Hence, knowledge of the nature of things, of the systems underneath experience, is not accessed by the senses, and interpretation of phenomena toward causal explanation is not acceptable to Hume.

Kant attempts to reply to Hume, but ends up turning causality into a synthetic apriori category in the mind, thus it is not in the noumenal world, but rather in the phenomenal world of what is first individual human experience. Given this formulation of cause and effect, Pearson's approach using probability makes sense, since whatever is occurring inside the causal relation is not accessible to the senses; it is a kind of black box. Human understanding and the interior of the causal relation may never speak to one another.

[163] I wish I could cite someone for this argument, but unfortunately, to the best of my knowledge, I thought of it first. It is so obvious, though, that somebody, somewhere, must have thought of it already. It first occurred to me when researching an epistemological problem in knowing causation in early Buddhist philosophy.

[164] An extended treatment if Hume's full argument is beyond the scope of this dissertation, but it would help to make clear here that Hume is not rejecting that cause and effect is not in play in nature, only that humans can never have knowledge of causal relations. It follows that causal relations, for Hume, are in the same category as religious claims regarding miracles. Both claims go beyond the evidence. In a representative passage Hume writes, "When we reason *a priori*, and consider merely any object or cause, as it appears to the mind, independent of all observation, it never could suggest to us the notion of any distinct object, such as its effect; much less, show us the inseparable and inviolable connection between them" (sect. IV part 1, 27, in 1935).

[165] See previous footnote.

When a philosopher as gifted and careful as Hume makes a mistake like this, one should honour Hume's philosophical contribution by learning from the mistake.

The take-home lesson from Hume's mistake is that causation is a precondition to human experience. Kant made much of preconditions to human experience, but here I do not suggest this in the Kantian sense. Rather, hermeneutically, it would seem that causation is one of those basic preconditions of intelligible human experience which must be assumed and employed in order to function, but one must also use them even in the process of attacking them. It is as though there is a hermeneutical circle of, in particular, causal interpretation, that one can never leave, at least with one's sanity.

The hermeneutical circle of causal interpretation I suggest here follows from two notions. Firstly, it follows from Ricoeur's own discussion of the hermeneutical circle, which featured prominently in the previous chapter. The phenomenal world is filled with symbolic content, symbolic in that the meaning of the content is more than the observable manifestation of the symbol. Ricoeur approaches symbolic relations banking on the additional opportunities for understanding promised by thought that reflects on symbols. In this way, "The symbol gives rise to thought" (1967, 352). Secondly, this quality of the symbol can be extended to causal relations if the hypothesis that I presented in the introduction is correct, namely if *function* is the teleology of *process* as *meaning* is the teleology of *discourse*.[166] If this relation holds, then it follows that function can be "unpacked" like meaning through hermeneutic interpretation.

A. J. Ayer disagrees with the assessment that Hume is attacking causation, and if Ayer is right, it would do my argument in (1936). Ayer finds much common ground between his verificationism and Hume's philosophy, and he reckons Hume's analysis of causation as "the main feature of his philosophical work" (54). However Ayer advises against interpreting Hume as denying the possibility of knowing causation. In Ayer's view Hume "was concerned only with defining it [causation]" (54). He draws attention to Hume's (1977, 173-6) chapter "Rules by which to judge of causes and effects" which shows, to Ayer's mind, that Hume believed in the relationship of cause and effect. Ayer, however, fails to interpret this chapter in view of Hume's whole philosophical project, which is to move causation from the discipline of natural science to philosophy. Causation, for Hume, is not in nature as something that one can see; rather, it is in the mind *only as far as any reliable epistemology is concerned*. The human mind cannot know if there is any necessary cause and effect relations in nature.

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[166] This formulation is first introduced in this dissertation in the introduction, in the list of five things this research project will assume. Chapter 6 will develop the idea, as well as an initial case for it. In the introduction I also mention that the notion is assumed in this dissertation because a full defense of the idea would take another dissertation to defend.

Why? Because no causal relationships are given in experience; only *resemblance*, *contiguity* and *cause and effect*, as construed by the mind (Hume 1935, 22). Hume divides the perceptions of the mind into *only* two classes: *thoughts* or *ideas*, and *impressions*. It would have been easy for Hume to distinguish these two classes based on one being mental activity and the other being sensation, but his sense of idea (something only present in the mind, not nature) forbids him from dividing the classes along those lines. He instead appeals to *liveliness*. Lively perceptions of the mind are more forceful and thus he calls them *impressions*, but both classes are still individual perceptions (Hume 1935, 15). To make sure that the reader does not miss this point, he applies the limitation of these categories to sense perception itself:

> We say, for instance, that the vibration of this string is the cause of this particular sound. But what do we mean by that affirmation? We either means that *this vibration is followed by the sound, and that all similar vibrations have been followed by similar sounds: Or, that this vibration is followed by the sound, and that upon the appearance of one the mind anticipates the senses, and forms immediately an idea of the other*. We may consider the relation of cause and effect in either of these two lights; but beyond these we have no idea of it. [*his emphasis*] (Hume 1935, 79-80)

The object behind the sensation, the string, is only constantly conjoined (having the quality of *contiguity*) with the sound one hears, but this does not mean that the string causes that sound. However, we are forced to ask how Hume can even make his inference if there is no known causal relationship, either in experience, or in the mind, between the string and the eye that sees it. For this reason I suggest that "the main feature" of Hume's philosophical work supports the observation that even to philosophically engage with causation requires one to employ a causal hermeneutical circle. Even the critique of causal relations requires that one use them, or assume[167] them, in the process of critiquing them.

This chapter will not develop a whole theory of causal hermeneutics. The universe is filled with many interesting and difficult questions of cause, and a chapter claiming to answer them all in the time it takes to listen to a jazz CD and drink a beer will almost certainly

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[167] If Hume is permitted to assume causality in the process of refuting causation as not empirically proven (while the only epistemology he will permit is empiricism), then Descartes is equally vindicated for his circular appeal which assumes God to protect the possibility of certainty in the human mind—the foundation upon which Descartes then proves that God exists. Hume is making the same move, but commits a worse mistake, for he *denies* the source of his justification for causation which makes possible the empirical observation, as Descartes God is the protector of human reason.

underwhelm. Instead, I will point to where hermeneutic circle of causal interpretation connects with Ricoeur's model of the text, in what Aristotle calls *mimesis*. I will do this by first showing how Aristotle developed an articulate complex systems theory out of his causal model, even though he thought he was just explaining the parts of animals; and second by showing that Aristotle's system theory (AST) implies a fifth cause that Aristotle does not delineate, but which complex systems necessitate; and third by showing that the five causes organize the various types of scientific models described by Max Black; and finally by showing that Ricoeur's observation that tragic mimesis incorporates all four of Aristotle's causes in the act of *redescription*, suggests that tragic mimesis models a fifth cause, the instrumental cause, and thus show that narrative is a significant path to a hermeneutic phenomenology of complex systems (see introduction and chapter 4).

3. RICOEUR'S USE OF ARISTOTLE—METAPHOR AND THE ANALOGY OF BEING

Ricoeur (1977, 1984, 1985, 1988, 1991, 1992, 1976) makes significant use of Aristotle in the process of developing his hermeneutic phenomenology. In the first study of *The rule of metaphor,* Ricoeur builds his initial analysis of metaphor on the unity of Aristotle's treatment of metaphor in *Rhetoric* and *Poetics* (Ricoeur 1977, 9-43). Through a careful reading Ricoeur is able to show that metaphor is more than simply deviant predication (see chapter 4); it actually says something about the world. Ricoeur goes on to argue that there is metaphorical truth (see chapters 1 and 4) and that truth is accessible because Aristotle, in Ricoeur's view, is more or less correct about the analogy of being[168] (1977, 216-256, 257-313).. Ricoeur explains that he sees himself "extending the Aristotelian meditation on the multiple senses of being" (see "reply to G. B. Madison" in Hahn 1995, 93). He explains that he is "far removed" from the Heideggerian ontological approach to metaphysics. "[M]y major concern has never been to know if and how I could survive the deconstruction of metaphysics 'itself'; it has been instead to do metaphysics in another manner, on the basis, precisely, of a hermeneutic phenomenology" (Hahn 1995, 94-95). Ricoeur explains that "[f]or a brief outline of this, the reader may be referred to the final chapter of *The rule of metaphor* and the discussion on the connection between analogy and metaphor, and the final chapter of *Oneself as another* for a more extended for a more extensive discussion" (Hahn 1995, 93). In these passages, uses hermeneutic phenomenology to approach something of an

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[168] Aristotle regarded being as analogous. Aristotle's notion of substance, his view of potentiality and actuality, and his model of the four causes apply to the structure of nature in multiple domains and disciplines as evidenced by his writing on logic, rhetoric, physics, chemistry, meteorology, psychology, biology, ethics, and politics.

Aristotelian ontology through a longer and more careful route than Heideggerian metaphysics Ricoeur (1977, 257-313, 1992, 297-356). The conclusion of *The rule of metaphor* treats the metaphysics of metaphorical truth, while *Oneself as another* deals with the ontology of the self. But Ricoeur's use of Aristotle's philosophy does not stop with those two works. One might even see *Time and narrative* as an extended commentary on Aristotle's *Poetics* with the analogy of being in mind.

4. DISCLAIMER ON ARISTOTLE'S METAPHYSICS

Ricoeur approaches metaphysics, not with bombastic boldness, but with tentative patience. Similarly, this dissertation attempts to approach Aristotle patiently in order to glean resources useful for the development of a hermeneutic phenomenology of complex systems, which can situate brain science within hermeneutic phenomenology. By taking this tour through Aristotle's metaphysics, and particularly his analysis of complex systems, I aim to draw on an understanding of being coterminous with hermeneutic phenomenology, for Ricoeur developed significant aspects of his philosophy through reflection on Aristotelian insights. While I am confident in the accuracy of my reading of Aristotle, I do not offer this reading as an absolute or perfect reading.[169] The following discussion will only pursue Aristotle's ideas as far as they aid this research project.

5. COMPLEX SYSTEMS IN *ON THE PARTS OF ANIMALS*

We saw earlier, in Alwyn Scott's report on the recent developments in nonlinear science, that Aristotle's four causes are back within the general ken of science (*Metaphysics* II, *Physics* II.3). William A. Wallace, in *The modeling of nature* unites these four causes under the term of the causal model (1996, 5). Since human experience only reveals nature incrementally, progressively, there is no one moment when the whole of nature on any given subject, is revealed, so Wallace suggests modeling as an important and necessary tool for understanding the natural world. Model-making binds together nature's revelation of itself over time into a more complete picture than any one moment's observation can ponder. The causal model draws its archetypes, to use Max Black's terminology, from the way knowledge of causes helps humans to understand artefacts, i.e. humanly manufactured things (1962, 241). Knowledge of the design, material, fashioning and purpose of an artefact permit humans not only to make use of artefacts, but also to develop new artefacts. This is a kind of

"as if" anthropomorphism, not anthropomorphism in the sense of treating something as if it were human, but rather as if the structure of the universe shares the same internal structure as artefacts, an understandable, interpretable being, something open to human understanding and possibly to human ingenuity given the right resources. Thus the causal model may be applied to glacier formation, global warming, star formation, and the like. Darwin does exactly this when he studies the breeding of animals as directed by humans, and then makes an analogy to natural forces—what if nature did the same thing? (1859). Can nature select which animals ought to reproduce?

Wallace encourages his reader not to think of each cause as separate from the other, hence the four causes—*material*, *formal*, *efficient*, and *final*—are seen as one model. For Wallace, matter is one aspect of *nature* (the rich and in some places living nexus of Aristotle's plurform notion of cause). Nature is the structured physical world as it behaves, as it lives, living organisms acting upon others, ecosystems and the like. An ecosystem can be both nature and matter. Matter has potential to be any one of a number of things, and Wallace is quick to point out that this is why Aristotle talks of matter as *proto-matter*, or "first matter" (Wallace 1996, 8). But notice that matter cannot be "seen" this way without an eye to what it could be.

Artefacts also are formed--they have a structure and this structure makes possible the artefact's polysemy of function. This structure permits them to have a certain function, or collection of functions. The goal of the chair is to hold a person off the ground when sitting. The achievement of this goal is only possible if the chair has a structure appropriate for holding someone, or at least some part of someone, off the ground. A two-foot cube of wobbly gelatine lacks the form to do the job.

Here it may be a good place to emphasise that I am not following the Platonic interpretation of Aristotle that reads *form* as being something pressed into matter, thereby giving matter its shape. Rather, I understand form and matter as ways to conceptualize substance. Therefore a form is not *added* to matter. It is (almost like Christopher Langton's definition of "life"[170]) the arrangement of the matter, which in today's physics is an arrangement of energy, which brings us back to form, and so the circle goes. So as far as the present research is concerned, matter cannot exist without form.

Returning to the causal model, nature may also be seen as an *agent*. Wallace explains:

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[169] To perfectly substantiate that this reading is *exactly* what Aristotle's texts mean is beyond the available space here.
[170] See chapter 3.

> [O]perations and activities, and re-activities as well, proceed from the abilities
> and potentials that are lodged in the natures of agents and so can serve to
> explain the ways in which they act and react with neighbouring objects.
> Natural forms are the inner source of these activities, but such forms are
> equipped with powers that can be activated and so enable substances to act
> on, and interact with, things external to them in distinctive ways. (12)

So "agent" here does not mean a personal will making choices, but it does mean that natural forms act upon the world, upon other natural forms in some way. These natural forms include biological organisms and ecosystems, but could also include stars in their full life span as well as solar systems. Natural forms do things to other things on some kind of regular basis, and one can see that the notion of natural forms that Wallace describes here best fits natural *systems.* Natural systems, like animals, weather systems, planetary systems, etc., each have physical properties; they each have components that work together and act on each other.

Finally, and most controversially, nature has *teleology.* Because of scholastic philosophy, teleology has the reputation of importing with it the embarrassing baggage of intent, as though nature is, itself, *willing* to achieve some end, some goal. Wallace helpfully distinguishes three different senses of the term "end" (*telos*) found in Aristotle's writing (16-17). The first sense is that of "terminus," simply the physical end of a procedure. If I fly from Pittsburgh to Boston to Paris, Paris is the terminus, the end, the *telos* of my journey. The second sense of *telos* refers to the end of a process. There is no necessary intent located in this process. A wave crashing on a beach is that *telos* of the wave-making process. The third sense of *telos* is the offending sense of teleology, a goal. Put less offensively, it is the function which the other causes aim to achieve, whether they know it or not. Let us apply each of these types of *telos* to a duck. The end of a duck is probably its death. If one focuses for a moment on a part of the duck, say his little webbed feet, the point at which the duck's leg ends with the sole of its little webbed foot would certainly be an end in the first sense. The process by which this formation occurs is a procedure guided by the duck's DNA. Furthermore, one can see the various types of minerals and nutrients, through various biological systems internal to the duck, are assembled to form his feet. Therefore the feet themselves are the *telos* in the second sense. However, these feet poke out the bottom of the duck's body so he can put one foot in front of the other and walk, or swim, thus walking is the *telos* in the third sense.

Aristotle's causal model has been criticized as being too simplistic; certainly biological systems have more occurring inside of them than a mere externally-applied four-

causal model would suggest. If Aristotle's causal model is applied in a "paint-by-numbers" sort of way, it does seem simplistic, especially when Aristotle's notion of form is interpreted in the Platonist at way, as though a thing's form is some Erector Set, embedded within it. A strong clue that a monolithic interpretation of Aristotle's causal model is far removed from what Aristotle intended, is found in his biological works. Arguably the most complex systems in the known universe are the biological systems of the earth, and the systems which they form by interacting with one another. Poincare may have discovered non-linear dynamical systems by carefully studying the orbits of the planets, but the locus of naturally occurring complex system is the creaturely domain of biology. It is no wonder then that Aristotle addresses the question of how to understand a complex systems in his biological text *De partibus*. I will refer to the text by the English title, *Parts of Animals*, which pays homage to the Latin, but Aristotle himself, in *On the Generation of Animals,* calls this treatise "*On the causes of the parts of animals*" (782a 21 Aristotle 1943, 513). Clearly Aristotle intended that this text be understood in terms of what I will now explain.

Aristotle begins *Parts of animals* by clarifying which method one ought to use in classifying animals. He asks,

> [S]hould one take each substantial being singly and define it independently, e.g. taking up one by one the nature of mankind, lion, ox, and any other animal as well; or should one first establish, according to something in common, the attributes common to all? For many of the same attributes are present in many different kinds of animals, e.g. sleep, respiration, growth, deterioration, death, and in addition any remaining affections and dispositions such as these. (639a 16-22 Aristotle 2001, 1)

The problem facing Aristotle is the same one that has faced all biologists down through history: how does one classify living things? They have an awful lot of parts, and many of those parts are similar on substantially variant creatures. Aristotle concludes that the natural philosopher should classify animals on the basis of genus and difference, but Aristotle also needs to develop a method of understanding the parts of an animal in a way that fits within his theory of form. It is not enough to apply potentiality and actuality, or the four causal model to the whole of an animal; these concepts must also apply to the parts as well, but in some way that appreciates how the part is different from the whole. Thus, as we should expect, we find that Aristotle applies his theory of the four causes not only to the whole of an animal but also to its *parts*. In doing so, Aristotle develops something we today would today call a theory of complex systems.

To better understand AST, first I will analyze Aristotle's application of the four causes to the explanation of the development of an organism as a whole. Second, I will review his instruction on studying the individual parts. Finally, I will contrast how one ought to approach the whole and the parts and tease out an AST in greater detail.

Aristotle's theory of form aims to account for change in nature by the interplay between *potentiality* and *actuality*. In biological organisms, this interplay causes the organism to mature. As the organism matures, it assembles itself, and thus the use of the causal model helps to understand this process. Aristotle specifies that of the two causes at work in generation of an organism, the efficient and teleological causes, the more significant cause, the "account" or *logos* (see Lennox commentary in Aristotle 2001, 126), is the teleological cause (639b 12-17). To clarify how the *telos* is what accounts for the whole, Aristotle compares the works of nature to those of a builder and a physician:

> For once the doctor has defined health, and the builder has defined house, either by thought or perception, they provide the accounts and the causes of each of the things they produce, and the reason why it must be produced in this way. (639b 17-19)

The works of humans aim toward a final cause, a purpose, but Aristotle goes on to say: "Yet that for the sake of which [the purpose] and the good [the beautiful] are present more in the works of nature than those of art" [my addition] (639b 20-21).

For this reason, Aristotle contrasts natural science with the theoretical (contemplative) sciences, because nature actually generates a product. Aristotle further substantiates his point by distinguishing between the modes of demonstration and of necessity between natural science and theoretical science. He makes his distinction based the concept of maturity, or what will be. Natural science must deal with a world of forms that mature, and in this sense they have a purpose.

> [T]he mode of demonstration and of necessity is different in natural science and the theoretical sciences…. For the origin is, in the latter cases, what is, but in the former, what will be. So: 'Since health or mankind is such, it is necessary for *this* to be or come to be', instead of 'Since *this* is or has come about, *that* from necessity is or will be'. Nor is it possible to connect the necessity in such a demonstration into eternity, as if to say, 'Since *this* is, therefore *that* is.' (640a 3-7)

Notice that health or mankind, to be understood, must be considered in terms of purpose. Aristotle distinguishes demonstrations in nature from a simple and simplistic use of syllogism, and his reasoning holds. The paediatric dentist does not replace the baby teeth of a child with implants for this very reason. In fact, the implants would actually injure the future developing teeth. They work against the maturity of the child. The child will one day become an adult, and the paediatric dentist works with this end state in mind. Nature, for Aristotle also works toward an *end* state. Aristotle argues that the craftsman holds in his mind a plan of what he will do and works backward from that plan to find materials and build that which he has intended. In contrast, nature, specifically the developing organism, works forward, drawn, as it were, to maturity through various stages of development. It is no wonder then that Aristotle's notion of form works better for organisms, or for those things where in maturity can in some way be defined. In living organisms it is clear when an organism reaches adulthood, it reaches its full capacities. It may take weeks, months, or years to reach maturity, and the signs of maturity for a paramecium, fish, lizard, or human may be different signs. It still remains that each can and does reach maturity. However, it may be possible to trace maturity in complex systems that are not organisms.[171]

Secondly, dynamical systems even get their name from Aristotle; dynamical, from the Greek *dunamis*, meaning "potential", "power", or "potency" as in dynamite. *Dunamis* is Aristotle's word underneath the frozen Latin of "potentiality". *Dunamis* the partner in the dynamic duo of *potentiality* and *actuality* (Greek: *energia*—from which English gets the word "energy"). In fact Aristotle's universe is very much a world operating far from equilibrium; only the clarity and sanity of its commentator (or modeler) make it seem calm. Even though the universe operates in constant motion, as power acting, the observable quality of maturity, toward which biological (and other types of) organisms move makes the movement from power to action intelligible, and is something that humans might model.

Thus, Aristotle believes that the development of an organism can not be understood without understanding its mature form, or the teleological cause toward which that form

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[171] A digression is appropriate here: One may reply to this introduction to AST that biological systems, as complex systems, operate far from equilibrium, according to sub-point-8 of Paul Cilliers's trenchant definition of a complex system (1998, 3-5). One may respond, "Isn't this notion of maturity wholly contrary what complex systems do, what a complex system is? Those wild complex systems are untameable, out of control, evolving, who knows what will happen, maturity pshah!" For some "maturity" may be perceived as an equilibrium, and in complex systems equilibrium is death. However, maturity does not equal equilibrium. An organism's achievement of maturity still must entail perpetual interaction with the environment in terms of the information and energy necessary for complex systems. For example, humans mature, at least they are supposed to. When they don't physically mature due to a terrible accident, we call that a tragedy. When they get old but never do mature, that we call foolishness. We recognized that the information exchange that should have occurred did not. Yet maturity leads in no way to equilibrium, the term may have that connotation, but the referent of the term does not. That use of the word need not apply here.

matures, and on this basis he castigates Empedocles for thinking that "many things are present in animals because of how things happened during generation—for example, that the backbone is such as it is because it happened to get broken through being twisted" (640a 20-22). Aristotle recommends that

> It seems we should begin, even with generation, precisely as we said before: first one should get hold of the phenomena concerning each kind, then state their causes. For even with house-building, it is rather that these things happen because the form of the house is such as it is, than that the house is such as it is because it comes to be in this way. *For generation is for the sake of substantial being, rather than substantial being for the sake of generation..* (640a 13-19, emphasis added)

The process of generation is an animal's individual assembly[172], and the assembly of that animal moves toward its *telos*, its maturity. According to contemporary science, this would refer to an organism developing the complete adult expression of its genetic information. Aristotle sees the development of the organism as goal-directed, toward the end of reaching maturity. This process of maturity occurs not for itself, but for the sake of the substantial being, and not the other way around. This final point is of great importance for the modeling of complex systems, and it will be important that I clarify what Aristotle means to here.

Generation occurs for the sake of *substantial being*. But what is substantial being? Aristotle's word, which James G. Lennox translates here as *substantial being*, is *ousia*, which in Greek literally means "being." However, Aristotle puts the word to special use, identifying the fundamental stuff of the world as *ousia*, for which his English translators tend to use the word "substance." For Aristotle, the world is made of *ousia*, which can be abstractly dissected by the mind as matter or form, but only as a mental abstraction. And for Aristotle, ultimately there is no form or matter but really just potentiality and actuality since one can become the other. Thus, in Aristotle we have an anticipation of the modern relationship between matter and energy. Form can be actualized, pass its maturity, become corruptible, and break down into new potential for a new actuality—another possible form, in a *cosmos* that operates far from equilibrium.[173] However, in the context of *Parts of animals*, *ousia* takes on a special meaning, for here Aristotle is not referring to mere substance, but to

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[172] William Ogle translated *Parts of animals* in the years following the publication of Darwin's *The Origin of Species*. Ogle renders *geneseos* as "evolution," which makes it seem as though Aristotle is talking about the development of an entire species in this passage rather than the development of a single growth to maturity of single individuals.

an *organized substance*--what Lennox is trying to get at when he translates *ousia* as "substantial being." Substantial being is Aristotle's way of describing what the term "organism" refers to today.

This concept of substantial being is analogous to the notion of "emergence" discussed in chapter 2. Recall that emergent properties are those which are possessed by a unity of parts, but which cannot be reduced to the behavior of the individual parts. The property "emerges" from the complex interaction of the parts. I pointed out the term "emergence" suggests a story of how these complex properties came into being, namely somehow they emerged from the parts through some process of iterative development, and I suggested that this latent "myth" in the term can confuse the point, and can tempt one to reduce the whole to the parts. Aristotle is careful not to fall to this temptation, evidenced clearly by the way he handeled Empedocles' demand to explain biological features interms of a conjectured natural history, rather than studying an organizms observable systemic traits. The notion of substantial being designates essentially the same idea as "emergence" in complex systems theory.

Aristotle gets at this idea of *substantial being* in a number of ways in *Parts of Animals*. For example, a nature can be "spoken of and it is in two ways: as matter and as substantial being" (641a 24-25). Thus, in this usage, *ousia* seems to refer to a particular nature's *form*. However, he goes on to add "And nature as substantial being is both nature as a mover and nature as end" (641a 26-28). Note then that *substantial being* as animal form can be both spoken of, and is matter, form, agent and end. *Unlike an artefact, substantial being is all four causes itself.*[174] If one and the same item is all four causes itself, then the four-causal model must be a hermeneutical tool and not an ontological organization schema. It is possible that the material cause of one substance could be the teleological cause of some other process. Or it could be that the formal cause and the efficient cause are the same. DNA is an example of this, since it has the ability to be functionally interpreted under both aspects of the causal model. The model permits the interpretation of causal relationships that can be understood in terms of potentiality and actuality. Furthermore, though it may be possible, it is not necessary to segregate the formal cause from the material cause, so that one can point at the formal cause, lonely, bare, and shivering, divorced from, and bitter at, the material cause. The causal model is not like that. It is possible that every one of the four categories of the causal model could have something, some property, some potential associated with it, and yet the causes (in the Aristotelian

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[173] See the discussion of Cilliers's definition of a complex system in chapter 2.
[174] All four causes apply to material things, but it is a mistake to see matter as the bedrock with the complex of other causes built upon it. Substance retains all five causes equally.

sense) would not be adequately delineated. As Wallace observes, "The fact that a nature is only progressively disclosed in experience, and perhaps is never exhaustively understood, makes it especially amenable to study your modeling techniques" (1996, 5). If biology has taught us anything, it is that substantial being is only progressively revealed, and edification into substantial being often requires government grants and vast endowments. So, at least in Aristotle's eyes, substantial being may be spoken about as, and it is, each of the four causes, as one whole. Which means that, on an ontological chart, the total organism fits each of the spaces, yet without being dissected. More on this to come (see the next chapter).

Aristotle adds, and "And it is the soul—either all of it or some part of it—that is such in the animals case" (641a 26-29). Of course by "soul" (Greek: *psuche*) he does not mean the Platonic notion of soul as indivisible non-material existence housed by the body. Rather *psuche* in the context of biological organisms better refers to the life of the organism, that which is the organism living, thus plants can have vegetative souls, animals sensitive souls, and humans rational souls, yet these souls are not separable from the organism, but are the organism living, being an organism. Here Aristotle again finds some common ground with Christopher Langton. According to Langton, "Life is a property of the *form*, not *matter*, as a result of the organization of matter rather than something that inheres in the matter itself" (Langton 1996, 53, cited in Kember 2003, 63). Aristotle would certainly disagree, as one can see from *Parts of Animals*, that all four causes, not just *form*, denote substantial being; however, Aristotle and Langton are mostly agreed that life is "a result of the organization of matter". The soul is the life of the substantial being. But mere material arrangement does not make life. Aristotle warns that the mere shape and colour of the body of an animal are inadequate to understand an animal. "[Y]et so the configuration of a corpse has the same shape, it is nevertheless not a human being…. Likewise none of the parts of a corpse is any longer such—I mean, for example, any longer and eye or a hand" (640b 34-641a 5). When an organism dies, it ceases to live; this obvious statement has special significance for Aristotle. At death, the parts of the organism, of the animal, cease to interact with one another. At death, an organism's eye does not remain an eye; it is part of a corpse. Eyes see. A corpse's eye does not see—thus a corpse's eye is not really an eye anymore.

We now arrive at the purpose of Aristotle's book, to explain the parts of animals. Aristotle recommends his reader take a different approach than that of his contemporaries: "It is clear, then, that these natural philosophers speak incorrectly. Clearly, one should state that the animal is of such a kind, noting about each of its parts what it is and what sort of thing it is, just as one speaks of the form of the bed" (641a 15-18). Notice here that the analysis of substantial being that one performs on the animal as a whole should also be

performed on its parts. There is ample evidence in *Parts of animals* and *History of Animals* that Aristotle thought that each of the parts of animals—the brain, blood, bladder, kidneys, and so forth—could be studied separately from the whole creature and compared with that, or those, of other creatures. These books reveal that he employs his causal model to understand a variety of parts. This dissertation is not the place for an extended study of the use of the four causes in all of Aristotle's biological treatises. It is enough to draw attention to the obvious fact that Aristotle employs the four causes to study the various animal organs in *Parts of Animals*.

Aristotle has a richly developed notion of "part" (Greek: singlular *meros*, plural *muroi*) in *Parts of Animals*; so developed in fact that the English sense of "part" is simply inadequate to communicate it. So I will explain it, and henceforth use the term *meros* to designate what Aristotle means by part. Aristotle's notion of *meros* is a critical concept for the development of AST, and after I develop what a *meros* is, it will be possible to tease out an Aristotelian complexity theory.

A *meros* is obviously a "part", but part takes on a more significant meaning in *Parts of Animals*, because the *meros* is like a mini-substantial being. Above we mentioned that the substance in Aristotle's thought is not just some hunk of matter, it is a complete form that has a purpose. In biological systems, organisms are substantial beings. A *meros* is like a substantial being in that the causal model aptly applies to it. Each *meros* has a form, has material, has at least one function that it accomplishes, and is, in Rom Harre's terms, a "powerful particular"--it acts. A *meros* is unlike substantial being in that its existence depends upon the whole organism. All the processes in substantial being go to support substantial being.   For example, an eye is a *meros*. If an eye is plucked out of its socket it ceases to see. Thus, while its structure remains the same, it has been removed from substantial being, and thus is no longer an eye, in that the end of an eye is to see, so at least in terms of its *telos*, it is no longer an eye (640a 3-4). Again, substantial being is Aristotle's way of describing what the term "organism" refers to today.

Because of the relationship between *meros* and substantial being, Aristotle writes "the body is an instrument [Greek: *organon*] (each of the parts is for the sake of something, and likewise also the whole)" (642a 11-13). But by this phrase, Aristotle does not suggest that the parts each have the same function as the whole. He understood that if a whole animal has a teleological cause, then every part—in contemporary terms: organs, tissues, cells, organells, etc.—must each have a teleological cause. Each organ has a purpose for which it matures. It is tempting to say that the purpose of the whole body is the purpose of the part, but we must avoid that temptation. Aristotle thought (and many have disagreed)

that the teleological cause of the human is *eudaimonia*,[175] but that reality about the human does not mean the teleological cause of the heart, lungs, intestines, or brain is *eudaimonia*. The human heart's teleological cause is to pump blood, not seek for the best kind of *eudaimonia*. In fact, if a human heart were to seek *eudaimonia* (in the way Aristotle uses the term[176] in *Nicomachean Ethics*) it would spell the end of *eudaimonia* for its owner. The heart should not seek happiness. It needs to pump blood, and if it does all the other organs will flourish. Each organ has purpose, in Aristotle's view.

It is a reasonable conjecture to say that Aristotle would have rejoiced in our modern scientific instruments. His observations, by our standards, are certainly crude. And much of the underserved mockery his reputation endures in scientific journals is due, not to a lack of brilliance, but to a lack of technology. Modern scientific advances and discoveries show that a charitable reading of Aristotle's insights can be applied again and again. For an example of this application consider: the heart is a *meros*, but so are each functionally identifiable muscle layer, each cell within that muscle layer, and each organ now with in each cell.

Aristotle's interest in the causes of the parts of animals demonstrates that he did apply his theory of the four causes to the parts of animals; thus, it is fair for me to challenge Aristotle on two counts: firstly, it seems to me that a thing can have more than one teleology. Secondly, it would seem there are in fact five causes.

Regarding teleology: at least in the case of *meros* (for simplicity's sake I shall leave out substantial being for the moment) there is no reason why a *meros* cannot serve multiple teleologies. We certainly see this in the human body. Bones give support to the body's structure, and they also make white blood cells. I would argue that both teleologies are equally important. The lungs bring oxygen to red blood cells, but they also expel carbon dioxide from the body. Fingernails protect the tips of the fingers from injury, but also really help when one tries to pick up one's keys. The hair atop the head protects the head from sunlight and also from injury through moving the body to quick reflex action as a result of stimulation by objects near one's head. This is not to say that every single part of the body must have a multiplicity of teleologies. But, in terms of developing a complex systems theory, the fact of multiple teleologies is overwhelmingly important. Because complex systems are made up of parts that can have many different functions, it is often difficult to understand the system because of all the possibilities.

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[175] *Eudaimonia* is translated into English as "happiness," but the word is more fully understood by the added concept of "flourishing." Aristotle includes with his definitions of happiness, things outside what the English word happiness would suggest—for example, Aristotle includes a full life, full of good friends, good children, wise children, honor, health and wealth (1360b 4-1362a 14). Aristotle also includes as part of what develops this "flourishing" the development of moral and intellectual virtue (1102a 5- 1103a 11).

To my knowledge, Aristotle does not say that objects have multiple teleologies, but he emphasizes the single end of items toward the ultimate teleology, the prime mover. Thus in a sense everything has the same teleology for Aristotle. Aristotle even ties the prime mover to the motion of animals (see Aristotle's short tract *On the motion of animals*). But taking this statement in isolation obscures the rich implications of the interconnected work of the *meroi* within the single substance of the whole universe. It would seem that, in Aristotle's initial schema (which I am not necessarily adopting for the present study) the universe has a single purpose, bound up in the prime mover. However, his doctrine of the *meroi* implies that *meroi* could serve the overall single purpose of the substance by having an "antithetical" local teleology, or teleologies. The heart illustration used earlier would be an embodiment of this principle.

The question of teleology gets all the more complicated when *meroi* work together on a single teleology, or even multiple teleologies. The teleological cause of the heart is to pump blood, while that of the lungs is to get oxygen into the blood stream. Notice, however, that the both of these organs are devoted to acquiring a material cause necessary for the operation of other organs, and they synergize efficient causes for that teleology to be accomplished. If the heart did not pump blood, oxygenated blood would not get the rest of the body. Thus, if one wishes to be complete, it is not enough to say that the lungs bring oxygen into the body for cell respiration. Of course one could go into greater detail here, but this brief account will suffice. C Consider another example: the intestines also acquire a material cause, or rather a number of different material causes for a number of organs in the body, but they also expel waste.

Furthermore, in one sense, each of these organs receives information from a single formal cause, namely DNA, but in another sense, they do not. The information on the DNA strand[177] must be managed by special information processing enzymes so that the wrong part of the blueprint does not make the wrong body part at the wrong time and location within the body. DNA is a library of blueprints, each plan well fitted to the others. In a sense, DNA is a single formal cause; in another sense, it is many different formal causes, and as such it satisfies both the formal cause of the organism as well as the individual organs, tissues, and cells.

In addition, the brain acts as an efficient cause for a number of systems of the body. It may seen like the goal of the brain is *eudaimonia*, but such a goal cannot be pursued by the brain itself. *Eudaimonia* only applies to the person as a whole, and is not reducible to being confined in only one part, like the brain. In fact, only by serving as the leadership hub

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[176] See previous footnote.

of the body, can the brain ever hope to share in Aristotle's vision of happiness. In Aristotelian terms, the brain is a very complex system. Following his analysis of an animal and its parts, the body has a number of parts, but those parts can also have parts. The brain is a part with parts. Not only is it an organ, but it functions because it, in itself, is a network of related tissues, that form substructures within the organ of the brain; in a way, they are sub-organs. Each of these parts and sub parts (including cortical regions), down to the level of each organelle, has its own teleology, form, material, and so on

As if the brain weren't complicated enough, its network is a *meros* that, as best we know, does not include the glia cells and other support tissues, yet as a network it also employs sub-networks, which (as mentioned in chapter 2) cannot even conceptually be removed in such a way that they function as they would within the brain. Here are more *meroi*, and we could continue this mental dissection all the way down to the level of neurons, and organelles.

On top of the physical structure of the brain, the separate impulses--the information processed by the brain--are *meroi* travelling over *meroi*. Although these two kinds/sets of *meroi* are of different types, one electrochemical, the other the organic substrate that transfers the information, each cannot wholly be removed from the other conceptually to be understood. The great debates in cognitive science seem to rage over the second kind of *meroi*. Aristotle's term *meroi* here is especially helpful, for it reminds us that the local process of one region in the brain cannot be segregated wholly and understood, for it is a *meros*, and not a substance. What is more, even the whole network, if understood as network only, would only be the anatomy of a single *meros*, and not substantial being. Its teleologies in substantial being are unknown, unless the relationships between the *meros* and substantial being are understood. Treating the *meros*, as though it is separate from substantial being may be a helpful methodology. After all, *Parts of animals* is just such a study. However, Aristotle is quick to point out (so quick that he places Book 1 before all his research to make sure his reader does not forget) that the causes of the parts of animals necessitate that all the causes be understood in the context of the substantial being, or in our terms: the *organism*.

Clearly, *meroi* can have multiple teleologies, but what is more remarkable is that substantial being can also. Aristotle argues that an individual's teleology is *eudemonia*, but an individual who is a biologically substantial being may also be a *meros* in another system. A man can also be a father in a family. He can be a citizen in a state. He can be a buyer in an economy. Very likely, he is a speaker in a language community. In each system he can

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[177] In one sense, a strand of DNA is a single molecule. In another sense, it is many.

serve a different purpose while being the same individual. This quality of biological substantial beings, that they have multiple teleologies within the systems in which they participate, helps to account for the quality that John Searle observes about human behavior – that human actions cannot be directly correlated with particular bodily movements (1984, 57). Put simply, we can do more than our bodies can do, and I am suggesting this is true, in part, because we have a plurality of function within a number of different systems.

At any rate, we may now formulate an AST. Following Aristotle's analysis of form, every part of the animal contributes to the building of the whole animal and is drawn to the final cause, (without contradicting my previous case that substantial being can also be *meros*), which occurs when the organism aims at its own final cause or causes. It is by fulfilling its own final cause that it brings the whole to its final cause. Within the creature (and form) of which it is a part, it must first perform its function and bring causes to the other parts of the body. Thus in Aristotle's approach to the causes of the parts of animals, the animal is a tapestry of woven causes, a complex system of divergently formed parts – each doing its job and ignorant of the whole – that are at the same time equally "of the whole," a single form moving to its final cause. So, it follows that *Parts of animals* may be the first scientific text on complex systems.[178]

Aristotle summarizes what I have outlined in this chapter in his conclusion to *Parts of animals* Book 1:

> Since every instrument is for the sake of something, and each of the parts of the body is for the sake of something, and what they are for the sake of it a certain action, it is apparent that the entire body to has been constructed for the sake of a certain complete action…. so it is clear, then, that whenever there are actions that are for the sake of other actions, the things whose actions they are differ in the same way that their actions do. Similarly, if some actions are in fact prior to, and the end of, others, it will be the same way with each of the parts whose actions are of this sort. And thirdly, there are things that are necessarily present because others are…. and so it is with the other parts as well. (645b 15-33)

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[178] *Complexity theory* is a term which can be used to refer to mathematical complex systems study, the study of complex phenomena and the study of emerging systems which may or may not have an apparent purpose. Aristotle's theory of complex systems does relate teleology to the substance and *meros* of complex systems, but as chapter 6 explains teleology is treated here as a heuristic concept which unites other causes into a singular concept for the purposes of understanding.

Aristotle here summarizes the relationships between the whole and the various parts that support the action of the whole. When the organism undertakes a specific action, it is also necessary that the parts of the whole also act, but their action is prior to the action of the whole. It is also the case that some actions are the end of other parts. Thus the parts make up a system in which some parts are causally prior to others, and subsequent to others, the various processes feeding one another. In a very condensed explanation, Aristotle summarizes what this chapter has explained in detail.

It also follows that, if Aristotle is right, the labour of modeling a complex system is intrinsically bound up with understanding the limits of a substantial being's final cause/causes and the final causes of its parts.

6. A FIFTH CAUSE—THE INSTRUMENTAL CAUSE

In complex systems, it is often difficult to locate a single efficient cause for an event. It can also be difficult to establish exactly when an event begins and ends. As Aristotle mentions, above, in substantial being the *meroi* contribute to one another. This means "that whenever there are actions that are for the sake of other actions, the things whose actions they are differ in the same way that their actions do" (645b 28-30). Each action in substantial being must be performed by a *meros* structured for such work to contribute to other *meroi* in the system. For example, the reason why a muscle cell aerobically breaks down one molecule of glucose into 36 ATP[179] is that red blood cells carry oxygen from the lungs to that muscle cell. If the red blood cells were not ready and waiting, the lungs could never provide oxygen to that muscle cell. Furthermore, if the vascular system of the body was not ready and waiting to carry those red blood cells from the lungs to that needy muscle cell, it also follows that the muscle cell would not get the oxygen it needs. Thus, red blood cells and arteries serve the muscle cell by bringing it nutrients that it needs. But one must ask, are the nutrients a material cause or are they an efficient cause? Material cause does seem more appropriate—yet they bring energy and energy seems better organized under the rubric of the efficient cause. This dilemma, I would argue, is evidence for the earlier point, that the four causal model is a hermeneutical tool for opening causal relationships to understanding, referential in the way that Brown and Ricoeur maintain (see chapter 1) but some ontological schema that binds each element to fit into only one of the categories. But the application of the model requires care. Complex systems analysis requires the researcher to wrestle with these sorts of problems.

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[179] Of course 2 ATP are formed through glycolysis during the Krebs cycle, but glycolysis is anaerobic.

When *meroi* function according to their peculiar function, supporting the life of substantial being, they inevitably engage in serving one another as instrumental causes that supply resources that other *meroi* in need. For this reason later supporters of the Aristotelian tradition coined a new cause, the *instrumental cause*[180] , or the cause of facilitation.

For some, the instrumental cause is a subset of efficient cause, however that classification does not account for the full range of supporting activities that instrumental causes serve. A hormone may act as an instrumental cause, being released from one portion of the body to communicate a kind of information to another part of the body. But certainly one may argue that a hormone participates in more of Aristotle's causes. Maybe, it is better to see the hormone more in the category of the formal cause, because *chemically* hormones and neurotransmitters, which accomplish different teleologies in different systems, could be formally identical. This returns me to an earlier theme about the ways that the causal model does not represent strict ontological categories, as though one needed to find all formal cause parts, all the material cause parts, etc. In fact, the curious interplay between neuromodulators and neurotransmitters appears to be one of an instrumental cause determining which of the four causes it's going to be. But this is to be expected within substantial being, where the *meroi* will naturally interact with one another to share material, structure, energy, and also, each of them becoming goals for the others for which the labours of the other *meroi* work to contribute to them. At this stage, I can at least suggest that the instrumental cause serves the operation of the other causes within substantial being.

The instrumental cause may seem like a grab bag of other causes; to some degree it is. However, it accomplishes something distinct which earns it the right to be designated as a specific cause, and the thing it does is facilitate. The instrumental cause also distinguishes biological substantial being from other kinds of being (such as rocks or gases). "[T]he body is an instrument [Greek: *organon*] (each of the parts is for the sake of something, and likewise also the whole)" (642a 11-13). Thus the body is an instrumental cause for any one *meros*. One might even say that organism is the activity of the instrumental cause in play.

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[180] Medieval and Reformation scholasticism, in large part, embraced some aspects of Aristotle's philosophy through the work of (for the Catholic Tradition) Albert Magnus, St. Thomas, and (for the Protestants) Francis Turretin. In Christian theology, the important question of the cause of salvation lead Medieval and Reformation theologians to try and answer the question of what causes salvation. Both agreed that God efficiently caused human salvation, but both Roman Catholic and Protestant theologians disagree on the instrumental cause of salvation, the Roman Catholics believing that the sacraments are the instrumental cause, and the protestants holding that faith is the instrumental cause.

One should not be surprised to find that in organisms a *meros* can be analysed according to the four causal model and, in doing so, its fifth cause--its instrumentality to serve other parts of the system can be identified. It is not wrong then to call a *meros* an instrumental cause itself, and that is the way doctors tend to talk about *meros* anyway. The heart pumps blood to the organs of the body. The kidneys purge the body of cellular waste, and so on.

Therefore, the *fifth cause* is the work of *facilitation* which requires the work of all four other causes. Like discourses relationship to *langue*, the fifth cause, is the four causes, but cannot be reduced to any one of them. Thus the fifth cause may legitimately be identified with the substance, without being reduced to any of its parts. The addition of the fifth cause permits us to further close the gap between the natural world, and the phenomenological world in which human's model.

7. THE POLYSEMY OF MODELING: A REFLECTION OF THE FIVE CAUSES

The instrumental cause may initially appear to complicate things considerably, and this is an accurate observation. Complex systems study is a complicated business; however, it may turn out to be one of those things that is paradoxically both complex and simple. One need only fear the added complexity of the instrumental cause if one cannot apply it clearly, and here Max Black may turn out to be quite useful (1962, 219-243). Black catalogues the various types of models in his essay "Models and Archetypes".

A review of the models Black discusses, along with some additions in model theory, show that models embellish (in the classical sense of embellishment) one or more of the five causes.

- *Scale models* retain the form but contract or expand, the material of the model. Our ability to distinguish scale models from, say, analogue models illustrates how the human mind employs something like an awareness of the distinction between material cause and formal cause, in the model building activity. One may make a hyper-accurate 1/6th scale model of the USS Constitution, down the planks, cannon, rigging, and captain's cabin glass. All the materials may be the same, and only the scale has changed. Nevertheless, human mind can still discern, though the model's material is identical to the original, that the form has contracted while the proportions have been retained. Such a set of relationships defines the scale model.

For an example of a pre-Tridentine expression of the conflict that gave rise to the codification

- *Analogue models* find points of formal sympathy between unlike things. They are able to find points of similarity. It should be observed that analogue models, though mostly formal analogues, can feature analogies rooted in any of the five causes. For example, homologous structures in living organisms may be studied using any of the five causes. For example, one can compare the bone structure in the human hand with the bone structure in the wing of a bird and notice in the wing structure an analogous wrist and finger like structure.

- *Mathematical models* aim to reduce form to formula, which is not to far from the later Plato's characterization of form. Mathematical models find ways to reduce the structure of a thing to a formula or some set of mathematical operations. It seems that the later Plato moved toward developing his theory of forms in terms of this kind of approach.[181] The reason for doing so, it would seem, is similar to why se do this today. Mathematical modeling holds the promise of more universal knowledge. Notice though that mathematical modeling is actually a conversion, where in the form is treated like a thing or collection of things (a kind of raw *material*) which can then be put through various operations.

- *Metamathematical models*, depending on whether the model is viewed as the mapping assignment (form) or the model that determines the assignment (matter), we have numbers treated as matter or form.

- *Scientific heuristic models* are instrumental causes that lead toward understanding. A scientific heuristic model establishes a relationship between the knowledge and the learner such that it moves his knowledge from a state of potentiality to actuality, which is how the instrumental cause functioned above. The planetary analogy for explaining the structure of the atom to grade school students is an example of this.

- *Scientific existential models* aim at an accurate description of what is, which is the aim of the causal model to begin with. Thus the causal model is one of these.

- *Scientific theory as "model"* acts as an efficient cause to reconstrue data, for better or worse. Hopefully for the better.

- *Paradigm models* are teleological, giving examples or goals of what will be, of where the process is headed. In the first chapter I gave the example of Michael Jordan. For many young basketball players, Michael Jordan is a paradigm model

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of a distinct instrumental cause see Book III.14.17, pp 784 of (Calvin 1960).

[181] In Plato's *Meno*, Socrates walks a young boy, for whom the dialogue is named, through the process of using reason to deduce a universal formula which he has not seen, but some how has experienced in the realm of forms (1924).

for the kind of basketball player they would like to be. A young basketball player
may be in the process of training, or practicing and dribbling, but he may be
willing to continue knowing that if he works heard enough he may achieve some
level of ability similar to that of Michael Jordan.

"Model", then, shows polysemy, both in the functional sense that we observed neural
systems displaying in chapter 3 and in the semiotic sense because its use is distributed
across all five causes. As we have seen in the catalogue of various types of models
summarized above, the polysemy of the enterprise of modeling is commensurate with the
five causes. This feature of the modeling enterprise suggests that modeling is a pluriform
cognitive labour, in which multiple predicative acts are being performed at once, which is
consistent with what we observed in the contrast between the way that visual information is
processed and the way that textual information is initially processed (from the discussion of
Changeux's rhetoric in the opening of chapter 3). This feature of modeling may now be
united to the apparently four-fold predication of the Metaphorical Square of Opposition
introduced in chapter 4. The Metaphorical Square of Opposition illustrates how four
propositions can be predicated in the same act, and occupy the same space of discourse
while not contradicting one another. Though this four-fold predication occurs in the simple
single-sentence metaphor, the event of multiple models being able to inhabit the same
interpretive space, or having a single model which inhabits the a space joining the various
types of models, permits them to be examined like one would adjust focus through the
multiple focal-planes of a microscope (see discussion near the close of chapter 1). We now
find that the five causes, and the polysemy of the modeling enterprise, are not irreconcilable,
but instead are part and parcel with each other, in one single hermeneutic project, a project
we will continue to develop in the following chapters.

8. NONLINEAR INSTRUMENTAL CAUSALITY AND TRAGIC MIMESIS

Black and others point to the heuristic value of models for facilitating understanding.
In other words, models are *instrumental* in moving the human mind from the stated
ignorance to state of understanding. However models are not self-contained. Mary Hesse
has shown that models redescribe a primary system through a better-known secondary
system (1966, 157-177). The primary system has its own parts, its own peculiar qualities, its
own boundaries. So does the secondary system. However, the model unites the two by
channelling the heuristic-affecting resources from the secondary system to the primary
system. At the same time, a model itself has boundaries. A model of a particular

phenomenon does not necessarily apply to all phenomena. One would be hard-pressed to invent a model of all things. Even if there were such a model, through that model's modeling activity it would, by definition, redescribe all things in terms of that model's activity, including the redescribing efforts of other models or modeling systems. Therefore, a model functions like a *meros*—and is itself an instrumental cause.

I noted, above, that *meros* functions like substantial being in that the causal model designates the whole *meros* as each of the four causes. A *meros* can be analyzed in terms of form, matter, agent, and *telos.* It follows that both *meros* and substantial being can be analyzed in terms of the causal model plus the additional instrumental cause. It is at this point that we can begin to bring complex systems to terms with hermeneutic phenomenology. Ricoeur shows that poetic mimesis corresponds "point by point" with the distinctions in Aristotle's causal model: material, formal, efficient, and final cause (1977, 38). "[T]hree of [the six parts of tragedy] have to do with the object of imitation (*muthos*, *ethos*, *dianoia*), two others concern the means (*melos*, *lexis*) and the last the manner (*opsis*)" (38), *katharsis* functioning as the *telos*—not a part but the goal of tragic *mimesis*. The analysis of this article adds to Ricoeur's enumeration since tragic *mimesis* also functions as an instrument to bring the audience to *katharsis*.

Ricoeur's keen observation about the applicability of the causal model to tragic *mimesis* and the discovery that model building also displays similar affinities to the causal model both permit a coterminous relationship to be established between the redescription of human action in tragic mimesis and the redescription of nature in scientific modeling. One finds the unity of these two enterprises, in its smallest reduction, in the single event of "metaphorizing." As we observed in chapter 1, metaphor is the smallest reduction of the redescriptive work of mimesis which is found in narratives.

It should be no surprise that "nature" (Greek: *phusis*) becomes in Max Black's terms an "archetype" or, according to Ricoeur, an "'operational' concept" (Ricoeur 1977, 333). In *Poetics*, Aristotle aims to conduct his inquiry "as is natural [Greek: *kata phusiv*]," and takes as his measure of beauty "the actual nature of the matter," and so on (1995, 1447a 12-13 and 1451a 9, respectively). Nature then acts as an archetype for Aristotle, a source for model making. Again, we should find no surprise that the five causes should show up in both natural substance and the multiple "level of focus" represented in the various types of models (see chapter 1 and the previous section of this chapter).

Furthermore, and in a different sense, tragic *mimesis*, like all narrative assumes a *phusis*, a natural order in which the narrative operates, and this order is a kind of a complex system. Narrative has the peculiar capacity of limiting its possible interpretations with the addition of plot, while also leaving its own narrative structure and the objects of the narrative

discourse open to being redescribed (to use Hesse's terms), a quality of narrative which will be discussed in greater detail in chapter 7. The semiosis of narrative is not endless; a narrative cannot be re-narrated, and re-narrated, and keep its identity, unless those who re-narrate are most faithful to the original narrative. This capacity of narrative makes it a powerful tool for a hermeneutic phenomenology of complex systems.

9. CONCLUSION

This chapter introduced Aristotle's systems theory, and brought it into dialogue with the categories of scientific modeling and Ricoeur's extended commentary on Aristotle's poetics in *Time and narrative*. We saw, in *Parts of Animals*, Aristotle offers a carefully articulated, well-developed complexity theory that may be applied broadly to complex systems, one well suited to inform Ricoeur's approach to discourse and narrative. Aristotle's notions of substantial being and *meros* permit the causal model to be applied at all levels of system hierarchy. The interplay of substantial being and *meros* necessitate the addition of a fifth cause to Aristotle's causal model. Furthermore, a strong coterminous relationship holds between scientific modeling of the physical world and *mimesis* of human action in narrative through application of the causal model to both domains. This coterminous relationship subsists in the human capacity to metaphorise, which is the basis for both activities. The uses of discourse and narrative to model complex systems will be the focus of the remaining two chapters.

The task remains for the next two chapters to summon the resources that are now in place to develop sturdy hermeneutic phenomenology of complex systems. The next chapter will extend Ricoeur's model of the text (chapter 4) in dialogue with complex systems study (chapter 2 and 5) and the metaphorical nature of scientific modeling (chapter 1) to the direct application of the model of the text to complex systems. The final chapter will apply the model of the text to neuroscience.

CHAPTER 6

The model of the text as a model of complex systems: part 1

He also said to the crowds, "When you see a cloud rising in the west,
you immediately say, 'It is going to rain'; and so it happens.
And when you see the south wind blowing, you say,
'There will be scorching heat'; and it happens. You hypocrites!
You know how to interpret the appearance of earth and sky,
but why do you not know how to interpret the present time?
Luke 12:54-56 NRSV

1. INTRODUCTION

In the introductory quotation at the beginning of this chapter, the author of Luke's
Gospel portrays Jesus of Nazareth as speaking to the common people regarding the
relationship between complex natural systems and cultural symbol systems. He speaks this
remark to the "crowds" showing that the comment applies not only to scholars or
philosophers, but to the common faculties of all people, fitting what Aristotle calls at the
opening of his *Rhetoric* "the general ken of all men" (1354a 3). In the passage, Jesus of
Nazareth makes a moral observation regarding the hermeneutics of complex systems. At
the beginning of the cited passage, he reminds his audience of both their capacity and their
success in interpreting the behavior of a naturally occurring complex system, the weather.
The people of his day were able to tell from general regional cloud formation and movement

whether rain would come or not, with a success significant enough for the author of Luke's Gospel to portray Jesus of Nazareth as having said this without destroying the *ethos*[182] of Jesus of Nazareth as prophetic figure and sage. Not only can the audience predict rain, but also "scorching heat." On the basis of his audience's facility of interpreting "the appearance of the earth and sky," he indicts them for not being able to interpret "the present time."

What is fascinating about this observation, especially as it is relayed to us through the mouth of Jesus of Nazareth, is that the "present time" he is referring to can be none other than his own time. The crowds are supposed to be interpreting the present time of Jesus of Nazareth, and they are apparently unable to figure out the signs of what is happening. Even a cursory reading of Luke's Gospel would be hard pressed to miss that the Jesus of Nazareth that this author represents clearly thinks that his own work in the vocation of a prophet is the most important thing happening in his "present." Curiously though, the only way the crowds would know who Jesus was, at least on the terms given in Luke's Gospel, is if they were familiar with several of the Jewish holy texts available at the time. Thus, the interpretation of Jesus' "present time," which would require the interpretation of Jesus of Nazareth, is only possible through the interpretation of texts.

It follows then that the Jesus of Luke's Gospel thinks that if one can interpret the movements and functions of physical systems in nature, then one should be able to interpret the movements and meanings of cultural systems. This anecdote from a famous religious text illustrates the central thesis of a hermeneutic phenomenology of complex systems. The work of textual interpretation and the work of interpreting complex physical systems share some common ground.

This chapter and the next will disclose the outline of a hermeneutic phenomenology of complex systems, for the purpose of situating brain science within hermeneutic phenomenology. The present chapter will bring Ricoeur's model of the text to terms with complex systems, and the following chapter will apply the model of the text though narrative to complex systems, so that hermeneutic phenomenology can bridge the gulf between phenomenological time and the aporia[183] of time through narrative. The conclusion of the following chapter will apply this hermeneutic phenomenology of complex systems to Changeux's five advances of neuroscience.

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[182] *Ethos* is used here in the sense that Aristotle uses it in his *Rhetoric.* Aristotle writes, "Persuasion is achieved by the speaker's personal character when the speech is so spoken as to make us think him credible" (1356a 4-6). Aristotle later goes on to give three ways that a speakers cultivate his *ethos*, by showing (1) good will, (2) good moral virture, and (3) being knowledgeable or wise. It is this third area of ethos which I am highlighting here (1378a 6-19).
[183] *Aporia* is Ricoeur's own word choice which he applies to several of the various problematics of considering natural time as distinct from the phenomena of time experience (1984, 5-30).

The present article has but one ultimate purpose, to show how to extend Ricoeur's hermeneutics of human action to complex systems. I will show how this is possible by moving through five stages of argument, each building on the previous stage.

First, I will bring hermeneutic phenomenology to terms with neuroscience by showing how Ricoeur sympathetically engages with concepts at the joints of the three major approaches to cognitive modeling, namely the computational, connectionist, and Artificial Life models. Part of this stage will be helped by the work of Paul Cilliers who finds an analogy between neural networks and the relationship between signs in natural language.

Second, I will detour through structuralism and poststructuralism, via Cilliers's work, explaining how Ricoeur's theory of discourse adds a second signification that cannot be reduced to the interplay of signs in language, while at the same time being made from parts in the system of language.

Third, following the discussion of the second signification of discourse, I will suggest an analogy be made between function as the teleology of an event in a system and meaning as the teleology of discourse. This will be a suggestion, rather than a demonstration, because an extended defence of teleology is beyond the scope of this already lengthy chapter. Instead I will give warrant for this by tracing its success when applied to complex systems.

In the fourth and most decisive stage, I will show how Ricoeur's warrant for applying the model of the text to human actions also applies to the events in complex systems. The whole of my case rests upon this move.

Finally, I will address the problem of establishing the boundaries of complex systems, showing that it is possible to characterize a complex system and its functions without having exhaustive knowledge of the system. Throughout the article I will offer examples, even from complex systems other than the brain. I do this in order to show that the principles that underlie a hermeneutic phenomenology of complex systems do not require special pleading.

At several points in this chapter I will refer to *representation*. Unless otherwise noted in the context of the discussion, I define representation in several ways depending on how it is used as a part of speech. If a noun, then *representation* is a thing which refers to something else, though I'm not specifying the mechanism by which a thing refers, though this thing either is or is somehow related to a *mind*. If a verb, *to represent* means the act of a thing referring to something else. The quality of *referring* is carefully chosen, for a thing can refer to something else as the product of discourse which distanciates from the original event of discourse and is used latter by another mind to refer in ways that were not intended to designate a referent in its first use.

Before launching into the case I will present in this chapter, it will help to reiterate the difference between the positions of Paul Ricoeur and Jean-Pierre Changeux in *What makes us think?* (Changeux 2000). Ricoeur is careful not to define his position in a way that would allow phenomenology to be collapsed into a description of brain events. Ricoeur takes his stand on the position:

> …that these discourses [phenomenology and neuroscience] represent heterogeneous perspectives, which is to say that they cannot be reduced to each other or derived from each other. In one case it is a question of neurons and their connections in a system; in the other one speaks of knowledge, action, feeling—acts or states characterized by intentions, motivations, and values. I shall therefore combat this sort of semantic amalgamation that one finds summarized in the oxymoronic formula "the brain thinks." (Changeux 2000, 14)

Ricoeur's move puts hermeneutic phenomenology in a difficult position, a kind of intellectual closet. He certainly limits phenomenology from infringing on brain science, but nothing prevents the reverse. In *What makes us think?*, Changeux diminishes the effectiveness of this move by presenting neuroscience as a discipline *advancing* beyond the confines in which Ricoeur places it. Changeux presents five "advances" of neuroscience (2000, 41ff). First, he claims that the brain exhibits intentional behavior; it projects its beliefs onto its environment. In short, the brain has intentionality. Second, he points to neuropsychology, through Paul Broca's development of lesion studies, which correlates function with the topography of the brain. Third, brain imaging now permits us to see the brain in action while a person is performing various tasks to study what parts of the brain are *most active* during the task. Fourth, electrophysiology, the study of the electrical properties of cells through the use of very precise invasive means, like very fine electrodes, confirms that cells in regions highlighted by brain imaging appear to be electrically active. Finally, a strong connection has been established between brain chemistry and mental states, such that some emotional states can be controlled for a time.[184] Changeux insists that these support the conclusion: "Consciousness occurs in the brain" (2000, 52).

This point Ricoeur vehemently rejects:

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[184] From a neurophysiological perspective, it does not appear that emotional states can be reduced merely to the use of specific neurotransmitters, which is what the hermeneutic phenomenology of complex systems would predict. Psychiatry's extended history has shown the difficulties of

I do not understand what it means to say "consciousness occurs in the brain."
Consciousness may know itself -- or not: this is the whole question of the
unconscious -- but the brain will forever remain an object of knowledge; it will
never belong to the experience of one's own body. The brain does not "think"
in the sense that thought conceives of itself that you, as a neurobiologist,
conceive of the brain. (Changeux 2000, 52)

Here Ricoeur maintains that consciousness must be understood in the way it presents itself
to the conscious subject. Phenomenologically, a brain does not become conscious of itself,
rather people come to know their body as a body, Thus, the body, and the brain in particular
become objects of study, objects of which one can become conscious. Ricoeur is adamant
that the brain as a physical object is not conscious of itself. Changeux is quick to retort "of
course -- but thought cannot conceive of itself without the brain!" (Changeux 2000, 52).

Changeux seizes the high ground of the debate by pointing to the success of
neuroscience. Ricoeur attempts a reply to Changeux, but is not able to interact with
neuroscience directly because of his stated position that neuroscience and phenomenology
cannot interact[185], though he agrees they are inseparable. I will argue here that Ricoeur's
hermeneutic phenomenology can interact with neuroscience without reducing
phenomenology to physical states in the brain. This use of Ricoeur's work is possible
because hermeneutic phenomenology has the potential to generate a hermeneutic
phenomenology of complex systems. Put briefly: Ricoeur's model of the text and its
application to the exegesis of human actions may be extended to the study of complex
systems through Ricoeur's work on metaphor and *mimesis*. This will be necessary to do
because the brain itself is a complex system. If I can show that complex systems can be
modeled through hermeneutic phenomenology, and if the brain is a complex system, which
it is, it follows that hermeneutic phenomenology can model the brain.

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consistently regulating mental states, and that the practice is more art than science. For more detail
see Breggin (1994, 2000, 2001).

[185] Ricoeur thinks that neuroscience and phenomenology cannot interact because neuroscience
studies a physical object, the brain, while phenomenology studies the mind and the objects of
consciousness as known by persons. Thus the object of neuroscientific study is a mechanism not a
person. I belive Ricoeur's statements about the inability for neuroscience to interact with
phenomenology must be understood in the context of his debate with Changeux's reductionism. He
envisions neuroscience as a discipline which treats the brain as a mechanism to study, while
phenomenology assumes at all levels that a person is in fact conscious and present in the process of
thought. For Ricoeur, their interaction assumes a reduction of personhood to brain states. The
purpose of this dissertation is to remain within Ricoeur's philosophy, while at the same time
challenging, taking issue with this dichotomy, which in my opinion results from Ricoeur not taking full
advantage of the resources of his hermeneutic phenomenology.

2. STAGE 1: BRINGING HERMENEUTIC PHENOMENOLOGY AND NEUROSCIENCE TO TERMS: PART 1—SIGNS AND SYMBOLS

To bring hermeneutic phenomenology to terms with neuroscience I will focus on the theme of signs and symbols, evident in both the computational theory of mind, and in Paul Cilliers's identification of the poststructural analogy between neural networks and the symbol systems. In order to do so, I will now discuss both the connectionist and computational views. Instead of taking a short route to directly addressing brain science, we will thus begin by developing an approach to complex systems in general, and make sure that a hermeneutics of complex systems applied to brain science is not a case of special pleading.

The natural world and the human cultural world are filled with complex systems, and these systems should be distinguished from very complicated systems (see chapter 2). In nature, one finds ecosystems and biological systems of remarkable complexity. In the human world, natural language and economies also exemplify complex systems. The human brain is an especially intriguing case, because it would seem to be a member in good standing in both classes, creating the issue that this chapter addresses. Complex systems are tautologically complex, so it is important we start with a provisional definition of a complex system. For Paul Cilliers, a complex system consists of (1) large number of elements, (2) the large number being necessary but not sufficient, (3) interacting richly (4) and non-linearly, (5) generally in short range interactions, (6) with interaction loops (1998, 3-5). These systems are (7) open, (8) operate under conditions far from equilibrium, (9) they have a history, (10) once each element in the system is ignorant of the behavior of the system as a whole (for an extensive discussion of these points see chapter 2).

If one wants to model complexity, one must have a model that can approximate the complexity of the system being modeled. Since one important function of models is that they provide a heuristic guide, a means of understanding the thing they model, it is also the case that "The general description of complex systems will be influenced by the models of complexity. Such models must share the characteristics of the systems they model" (Cilliers 1998, 12). As we observed in chapter 2, if one models a complex system with a simple model, the very thing which gives the system its defining characteristic, namely its complexity, is removed. Hence the simple model is not modeling the complex system it purports to model. So, a curious relationship holds between complex systems and their models; how one models the system will affect how one defines the system. Even at the outset of our project we find a hermeneutical circle. Recall that in chapter 4 and chapter 5 it was shown that a hermeneutical circle applied both to textual interpretation and the interpretation of physical systems. Therefore we should not be surprised to see that the

source domain (see chapter 1) for modeling the target domain of a complex system is very important. Since the source domain in this case is the model of the text, I will follow Ricoeur's own method –I will detour through Cilliers's work, which supports correspondence between structuralism and neural network architecture. Cilliers's insight will help bridge the cleft between the model of the text and the complex system of the brain.

Cilliers's counsel should certainly encourage one to be careful to choose a source domain that promises the richest resources for such a task. The interpretive models of brain science present some direction for the mission of modeling complex systems, because brain science has been a significant locus of complexity study over the latter part of the 20th century, offering three primary models for interpreting brain data: specifically the rule-based, connectionist, and Artificial Life approaches to understanding human brain function. In what follows I will briefly explain each approach and then bring it to terms with hermeneutic phenomenology.

2.1 RULE-BASED MODELS AND THE SIGNIFICANCE OF SYMBOL

The rule-based model, commonly applied in the cognitive science of the mid to latter 20th century, found its origin in the Turing Machine, a hypothetical device that calculates by placing symbols onto a potentially infinite strip of tape, representing a single linear computing space. Hypothetically, a Turing machine can calculate any solvable equation, so long as the equation could be solved in a finite amount of time. The Turing Machine gave a model for the initial research in Artificial Intelligence. Hillary Putnam (1975) and Jerry Fodor (1975), took the Turing Machine as a model for human brain function. Putnam suggested that the Turing machine and some system randomness was enough to account for the human mind (for more on this point, see the extended overview in chapter 3) (1975, 102-3). Fodor, on the other, hand employed Chomskian linguistics with the Turing machine to argue for a mental language computationally sorting linguistic signs in accordance with a universal grammar.

The rule-based model has come under heavy criticism, notably from Putnam (1988) and Fodor (2000) themselves, but also many others. Instead of repeating these criticisms (see Chapter 3), I will turn to the important feature of rule-based systems that is significant for the task of modeling complex systems. But I will introduce it by revisiting Searle's Chinese Room. Searle gives the hypothetical situation: he is locked in a room with a rulebook that explains how to manipulate Chinese symbols into phrases (1980). He is handed Chinese symbols and follows the book to arrange these symbols into Chinese sentences. He then hands these assemblies of symbols to people outside the room, who

know Chinese and can read the sentences he assembles. He, though, is ignorant of what these assemblies of symbols mean. Searle suggests that this room is like a computer. A computer assembles and relates symbols but does not "know" what the symbols mean. Thus, he argues, computers lack intelligence, since they do not know.[186] Though Searle uses the Chinese room against Artificial Intelligence, later R. van Gulick uses the Chinese room against the computational theory of mind (1988).[187]

As discussed in chapter 3, Searle's Chinese room shows raises the significant criticism that rule-based approach does not *know* the symbols they use. A machine that employs the rule-based approach can perform operations, but it does not understand the symbols it uses. Even though the Chinese room points out the weakness of the rule-based model, it also draws attention to an important strength of the rule-based approach. *The rule-based model takes symbols seriously*. The reason why John Searle can attack the rule-based model is that symbols, and simple manipulation, are central to Artificial Intelligence (see chapter 3) and thus they are important in the computational theory of mind. Well why are symbols so important to the computational approach? The reason may be traced back to the developments of symbolic logic (see Devlin 1997) at the end of the 19th and the beginning of the 20th century. Keith Devlin shows how turn-of-the-century logicians, inspired by nineteenth century symbolic-logic pioneer George Boole's *An investigation of the laws of thought on which are founded the mathematical theories of logic and probabilities* (1958), wanted to distil the essence of logical thought without the muddiness of natural language, which is the central focus of Boole's project (Devlin 1997, 72-95). They constructed formal languages in order to eliminate equivocal discourse in favour of univocal expression. This important research project led to many benefits, not least of which is the conceptual framework that made computer programming languages possible. Moreover, the development of the Turing machine gave inspiration to scientists to connect machine and code, making a powerful tool with a functional polysemy (see chapter 3). The problem that faces us today, also the problem that Keith Devlin (1997) draws attention to, is that human thought does not seem to fit neatly into univocal symbols; for this reason, the rule-based approach does run headlong into problems (see chapter 3).

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[186] Searle explains that the Chinese room does not refute the possibility of any computer ever being intelligent, since even a door could be defined as a computer as it has a 0 (closed) and 1 (open) position (1994). Searle is willing to leave open the possibility that some technology, unknown to us at the present, could possibly produce AI. Rather his argument deals with strong AI employing symbol-based computation, which is what the computational theory of mind advocates. He criticizes symbol-based AI because, in his view, the computer does not know the symbols it is using. It merely performs operations with those symbols.
[187] For a more careful, and antagonistic discussion of the Chinese room see Dennett (1991, 435-40) and Cilliers (1998, 48-57).

The challenge that faces the manipulation of symbols in a rule-based system is that, in the end, there is no difference between the manipulation of symbols and a mere mechanistic process. This is the problem that Searle identifies, and the problem cannot be solved by giving s the symbols used in a computational mind some equivocal or plurivocal qualities. Put ten-speed gears on a single gear bicycle and one still has a bicycle. However, to humans, the symbols in formal systems *do* mean something. Because they have meaning, a meaning that we assigned to them, we can use them to accomplish things in the physical world. When programmers get sloppy and permit equivocal rules or symbols, problems will occur. Humans have the abductive capacities[188] necessary to scope both the symbols and the rules that guide the behavior of the symbols. It is though they can see over them both, and therefore discover how to use them more effectively. This capacity to not only manipulate but to understand symbols makes it possible for humans to build and program computers. Ironically, the computational theory of mind employs the computer in a way removed from the narrative (*mimesis*₁) of its origin and holds it up as a model of its maker.

Ricoeur identifies the stark difference between symbol as defined by symbolic logic, and symbol as tool in philosophical reflection. In *Freud and Philosophy*, before discussing the use of symbols in Freud's work, Ricoeur must first deal with the demands imposed on symbols by symbolic logic (1970, 47-56). Ricoeur distinguishes between "symbol" as characterised by symbolic logic and "symbol" as that which is open to the philosophical analysis of hermeneutics. Ricoeur contrasts the *equivocal* quality of the symbol open to philosophical analysis, with the *univocal* symbol of symbolic logic which is closed to philosophical analysis. After Ricoeur's work on Freud and his encounter with structuralism, Ricoeur will develop this notion of the equivocal symbol into his notion of polysemy (1974, 62-78).[189] The hermeneutics of symbols must, at times, wrestle with equivocation (or more specifically, polysemy) in symbolic discourse. The logician who holds the univocal language of symbolic logic as his standard for cogent discourse will immediately reject the hermeneutics of symbols as illogical. Ricoeur replies:

> The important status of symbolic logic obliges us to say something about this
> counter, which at the very least constitutes a strange hegemony: the

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[188] Jerry Fodor uses the term "abduction" to describe the ability of the human mind to "see over" the work of problem solving to locate the right mental resources to find solutions (2000, 41-53). This problem is analogous to the "frame problem" in Artificial Intelligence. Fodor argues convincingly that neither the computational theory of mind nor the connectionism has the resources to explain the globality of human cognition, that it somehow is aware and has access to use the mind's beliefs, and the survey mind as part of problem solving during the process of reasoning.

obligation is all the more pressing in view of the fact that [I have already]

constantly alluded to the duality of univocal and equivocal[190] expressions

and had implicitly assumed that the latter can have an irreplaceable

philosophical function. (Ricoeur 1970, 48)

Ricoeur replies that hermeneutics seeks "the very nature of reflective thought, the principle

of the logic of double meaning[191], a logic that is complex but not arbitrary, rigorous in its

articulations but not be reducible to the linearity of symbolic logic" (1970, 48). For Ricoeur,

the thought that there can be two different logics residing on the same level must be

rejected[192], because it "can only lead to the elimination of hermeneutics by symbolic logic"[193]

(49). Ricoeur suggests that the hermeneutician has three recourses when confronted with

symbolic logic: first, stand the essentially oral[194] symbol against the mere written symbol of

symbolic logic; the oral symbol is one emplotted, one told by a narrator. Ricoeur moves the

hermeneutics of symbols into the realm of human discourse, and away from the operational

procedures of a mathematics-like calculus. Humans's symbols have history and context, and

that context aids in the interpretation of those symbols (49). Second, interpretation aims at

understanding the richness in ambiguity rather than suppressing it. The ambiguity, or what

Ricoeur eventually came to call the polysemy of the symbol forces one to seek

understanding of the referent of the symbol and to question ones initial assessments of a

symbols meaning. Finally, in contrast with the emptiness of logical symbolism, the

"symbolism in hermeneutics is full; it renders manifest the double meaning of a worldly or

psychical reality" (49).[195] Because the sensible sign of hermeneutics has its meaning

"bound" to it, through the context of its use by a narrator, it contains a rich fullness separated

from the level of its operation as a sensible sign. The complexities of this additional level of

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[189] For more on polysemy see chapters 3 and 4.

[190] "[E]quivocal" here is an anticipation of the concept of polysemy which Ricoeur will later define in was dialogue with structuralism (1974, 62-78).

[191] Double meaning here is the initial term Ricoeur uses to refer to the referential quality of an equivocal symbol. He uses this same term in the title of his article which introduces the concept of polysemy, which applies the insights of *Freud and Philosophy* to a structural view of *langue* (Ricoeur 1974, 62-78).

[192] For Ricoeur, symbolic logic and traditional logic (which he argues *can* engage symbolic discourse) cannot long occupy the same space, because symbolic logic was created to erase the ambiguity present in natural language. Therefore symbolic logic assumes a deficiency on the part of natural language, which the purity and formalism of symbolic logic is fashioned to correct.

[193] This same thing is what I see happening between phenomenology and neuroscience.

[194] Here Ricoeur is not undermining his later development of the model of the text. Rather, he is distinguishing the symbol that can never escape text from the symbol that can be used by a narrator.

[195] Ricoeur goes on to explain, "A confrontation which restricts itself to the symbolic texture of symbols and does not face the question of their foundation in reflection will soon prove embarrassing to the advocate of hermeneutics" (1970). I see a similar need for Ricoeur in *What makes us think?*.

meaning, separate from the given qualities as a sensible sign, distinguish the symbol from the "symbol" of symbolic logic which was created specifically to remove such ambiguities. The additional meaning which transcends the sensible sign opens a worldly or psychical reality of understanding and philosophical analysis. This state of affairs in not existent with symbolic logic, no polysemy of symbol pushes one toward understanding of the symbolic referent. No predication is needed, for the univocal symbol may *only* mean one thing. Such symbols do not need discourse to open their meaning, for their meaning is bound up wholly with the definition of the sign.[196]

By opposing the hegemony of symbolic logic, Ricoeur is not challenging traditional formal logic. But he does want to make clear that symbolic logic "does not represent a higher degree of formalisation; [rather] it proceeds from a global decision concerning ordinary language as a whole; it marks a split with ordinary language and its incurable ambiguity…. Symbolic logic despairs of natural language precisely at the point were hermeneutics believes in its implicit 'wisdom' " (Ricoeur 1970, 50). In fact, Ricoeur uses a logic of symbols to excavate the foundation of Freudian psychoanalysis. His meditation on the Freudian use of symbolism, and the interpretation of the human psyche in terms of the "text" of psychoanalysis, illustrates that the logic of symbols is not something other than traditional logic. Ricoeur's engagement of Freud most certainly employs traditional logic, and is a carefully reasoned work (1970). Such a method is exactly consistent with Ricoeur's explanation of his methodology which opens *Freud and Philosophy*. Ricoeur is reasoning about symbols in their hermeneutic fullness, which transcends their sensible sign, and opens worldly and psychical reality to philosophical reflection. The hermeneutic phenomenology of symbols makes available more resources for the rich methodology necessary for a philosopher to engage Freudian psychology. By contrast, the philosophy of language supporting Ayer's (1936) verificationalism, discussed in chapter 5 of this dissertation, would have slim resources for such a task. The fuller implications of a hermeneutic phenomenology of symbols entail, in one sense, the full task of a philosophical project which Ricoeur could only begin in his life span. In relation to psychology, philosophical reflection on the use of symbols in Freud opens the system of psychoanalysis to being exegeted and understood like a text. Ricoeur then works with symbols in the full sense in which humans use them, and not only within the computational or operational domains where univocal

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[196] Were this a larger project than a dissertation, I would argue that the symbols of symbolic logic are dependent on other definition sentenced which define the univocal meaning of the symbols of symbolic logic. That meaning then distanciates from the definition sentence such that the symbol is treated as though it has the meaning itself. Thus, symbolic logic establishes the utility of natural language, for its success is the prequiste and the constructive tool which assembles symbolic logic.

symbols are common. Later in this chapter I will show how this feature of hermeneutic phenomenology opens the opportunity for a greater capacity to model complex systems.

2.2 CONNECTIONISM, STRUCTURALISM, AND DISCOURSE

The previous section showed how Ricoeur's notion of symbol is very different from that used in symbolic logic, and by extension, the symbolic operations which must occur in the brain if the computational theory of mind is correct. However, the emphasis on symbols in the computational theory of mind show that the computational theory of mind takes symbols seriously, and that project should be commended. Connectionism also takes seriously the networked nature of a system, and this approach also has strong sympathies with Ricoeur's view of symbol systems as a whole. It will be the task of this stage to briefly reintroduce connectionism (discussed more fully in chapter 3) and then to bring connectionism into dialogue with structuralism (and to some extent post-structuralism) through the analogy between neural networks and structural/post-structural semiotics developed by Paul Cilliers (1998, 25-47). Also, here I will focus on highlighting discussion points that I will then develop further later on in this chapter.

Connectionism explains brain function as the operation of a network of various nodes that receive an input and produce and output. Connectionism takes its inspiration from the neuronal network physiology of the brain itself, which irrefutably does resemble a "network."[197] For the purposes of modeling, each neuron is represented as a *node* of a network. It is assumed, on the basis of good evidence, that a neuron averages the sum of its inputs. Each input has a particular "weight", calculated by the average of the sum of all inputs, and this average determines the output. While it may be appropriate to talk about individual neurons in terms of inputs and outputs, such a vocabulary is strained when used of describe real neural networks.

Real neural networks do not necessarily have inputs and outputs, a point raised by supporters of the Artificial Life research program. For example, Rolf Pfeifer and Christian Scheier observe that "The function of a neural network (natural or artificial) can be appropriately understood only if it is also understood how they are embedded into a physical agent, how the sensors and effectors, work, and who they are positioned on the robot. This goes beyond the pure information-processing capabilities of neural networks" (1999, 176). Pfeifer and Scheier make clear that studying only "pure information-processing" is not

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[197] Here, "network" refers to the common use of the word, "any netlike combination of filaments, lines, veins, passages, or the like: a network of arteries; a network of sewers under the city" (Dictionary.com 2008).

enough to understand a neuron, rather one must also understand the way the network is embedded in the robot or, as in the case of natural neural network, the creature. A connectionism which characterizes the function of neural nets in terms of programming[198] mischaracterises the work of neural networks, as Pfeifer and Scheier argue (1999, 110-111).

Consider the human experience of physical pain. Harmful, injurious stimuli activate different types of nociceptor terminals. Impulses travel up these nociceptor fibers to where they terminate in the dorsal horn of the spinal cord, meeting with five ascending pathways that carry information to the cerebral cortex, which, in turn, contributes to the processing of pain. It would seem that this process would be an excellent candidate for the input/output model of understanding neural nets. The noxious stimulus is the input, which travels up the interconnected pathways, and the sensation of pain is outputted in the brain. Simple enough. However, it is clear that the sensation of pain is not an output, for if the network is embedded in an organism, as in the case of the human agent, the pain impulse does not leave the network. There is no output.[199]

At best, the pain impulse can be said to affect a brain system state change, as evidenced by PET imaging (Basbaum 2000, 484-485). But it would be explanation on the cheap to call that an "output," since the *output* is supposed to be what is outputted by network process, not the network process which is generating the *output*.[200] Put another way, the output would be the *outputting*, changing the linear necessity of the input/output relationship.

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[198] Pfeifer and Scheier are not saying that a network cannot have an input and an output. They are saying that one must understand the input/output model does not *appropriately* describe the relationship of the network to embodiment, since inputs and outputs can equally be found in disembodied networks. If the same model (in this case the input/output model) is used for both embodiment and disembodiment without giving added insights into how the network handles its embodiment, then that model is not appropriate (in such an iteration) for understanding how a network *works* in its embodiment.

[199] One may argue that pain itself is the output. If pain is the output, then *output* is being used in a different way that the initial term *input*. If a noxious input causes impulses to travel up the nociceptor to eventually signal the brain, then input is understood as a physical signal entering the brain. The brain receives input. However, if the phenomenon of pain is the output, notice that *output* is now understood in a different way from *input*. In such discourse output is understood phenomenologically, in terms of human experience. While no mistake has been made to recognize the phenomenon of pain as present to human consciousness, the fact still remains that the signal has not yet been outputted from the network. It is still in the network. Perhaps there is a place in the brain that represents human consciousness, which would function somewhat like a computer screen, so that inputs could be represented on that "screen" as outputs, but so much effort has been expended in cognitive science to reject the notion of a homunculus, that it would be a great loss to slip back to it now. We need reason only a few steps to see how the input/output model, combined with the notion of the neural network as least seems to imply that there must be some sort of network within the network which is conscious and is the terminus of input, or else, one must jump categories, from the physiological to the phenomenal. While this dissertation is arguing for uncompromising dialogue between neuroscience and phenomenology, it is not doing so based on a hasty misappropriation of categories.

While real neural networks may not necessarily have an output *per se*, their functioning does rely on the substantially linear processing of the individual neuron. For purposes of modeling the operation of natural neural nets, the various neurons are replaced by connected nodes which form the artificial neural net. In this abstract model, each node has connections with other nodes, and each of these connections has a certain *weight*. The various weights guide the reorganization of the input signal into a certain output. The behavior of the network is a product of the whole network structure, so a network's behavior is said to be "represented" across the network.

It is difficult though to see why one would want to call network behavior a "distributed representation,"[201] but the need for the term makes sense when one considers that to deny distributed representation within a connectionist framework[202] is to deny representation all together.[203] Why is this the case? Because to have intelligence, a mind must have an idea of something external to that mind. It is necessary that some inner state of the mind must stand for a situation external to that mind. In the computational theory of mind, this need is met through the hypothesis that the brain somehow does computation with a type of mental-ese which somehow is the language of thought. The early Fodor (1975), the early Putnam (1975), Dennett (1991, see especially 209-226), and Pinker (1997) hold something akin to this view, with impressive nuances peculiar to them, and befitting their creative wits, but the general picture of a language of thought at some level which designates an outside world, in some way, is a reasonable generalization of the computational theory of mind. It follows that one can say that such and such a process, or a computation using this kind of algorithm (supposing we could isolate it and abstract a general pattern of it, all things being equal) would stand for something happening outside the brain system. In some way, the computational theory of mind can claim that the brain is manipulating symbols, which is why Searle's Chinese room needed to be burnt down. However, the artificial neural networks of connectionism have no internal state which can be designated as a symbol, like the univocal symbols used in the rule-based model.[204] They do exhibit behavior. But note, the behavior is not the same thing as a symbol. In the computational theory of mind, symbolic computation leads to certain behaviors. A chess playing program may do symbolic computation to plan its moves, but the taking of a knight by a rook is not equivalent to the computational process

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[200] See previous footnote.
[201] For a more detailed discussion of this point see chapter 3.
[202] See chapter 3.
[203] Paul Smolensky is an exception to this point. Smolensky suggests that the rule-based model and the connectionist model can be wedded by having computational processing traveling down vectors over network connections. Smolensky's combination of the two systems ends up inheriting the problems of both rather than solving them. See Fodor (2002).
[204] See the discussion of distributed representation in chapter 3.

that solved for that move. The chess playing program may have evaluated several possible moves before choosing that one. Connectionism has no internal symbols to be studied.[205] Instead, the network has an input and an output, but no internal symbolism employed in its problem solving. Thus, if connectionism is to have any representation, it is necessary for connectionists to claim that the output is somehow distributed across the network. The need to claim distributed representation makes perfect sense when one considers the relationship between each of the zones of the connectionist model – the input, the network, and the output. The input is one situation, the output another. The network changes the input information into the output information. If there is representation going on, then it must be distributed over the network, hence the term "distributed representation."

This blunt statement of what distributed representation designates points to the lack of warrant for labelling the events of the network as "representational" at all. In her book *The Representational Theory of Mind*, Kim Sterelny sees the problem very clearly.

> It is not clear that a distributed representation is a representation *for the connectionist system* at all.... given that the influence of node on node is local, given that there is no processor that looks at groups of nodes as a whole, it seems that seeing a distributed representation in a network is just an outsider's perspective on the system. It is at most a useful heuristic. I am demanding to be told why I should regard distributed representations as states[206] of the system at all. (1990, 171)

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[205] One may suggest that connectionism does have internal symbols to be studied. If so one would have define what one means by "symbol." So far in this dissertation, two definitions for symbol have been presented. The first is that of symbolic logic, in which symbols are univocal variables or operators whose function in specifically defined. The second is polysemic symbol which hermeneutic phenomenology has the resources to engage.

    Each of these definitions is inadequate for defining the interior of a neural network as a symbol. In terms of symbolic logic, it is not at all clear how the interior of a neural net could be univocal. Possibly one could argue that the interior represents the output because it is producing the output, but then one could equally ask if the interior represents the input as well. If the interior of the net represents both the input and the output, then clearly the interior of the net is not univocal.

    One may then wish to argue that the interior is employing polysemy and thus it fits the definition of a polysemic symbol discussed in hermeneutic phenomenology. However, a symbol which derives is symbolic quality as a function of input/output operations, even if the symbol retains two symbolic values at the same time, still suffers from the same problem presented in Searle's Chinese room, with the one difference. In this second case, the symbol inside the Chinese room has two symbolic values. However, the symbol is still not *understood* by a human.

    Therefore, on both definitions of symbol, the interior of a neural net, as neural net, understood with inputs and outputs, cannot be called a symbol.

[206] In view of the introduction to the problem of representation given above, the relation of "states" and "representations" is clear enough. If the output of a network is distributed across the network, then the term "state" would describe the condition of the network during a distributed representation which would distinguish the condition of the network in that moment from other network conditions in which representation is not distributed across the network.

It appears that the connectionist model might be making the same move (and mistake) as the rule-based model, calling mechanics "representation" when what is occurring is a kind of mechanical manipulation. This is exactly the point which Searle's Chinese room aims to critique. Mere operations are not representation, in the classical sense of representation, where a mental state stands for something outside of the mind. All the more then, it would appear that the concern underneath Searle's Chinese room argument directly connects with so-called "distributed representation." Referring is not occurring. The symbolic nature of the symbol is something discerned by a human interpreter, but when the human interpreter is removed, as must be the case in the interior of the brain (since there is no man inside the brain making things happen), it would seem that something must take the interpreter's place, or at least explain why the interpreter is not necessary.[207] From a perspective that views only the mere network in action, the label of distributed representation is understandably troubling (since neither the interpretation nor the explanation how "representation" is "distributed" is given) especially if Changeux is right about the full identity of mere brain states as consciousness (Changeux 2000, 52).

Michael McCloskey (2002) meets the problem of distributed representation in a different way from Sterelny (1990, 171). Though he does not treat the question of distributed representation directly, for our purposes, he offers a way of redefining the problem. He asks whether neural nets are *explanations* of how the brain functions or behavioral *simulations* of activity, using similar (i.e. network) structures that, though similar in structure, are not necessarily duplicating brain function. He concludes that they are not explanations of brain function, but rather objects of study. In the way that comparative anatomy sheds light on how some aspects of the human brain functions, so artificial neural network modeling may shed light on the operation of natural neural networks. McCloskey's observation may apply to the question of distributed representation, in that if artificial neural net models are simulations of function, and not explanations, then one need not call the network process that outputs some product a *representation* of that product, in the sense that the output some how needs to be distributed across the network. The network may manufacture the output, but manufacturing and representing are two different activities.[208]

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[207] I will argue that the human interpreter is not situated in the human brain, but rather in the human body, which is "in" the brain, while the brain is "in" the body.

[208] While it may be true that any calculator can "represent" information somehow, one should keep in mind that a calculator's work of calculating is actually the fruit of human discourse setting internal relationships inside a calculator so that the calculator can calculate using something akin of formal system operations. The previous point about the relationship between the definition of formal symbols and natural language applies here.

Distributed representation seems to create a problem, but it must be in some sense true. Unless all nerve inputs report to some single cell in the brain, representation must be "distributed" over some part of the brain or body. There must be processes that involve several components that come together to "do" one thing *together*, that in some way means something, if cognition occurs within the physical substrate of the body. It would seem, then, to bring Ricoeur to terms with neuroscience will require the impossible. In some way, representation must be both distributed, and not distributed, at the same time.

The work of Paul Cilliers (1998) is a great help here, for he approached the problem of distributed representation through the tools of the semiotic poststructuralism of Derrida and Lyotard, and sees a strong analogy between the connectionist model of interpreting brain activity, and a postmodern view of signs. Cilliers's work will serve as a bridge between neuroscience and hermeneutics. He sees the initial root of the poststructural approach to complexity in the work of Ferdinand de Saussure (1983) who developed the "structural" model of language. Cilliers sees Saussure's core insight, which benefits the study of complex systems, in Saussure's claim "that meaning is generated through a system of differences" (37). He judges this insight as "an excellent way of conceptualising the relationships in a complex system." Cilliers does not stop with the fixed nature of Saussure's language structure, but follows the further development of Saussurian thought in the work of Derrida (1976, 1981, 1982) and Lyotard (1984), along three main theses: firstly, in his view, the best way to understand the interior complexity of a complex system is to see it as "arising through large-scale, non-linear interaction" (37). Secondly, "[s]ince a [complex system] is based on a system of relationships, the post-structural inquiry into the nature of language helps us to theorise about the dynamics of the interaction in complex systems" (37). Cilliers suggests that the complex dynamics that form meaning in language may also provide a model for dynamics of complex systems. At first this analogy may seem far-fetched. So thirdly, Cilliers painstakingly illustrates the strength of the analogy by specifying what properties hold between both the connectionist model of brain function and the poststructural model of "meaning" (1998, 37-47 and 25-36, respectively). These properties, or ones similar to them, can be used for computational or physical simulations of complex systems.

Just as Ricoeur detours through structuralism to develop the model of the text, I will now detour through the work of Cilliers to develop a hermeneutic phenomenology of complex systems.

2.2.1 SAUSSURE'S "STRUCTURALISM"[209]

Saussure wished to develop an empirical science of language and relates at the beginning of his *Course in General Linguistics* his frustration with the current state of linguistics (1983, 1-5). In his opinion, linguistics had failed to identify the primary object of its study and to grasp its nature. To make the study of language more scientific, he made the now famous distinction between a language (*langue*) like Arabic or Chinese and speech (*parole*) the psycho-physiological execution of that language. Thus, in Saussure's view, *langue* is a system. "The system of language is constituted not by individual speech acts, but by a system of relationships that transcend the individual user. This system is what Saussure calls '*langue*', as apposed to language in use, '*parole*'" (Cilliers 1998, 38). He places all the mental and physical aspects of performing language into the category of speech (*parole*). Saussure recognized that a language need not be written or spoken. Put another way, *langue* is the system that two communicators have in common with one another, and that system must be both temporally and conceptually prior to *parole*, since the existence of *parole* depends on *langue*.

Langue in Saussure's view constitutes a *system*, but that system can be scientifically studied in two ways. First it can be studied synchronically – the system's states can be studied at a particular moment in time. It can also be studied diachronically (i.e. its changes can be studied over time). However, the diachronic science of *langue* depends on synchronic science of *langue*. Either approach illustrates how *langue* can and should be studied as a system

What permits both synchronic or diachronic linguistic science is the relationship of mutual dependence within the system of linguistic signs. Since *langue* is made up of only two parts, *langue* as system of signs and the performance of those signs in speech (*parole*), each sign affects the other signs. Each sign nudges and pressures another sign in the *langue* system.

If linguistic science depends upon the systemic states of a mutually-dependent system of signs, the only way to submit that system to analysis is if it is closed. If the system of langue is in constant flux, the relationships of mutual dependence would forever be altering. Saussurian linguistics must study systems that are steady. Thus, synchronic study is not only first in priority, it is also necessary, to even understand *langue* itself, since the changes in *langue* would have to be *system changes*. The only way to understand a change in any part of *langue* would require one (on Saussure's terms, not on Ricoeur's) to

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[209] Saussure, of course, never called his view "structuralism," but since he is the organizer of its central tenets, I am following the example of many writers and labeling his approach to language with the name of the school of thought that it helped to generate.

understand the changes within the system of *langue* as a whole. As one would expect, Saussure admits in his account of diachronic linguistic science that the system changes over time. Cilliers observes that this leads to an apparent contradiction (1998, 38). Saussure's mutually dependent closed system requires that that signs be immutable. Saussure explains that this is because

> The signal [what Cilliers calls the signifier] in relation to the idea that it represents, may seem to be freely chosen. However, from the point of view of the linguistic community, the signal is imposed rather than freely chosen. Speakers are not consulted about its choice. Once the language has selected a signal, it cannot be freely replaced by any other. There appears to be something rather contradictory about this….What can be chosen is already determined in advance. No individual is able, even if he wished, to modify in any way a choice already established in the language. Nor can the linguistic community exercise its authority to change even a single word. The community, as much as the individual, is bound to its language. (Saussure 1983, 70)

Yet, Saussure also knows that languages have changed over time, and he admits to that fact.

> The passage of time, which ensures the continuity of a language, also has another effect, which appears to work in the opposite direction. It allows linguistic signs to be changed with some rapidity. Hence variability and invariability are both, in a certain sense, characteristic of the linguistic sign.
>   In the final analysis, these two characteristics are intimately connected. The sign is subject to change because it continues through time. But what predominates in any change is the survival of earlier material. Infidelity to the past is only relative. That is how it comes about that the principle of change is based upon the principle of continuity. (74-5)

So change and continuity, in Saussure's view, are both qualities of the sign, yet Saussure also needs a system to retain its synchronic relationships for the purpose of study. It would seem then that a tension exists between the need for a system to retain its synchronic relationships and the propensity of signs to be used in new ways. This situation is resolved in different ways. Cilliers suggests "The system [of *langue*] does evolve, but it remains in a

state near equilibrium" (1998, 42). So, for Cilliers, this quality of equilibrium accounts for why *langue* can be studied in an ever-changing stream of history. The system of language retains an operating equilibrium state that permits communication in a community, but that equilibrium state can be affected and altered by time and chance. Louis Hjelmslev, strongly influenced by Saussure, approaches the problem differently. Ricoeur observes Louis Hjelmslev as some one who pushes

> …Saussure's thesis to its most radical form[;]… Hjelmslev says: 'Behind every process one should be able to find a system.' [The view that language must be distinguished by two sciences, one of states and one of change] opens up a new range of intelligibility: change, considered as such, is unintelligible. We understand it only as the passage from one state of system to another, which is what the word diachrony signifies; it is therefore to the system, that is, to the arrangement of elements in a simultaneous grouping that we give priority in understanding. (1974, 81-2)

In Ricoeur's reading of Hjelmslev, diachrony requires a system change. Thus any change must be understood as a *system change*. The system is passing from "one state of the system to another." Analysis then necessitates that one understand the system, the grouping of elements, to make sense of the change. Far from seeing the system retaining an equilibrium, any change necessitates system change. We will find later in this chapter that this consequence of structuralism follows because polysemy must change the system as a totality rather than relating previous uses of the symbols to *langue*, a situation which follows from not having both the potentiality of *langue* and the actuality of discourse.

Saussure's definition of sign follows from the principles of linguistics mentioned above. The following summary of the argument both summarizes this discussion of Saussure and gives introduces the basic outline according to which I will introduce Derrida's philosophy in the next section.

- If language can be divided into *langue* and *parole*,
- if the study of langue can further be distinguished into synchronic and diachronic science,
- if the interior parts of langue only relate to each other via mutual dependence,
- and if the system must remain closed to submit to analysis,

- it follows that the sign may not point to anything outside *langue*.[210] (see Ricoeur 1974, 81-2) Saussure illustrates this point in the figure below.
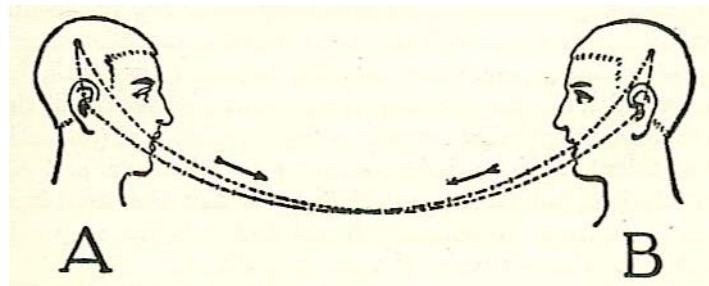

Figure 6.1. From Saussure (1983, 11). (For a diagram of Ricoeur's theory of discourse, see below.) This is Saussure's diagram depicting the speaking circuit. Curiously, the context for this figure carefully walks through every component involved in the speaking circuit, including speakers, brains, concepts and sound images, but the referential quality of discourse is absent, further validating Ricoeur's analysis of structuralism.

Furthermore, Saussure defines the sign as having two components: the *signifier* and the *signified*. The linguistic unit is the signifier. Cilliers observes that Saussure's system of signs self-organises through use. As people speak, the system grows and develops, but meaning still depends on the other signs in the sign system, and meaning can only be construed as the difference of one sign from another signs in a system of signs. Analysis will always be provisional, based on the constraints of a hypothetically closed system, since langue is constantly fluctuating. The reality that language is not a closed system opens the door to the pleasant turbulence of post-structuralism.

2.2.2 DERRIDA'S[211] "POSTSTRUCTURALISM"

Derrida's development of structuralism can be organized along the same five basic axioms as those of Saussure, and this organization will help to show that Derrida either adds to, or reverses each axiom to develop a post-structural philosophy. This section will show that in Derrida's view,

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[210] The outline of this section follows Ricoeur's analysis of structuralism, which I have followed to make the presentation of Ricoeur's dialogue with structuralism more intelligible (1974, 81-2). One may want to argue, at this juncture, that structuralism does not prohibit reference to anything outside the system, but rather what seems to follow is that we may be unable to analyze how the sign refers to anything outside. However, this objection does not take into account Saussure's definition of meaning as the relationship of difference between on sign and the other signs in a sign system. Difference necessitates that a sign participate with a system of signs, but being different from the other signs in a system. Given that situation, it seems necessary that sign is both empowered and trapped by the system that gives it the opportunity to signify.

- language cannot be divided into *langue* and *parole*,
- the study of langue can not be distinguished into synchronic and diachronic science,
- while Saussure is right that the interior parts of langue only relate to each other via mutual dependence, this destroys any possibility of hierarchy (at least seen in making preferences of interior and exterior) in the system,
- system's having insides or outsides becomes problematic,
- thus, all signs are composed by the system of differences

First, Derrida criticises Saussure's claim that one can distinguish between *langue* and *parole*, because it assumes that there is a mental aspect to linguistic signification; this psychological aspect constitutes a "metaphysics of presence" by assuming that signification requires something to which the sign must correspond. Signs do not have a signified component as Saussure would have it, because, as Saussure claims, meaning is formed by a system of differences. It follows from this that there is no referent of a sign. A sign cannot point to something else, or designate something beyond itself, since a sign is only constituted by a system of differences. There is no signified component, no revelation of a signified thing through a sign.

Derrida insists this feature of *langue* is revealed in text, where inscription distances an author from his words, "causing meaning to become unanchored" (Cilliers 1998, 42). Cilliers observes that Derrida does not find this a problem in the least, since "[h]e insists that the distance between the subject and his words exists in any case; that the meaning of the sign is always unanchored, even when we speak" (42). Derrida points to this when he refuses to talk of the signifier and the signified, but rather "the signifier of the signifier" (Derrida 1976, 7). This follows from his (Derrida 1976, 1-73) development of the notion of the text. Contrary to Ricoeur, who uses the text to refer to written artefacts of inscribed discourse, or those things which can be treated as written texts (Freudian psychoanalysis for example), Derrida treats everything as text. He once deconstructed a dining establishment with, "'Everything is a text: this is a text,' he said, waving his arm at the diners around him in the bland suburban-like restaurant" (Ragland-Sullivan 1999, 13). He can make such a statement because he collapses the Heideggerian question of being into that of text, since the understanding of being has been throughout the history of philosophy one of propositional expression (Derrida 1976, 22-23). Western philosophy has generally retained a faith that *logos* can in some way reveal being. Derrida takes this latent assumption and

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[211] This signification is naturally problematic.

reverses the hope of revealed being into a suspicion toward the idea that text can be distinguished from a referent, or a meaning. Instead the boundary between text and referent, or signifier and signified, goes away. All that remains are signifiers of signifiers.

Second, Derrida rejects that the study of *langue* can be distinguished into the study of the state of the system and the study of change, for by definition, the system must always be changing, since people are using signs, and it is this use of signs that is constantly reorganizing the system. When one speaks or writes, one points merely to other signs, yet those signs are also adjusting in play with the use of other signs. This action among signs destabilizes them such that even other signs cannot stand present as meaning, only the "traces"[212] of relationships with other signs, relationships of difference. Traces are "a formal play of differences" (Derrida 1981, 26). The system is always in flux, always changing. "The play of signifiers does, however, 'create pockets of stability'[[213]] otherwise communication could not get started" (Cilliers 1998, 43). According to Cilliers, these pockets[214] permit the analysis through the concepts of *trace* and *difference*, to be discussed below.

Third, Derrida affirms, with Saussure, that the relationships between various signs are only those of mutual dependence, but he adds a conclusion that flows from Saussure's premises, that there can be no natural hierarchy within that system. No one signifier, or order of signifiers, can claim hegemony over another. To make this case Derrida derides the claim that "written" signifiers can be ranked higher than "phonic" signifiers: "Now from the moment that one considers the totality of determined signs, spoken, and a fortiori, written, as unmotivated institutions, one must exclude any relationship of natural subordination, any natural hierarchy among signifiers or orders of signifiers" (1976, 44). Derrida comes to this conclusion because the boundary between the interior and exterior of the symbol system does not hold in his view, if the system is an open system. Here, Derrida finds no warrant for establishing hierarchies, and he applies this principle specifically to the classic Aristotelian distinction between natural signs and institutional signs, the products of human systems. For

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[212] Derrida uses the metaphor of "traces" to denote the product of signification in the formal play of differences. In his development of *differance*, the trace also is part of the action of play resulting in the space and system motion of symbols relating to one another through the relationship of difference. One sees this definition encompasses Derrida's use of the term when he *says*, "The gram as *differance*, then, is a structure and a movement no longer conceivable on the basis of the opposition presence/absence. *Differance* is the systematic play of differences, of the traces of differences, of the *spacing* by means of which elements are related to each other" (Derrida 1981, 27).
[213] Cilliers here quotes (Stofberg 1998)
[214] The reference here to "pockets of stability" is not intended to prove that they exist, or that Cilliers is prudent in recommending them. The mention of them here is only meant to offer some account for how diachronic system movement can occur without necessarily overturning the system itself. For more on this point see the contrast between Cilliers's approach and that of Hjelmslev earlier in this chapter.

Derrida, there is no natural order in the sign structure of human systems, and from that reality it follows that one may not *rank* one order of signifiers *naturally* above another.

Fourth, while Saussure required that a system remain closed to submit to analysis, Derrida problematises the distinction between the outside and the inside of the system. If Saussure is right, then there can be no inside or outside of the system. The system cannot refer to anything outside of itself. As mentioned above, the sign is constituted in a system of differences, and signs do not signify a signified. They do not point. Rather they have relationships of difference from other signs in a system. If follows then that the "meaning" of a sign requires that it be part of a system, and that its meaning be designated in terms of that system.

It follows, then, that the structural perspective cannot go beyond its own system of signs, and, therefore, there is no distinction between "inside" and "outside" the system. "The outside bears with the inside a relationship that is, as usual, anything but simple exteriority. The meaning of the outside was always present within the inside, imprisoned outside the outside, and vice versa" (Derrida 1976, 35). Cilliers (1998, 43) goes on to explain "Only when the distinction between inside and outside is ruptured, can the system become an open one" Cilliers's commentary aptly assesses Derrida's deconstruction of Saussure's definition of the sign. If the meaning of a sign is constituted by a system of differences, it follows that a sign must somehow be "inside" the system in order to have meaning. However, Derrida's deconstruction shows that this dichotomy between inside and outside is neither true nor false. "Inside" and "outside" cannot be designated, since there is no signified "outside" the system. After this distinction is ruptured, the system of difference is open to being influenced by outside factors, it can be changed. It can be changed because new signs can alter the system through its relationships of difference, which leads us to the fifth point.

Finally, Derrida's deconstruction of Saussure's definition of the sign follows these axioms: if there is no mental component to the sign, such that a signifier may only point to other signifiers; if the study of *langue* cannot be distinguished into synchronic and diachronic science because the system is in constant flux; if the relationship of mutual dependence has no hierarchical signs or orders; and, if there is no interior or exterior to a necessarily open system, signs may only point to other signifiers on the basis of difference. "[A]ll signs are constituted by the system of differences" (Cilliers 1998, 44). As Derrida explains:

> The play of differences supposes, in effect, syntheses and referrals which forbid at any moment, or in any sense that a simple element be *present* in and of itself and referring only to itself. Whether in the order of spoken or

written discourse, no element can function as a sign without referring to another element which itself is not simply present. This interweaving results in each "element"—phoneme or grapheme—being constituted on the basis of the trace within it of the other elements of the chain or system. This interweaving, this textile, is the *text*, which is produced only in the transformation of another text. Nothing, neither in the elements nor within the system is anywhere ever simply present or absent. There are only, everywhere, differences and traces of traces. (1981, 26)

Thus, no sign may claim positive content that is merely its own, but it also may not point to any other sign as its counterpart. "[I]t is merely the collection of the traces of every other sign running through it… The input station is clearly that the traces constituting a specific sign do not emanate from other signs that are self-sufficient and therefore have some positive content to be so. On the contrary, all signs are constituted by the system of differences" (Cilliers 1998, 44).

Derrida goes a step further to identify *differance* as the mechanism of a sign's trace. But he is also quick to point out that trace and *differance* are not words or concepts. "[*Differance*] is a complex notion with several layers of meaning" (Cilliers 1998, 44). Cilliers uses the terminology of complex systems theory to describe Derrida's notion of *differance*. It first identifies *langue* as a system, but one constituted in its *differences*. Since the traces that constitute meaning are traces of difference, and traces are caused by a movement and change in the system, it follows that there can never be ultimate, final traces. Hence, one never arrives at final meaning; meaning is always deferred. One also cannot speak of original meaning, because that would insinuate hierarchy and privilege, which is not possible in an open system with no interior, exterior, up, down, or sideways. Furthermore, for signs to interact with one another, there must be spacing between them. They cannot "be stacked tightly against each other" (Cilliers 1998, 45). *Differance* also implies that space exists and is perpetuated for the "play" among signs (see Derrida 1982, 13). It is this "space" that, in part, distinguishes Derrida's poststructuralism from Saussure's structuralism. The "temporal" and "spatial" dimensions of sign interrelation open the play among sign, permitting the evolution of *differance*. Derrida does not advocate a formalization between signs wherein each symbol must be univocally defined and every symbol operation must be specified. For Derrida, the symbol system leaves room for change.

Cilliers finds an analogy between poststructural sign theory and connectionist neuroscience via a detour through Freud, whose journey to a fully developed psychoanalytical theory traversed through an early stage, in which Freud attempted to

account for the mind's operation through direct appeal to physical brain states. In his posthumously published *Project for a scientific psychology* (*Project*) (Freud 1950). Ricoeur observes that "the notion of the 'psychical apparatus' that dominates this essay appears to have no correlation with a work of deciphering," which is a significant theme of Freud's work after *The interpretation of dreams* (1970, 69-86). Ricoeur argues convincingly that Freud moved away from a physiological explanation because it offered no explanation for why human phenomenal experience, interpretation, and personal decisions *caused* the psychological problems he observed. While the significance of Freud's departure from the methodology of *Project* must wait for later discussion, the model represented in it is important to us because Cilliers uses it to connect poststructuralism and complex-systems theory, explaining that in the *Project* Freud develops an account of "memory," which Freud views, not as the faculty of mere remembrance, but rather "the substrate that sets up the conditions for all the functions of the brain" (Cilliers 1998, 46). Freud attempts to account for memory, not in one particular location, but "in the relationship between neurons" (46). In this account Cilliers finds strong analogy between a poststructural sign theory and the connectionist model in neuroscience. Recall from chapter 3, how connectionism presents the neural network as a collection of nodes in which the most distinct property of the node is its location in the network. Thus, it would seem each node "is what it is" based solely on it relative network position, which is a relationship of difference from the other nodes in the network. Cilliers find this same basic account, a kind of proto-connectionist account, in the Freud of the *Project.* "What we have, therefore, is a model structurally equivalent to Saussure's model of language: a system of differences" (Cilliers 1998, 46). For Freud, in Cilliers's reading of him, the brain is a system that works on *differences.*[215] Like the poststructural view of a signs system, the brain functions far from equilibrium, as different neurons, like signs, relate to one another in short-range interactions, such that what remains in each neuron is the trace, a passing trace, of the differences of surrounding neurons. Therefore, Cilliers uses the early Freud as an explanatory transition between poststructural sign theory and connectionism, and on the basis of that analogy suggests that a poststructural theory of language can model complex systems in the world.

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[215] For a more extensive discussion of connectionism, see chapter 3.

3. Stage 2: Bringing hermeneutic phenomenology and neuroscience to terms: part 2—a structural detour

Cilliers's analogy between neurological structures and the semiotic theories of Saussure and Derrida will be useful for bringing Ricoeur to terms with neuroscience. Since my aim in the present and following chapters is to develop a hermeneutic phenomenology of complex systems for the creation of a hermeneutic phenomenological approach to neuroscience, I will follow the order of Ricoeur's own approach to structuralism. Retracing Ricoeur's steps, one may open a Ricoeurian approach to networks that includes the hermeneutic quality in system events through the work of Cilliers. After using Cilliers's analogy between structuralism/poststructural semiotics and connectionism, I will also draw a comparison between Ricoeur's hermeneutic phenomenology and Artificial Life through Aristotle's systems theory. This comparison will set the conditions for a hermeneutic phenomenology of unity, part and whole which I will eventually develop through the work of Merleau-Ponty in the following chapter.

3.1 Ricoeur's approach to signification in discourse

In "Structure, Word, Event," Ricoeur supports the fundamental insight of structuralism, namely that the words of the *langue* possess arbitrary meanings, rooted in their differences from one another (1974, 79-96). He also supports Derrida's observation that the meaning of a word is not immediately fully and completely present. Ricoeur treats structuralism as an important detour in his philosophy because, unlike structuralism, he identifies the primary signifier of spoken or written discourse to be the sentence, not the individual words, and we will see that this makes all the difference. He draws this insight from Aristotle's (1949) *On Interpretation* (see Ricoeur 1976, 1-2), wherein he calls the sentence "the significant portion of speech" (Aristotle 16b 26-7).

Ricoeur shows that while the structural point of view represents success in some areas it also carries with it two significant costs: First, the isolation of *langue* for scientific study separates it from history:

> not simply [history as] the [mere] change from one state of system to another but the production of culture and of man in the production of his language. What Humboldt called production and what he opposed to the finished work is not solely diachrony, that is, the change and passage from one state of system to another, but rather the generation, in its profound dynamism, of the work of speech in each and every case. (1974, 84)

In other words, Ricoeur defines the need for langue to be among the people, but to be such it must be part of the events of production, a continual production which is an unfinished work.

Second, structuralism exiles from language its primary purpose "which is to say something about something; speaker and hearer understand this intention immediately" (Ricoeur 1974, 84). By rendering langue into a pristine system, structuralism removes langue from a real reference. In Ricoeur's view, this constitutes absolutising phenomena, making absolute something that is not necessarily so (84). Even though a langue is not an absolute object, its mediation makes a path we use to communicate. Since language has this mediatorial function, speaking moves langue beyond itself. To accomplish its mission, it dies so that something greater might come, the movement of "a sign toward its reference" (85). As Ricoeur explains it, "Language seeks to disappear; it seeks to die as an object" (85). This death is the creation of something new, the event of discourse. Langue bequeaths to discourse an inheritance greater than the use of words. Discourse bears meaning. It is not another place amid langue, which merely "points" to other sign tokens amid a system of signs..

By making the epistemic decision to limit the study of langue to a closed universe of signs, it naturally follows that "the system has no outside"[216] (84). Thus, Ricoeur advocates the reuniting of langue and speech in such a way that the phenomenology of speech is not made to oppose the study of langue as a simple system. The problematic of structuralism cannot be removed simply by compressing langue and speech together. The structuralist defines langue as a fixed system. If speech, the act of discourse, is merely one sign among the rest of a fixed system then no new production can arise through discourse, which is again antithetical to the intention of speaking. Since collapsing discourse into langue problematises language, Ricoeur takes this as evidence that the sentence is not a unit of langue but distinctly a unit of discourse, that it has a different signifying function from langue. We find, then, an antinomy between langue (the system of potential sentence signs) and discourse (the act of communicating with sentences), or put more briefly—"between structure and event" (Ricoeur 1974, 86).

Ricoeur traces the implications of this antinomy in his reply to structuralism, as such, which he organizes along the same basic outline that I have used to organize the axioms of structuralism and post-structuralism.

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[216] It is significant that Ricoeur recognizes, before the advent of Derrida's poststructuralism, that the boundary problem of the langue system naturally follows from the structuralist's choice of axioms.

First, while the system of *langue* may be atemporal, the mode of presence of discourse is an act, an event, present at the moment of discourse, yet in time transitory and vanishing.

Second, while the finite system of *langue* may be studied through the distinction of synchronic and diachronic science, as a system imposed upon the speaker (at least if he wishes to use the language in a way that anyone will understand), discourse comprises a sequence of *choices*, that reject some meanings in favour of others.

Third, the interior parts of *langue* must relate to one another without reference to things outside the system, requiring them to relate to each other via mutual dependence, but the choices that produce discourse "produce new combinations" (Ricoeur 1974, 87). The essence of discourse is producing, and understanding, new things[217]—this is why humans act and speak. The resources of *langue* permit potentially infinite variations within the significance of discourse.

Fourth, while Saussure insisted the system must remain closed to submit to analysis, it is the antinomy of *langue* and discourse which frees discourse to employ *langue*, without problematising the relationship between the system of *langue* and the reference of discourse. Each employs one form of signification, without collapsing one form of signification into the other. Thus, a speaker has no need to break free of *langue*, to leap out of it and into the world. He was never trapped by it. Ricoeur unites the projects of Frege and Husserl, providing a clarification of the relationship between "sense" and "reference" while also following the phenomenological anticipation that *discourse* gives us, a strong anticipation of *reference* (1974, 87). Ricoeur does this by matching Frege's helpful distinction between "sense" and "reference" to "Husserls's Logical Investigations which "does not say anything different…. [T]he ideal meaning is a void and an absence which demand to be filled" (Ricoeur 1974, 87). Ricoeur need not oppose two different definitions of "sign": the *signifier* and the *signified*. And one need not be forced to choose between them. "One relates to the structure of the sign in the system, the other to its function in the sentence" (88).

Finally, the instance of discourse, the event-quality of it, does not rest in the definition of "sign."\ Discourse, fundamentally, is when "someone speaks to someone—that is the essence of the act of communication" (Ricoeur 1974, 88). By "speech", Ricoeur is not privileging spoken language over writing. He is not committing "phonocentrism" (Derrida

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[217] By this I do not mean new, in the sense of absolute newness, a totally original bold new utterance. That cannot occur because discourse summons language to its service. But the potentiality of language permits new construction, in relation to the fixed and closed nature of language as a system constituted by structuralism.

1976, 11-12). Rather, Ricoeur uses *speech* to refer to the event-quality of discourse, which requires someone to discourse in time and space with someone else, be it through text, oration, conversation, or symbol, but whichever medium of *speech* (discourse) one uses, communication requires the event of discourse (88). Ricoeur does distinguish the types of distanciation produced by aural speech, inscription in text and human action (1991, 144-167). It is also the case that Ricoeur uses the terms "speech" and "discourse" to refer to aural communication, but it would not be helpful to reduce the polysemy of these terms to obscure Ricoeur's point. If it were the case that aural speech were some how *better than* inscribed discourse, or human action, then both would represent a progressive decay of meaning as each is getting further from the event of aural speech. This clearly cannot be the case, since it would undermine Ricoeur's project of using the model of the text to understand human action. Frankly, the model of the text and "phonocentrism" cannot exist. Instead, Ricoeur is distinguishing between the way in which aural discourse, inscribed text, and human action distanciate themselves from their initial communicative event, so as to distil the hermeneutic resources available in each type of communicative event. To return to the point at hand: speech occurs whenever a subject can summon, in one act of discourse, the system of *langue* that stands ready for of the subjects use. Until a person does this, *langue* is but possibility, potentiality.

> By placing the word in a sentence position, the system of categories allows our words and our discourse to be applied to reality. More particularly, the noun and the verb are parts of speech thanks to which our signs are in a certain sense "returned to the universe" under the aspect of space and of time. By completing the word as noun and verb, these categories render our signs capable of grasping the real and keep them from closing up the finite closed order of semiology. (Ricoeur 1974, 90)

So though *langue* is potentialility, what makes the noun and verb "return to the word" is that they are parts of *speech*, of *discourse*. By completing noun and verb in the single signifier of the sentence, discourse grasps "the real," which is Ricoeur's metaphorical way of describing the referential quality of discourse.

By focusing on Saussure, and considering Ricoeur's reply to him, we may extend Ricoeur's analysis of the five axioms to post-structuralism. This move allows us to appropriate Cilliers's analogy between the brain and structuralism/poststructuralism in a vector more consistent with hermeneutic phenomenology. For example, though Ricoeur is sympathetic to Derrida's concern about "metaphysics of presence" (see the note on Rudolf

Bernet's work on Husserl in Ricoeur 2004, 519-520), hermeneutic phenomenology does not give the same warrant for this concern as Derrida, because for Ricoeur, as Aristotle (whom he often quotes on this point) observes, the analogy of being requires that being (both of nature and human existence) is not all revealed at once, but must be unfolded over time. Ricoeur aims to hermeneutically uncover being, never exhaustively, yet progressively over time, and one stage in that journey, is the detour through structuralism.

The above overview of structuralism, poststructuralism and hermeneutic phenomenology on the relationship between langue and discourse provides the necessary background establish common ground with hermeneutic phenomenology and connectionism through the detour through structuralism, and also the work of Paul Cilliers. In the remainder of this section I will develop that common ground more thoroughly through approaching the problem of distributed representation.

Chapter 3 introduced the problem of distributed representation. Kim Sterelny confronts the problem with frustration (1990, 188). She wants to know where the representation is in distributed representation. Michael McCloskey takes the problem of representation in a different direction (2002). He identifies the equivocation that arises from concluding that, if two processes can produce the same output, they must be the same process. For McCloskey, neural networks are tools that can lead us to greater understanding, but they are really simulations, and not models—especially not existential scientific models (see chapter 1). Paul Cilliers responds to distributed representation by giving it a poststructural interpretation, affirming, more or less, Sterelny's view of system nodes (1998). However, Cilliers is willing to deny classical representation: brain activity does not *represent* the world external to the body (72). For Cilliers brain activity is a process, in which post-structural semiosis happens, but not classical representation. Cilliers accepts distributed representation as legitimate, finding it similar to Derrida's notion of differences and "traces."

Chapter 3 also discussed the rule-based approach to cognitive modeling. While chapter 3 may have offered some strong criticisms of the rule-based approach (which itself focuses on the axiomatic manipulation of symbols), it also commented that although the rule-based approach has significant problems, it does take symbols seriously—which is at least a point of common ground with hermeneutic phenomenology.

Ricoeur's work draws together both signification and distributed network is way that suggests Ricoeur's model of the text can unite the symbol and the distributed network. Above, I mentioned that Freud's earlier work in *Project* aims to develop an account of human subjectivity through a physical account of the brain. He accounts for the work of memory through differences between the various neurons. Freud leaves behind this type of

explanation in his later work, which studies the symbols of thought for the purpose of revealing the subconscious. Ricoeur offers an explanation for why Freud left behind an "energetic without a hermeneutics" (1970, 69-86). He explains that Freud's general research project led Freud to offer an account for the meaning of human behavior through the physical energy of sexuality. However, that physical energy also has a "properly psychological stage," for which a global psychological theory must account (84). Even in *Project*, Ricoeur points out that Freud already finds himself moving toward hermeneutics in "the work of deciphering symptoms" (84). The university community did not immediately respond well to Freud's work as Ricoeur observes:

> [T]he great discovery… that was to estrange him from the scientific milieu of the university and the medical profession—the discovery of the sexual etiology of the neuroses—remains purely clinical and is not paralleled by any properly organic hypothesis; in particular the clinical entity of hysterical paralysis is established in opposition to the anatomists: everything takes place, Freud remarked, as if there were no such thing as anatomy of the brain. (1970, 83)

Freud could not reduce the human life-world to the interactions between differences in a system of brain cells, so he was forced to approach the mind hermeneutically.[218] One should not be surprised to find Freud shifting from the "distributed representation" of what he calls "memory," to a study of symbols. Granted, Freud's use of use of symbols differs greatly from that of the computational, rule-based mind.[219] Freud's migration through various iterations of

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[218] One may reply with a view that there was simply too little known about the anatomy of the brain in Freud's time for him to be able to continue along these lines. However, put in contemporary term, Freud's (1950) earlier approach is analogous to that of Jean-Pierre Changeux, which Changeux (1985b) recognizes at the opening of *Neuronal man*. This whole dissertation then may be seen as an argument against such a view. Briefly, the reduction of phenomenology to brain states misunderstands the systemic nature of the body's relationship with the brain, such that the interrelational activity of brain and body together in the labour of conscious experience is misunderstood. As some Artificial Life proponents have recognized, the network operations of the brain cannot be appropriately understood outside embodiment. When understood within embodiment, the work of understanding them requires recognizing schemas which necessitate a phenomenological epistemological priority be placed on the reliability of conscious human lived experience and cognitive hermeneutical processes, in order to then exegete the physical systems dynamical behavior. This brief summation merely articulates Ricoeur's critique of Freud's early work in contemporary terminology.

[219] The notion of symbol used in the computational theory of mind is derived from the developments in symbolic logic through the late 19th and early 20th century. The univocal quality of the symbols used by symbolic logic enable them be used in computational operations similar to those of mathematical computation. For an excellent history of the development of the computational theory of mind and its relationship to symbolic logic see Devlin (1997). The psychoanalytical Freud of *On the interpretation*

his psychology gives an example of one possible solution to the challenge that distributed representation presents for the kind of symbols that can give rise to reflection: ignore systems state when they problematises distributed representation. Ricoeur's insightful critique is helpful here. However, Cilliers's work through Ricoeur's hermeneutic phenomenology opens more possibilities than Freud made available to himself. The structural/poststructural resources of Cilliers's analysis which draws semiotics and brain anatomy into dialogue may be useful in developing a hermeneutic phenomenology of complex systems, which permits Ricoeur's philosophy of engaging in dialogue with brain science. But what would such an approach look like? To introduce that approach, it will first be necessary to show *what* features of the rule-based and connectionist approaches are being brought together.

The work of both McCloskey (2002) and Sterelny (1990) helps us organise these possibilities. They distinguished between network functions and the duplication of what humans do. McCloskey's study focuses on neural nets that can recognise words, and Sterelny discusses the problem of representation. Both find difficulty in simply "distributing"[220] the significance of the external behavior across the interior of the system. The problem is clearly itemised through McCloskey's distinctions between the output of the system, its behavior, and the internal process (see chapter 3).

One aspect of distributed representation must be correct. If some mental activity occurs in the brain[221] (which this study assumes) such that the brain's participation in mental activity is decisive; and if these events are not localised in one neuron, then "representation" must be distributed. No matter where one wishes to specify a sign in the brain, that sign will always be "made" of something, be it code, or modules or memes[222] (see Dennett 1991, 1995). It is imperative then to find a way to draw together the parts in such a way that they can function as a unity; if not, representation (in an organism) is not possible. If the network is irreducible, and the network is informed by, and reaches through, the body to the world, at least one hypothesis worth considering (one consistent with hermeneutic phenomenology) is that *the human, as human in pluriform aspect, is an irreducible representer* (Merleau-Ponty

of dreams and the rest of Freud's psychoanalytical corpus, reveals a very different notion of symbol. For Freud the symbols of dreams, and other types of psychoanalytical symbolism open the opportunity for hermeneutical reflection, the very quality of symbols that symbolic logic was invented to remove.

[220] For more discussion of their respective positions see chapter 3.

[221] I will go on to argue that we must think of thought as occurring in the body, not just in the brain.

[222] Memes are cultural production like ideas, fads, discoveries, behaviors, etc., which come into being in culture (generally the research in memes focuses on human culture). Meme theory gives a conventional framework for research that aims to study human cultural productions through the application of an evolutionary model. Richard Dawkins (1976) coined the term. For an introduction to memes see Susan Blackmore and Richard Dawkins (2000).

2006). The human represents, and to the human body belong the tools to represent. Furthermore, the neural anatomy reviewed in Chapter 3 would overturn the egalitarianism of network nodes[223] in Sterelny's work, since each aspect of the various networks interpenetrate one another, influencing one another, while retaining their multi-various "hierarchical" qualities. Therefore, the brain and nervous system are not reducible to a single network; this observation is the great insight of the Artificial Life research project. The aim here is not to force some trendy analogy between hermeneutic phenomenology and a research project in its adolescence; however, the observation that life is not reducible to parts in itself may also carry over to the work of symbol construction by humans. If the brain is the substrate of mental activity, as Ricoeur suggests (Changeux 2000) and if Ricoeur is correct in his approach to personhood in *Oneself as another*[224] (1992), to the relationship between the model of the text and human action in *From text to action*[225] (1991) and to the relationship between hermeneutics and the analogy of being in *The rule of metaphor*[226] (1977), then the human neurological interior is most certainly "meaningful" in the strong sense, so that a hermeneutic phenomenology of complex systems might exegete them.[227]

The relationship between *langue* and discourse in hermeneutic phenomenology when understood in light of Aristotle's systems theory opens the way to find the human neurological interior as "meaningful" without delimiting that meaning to symbolic physical or encoding states in the substrate of the brain. The relationship between langue and discourse helps to open the hermeneutics of systems to human understanding. Ricoeur demonstrates an antinomy between *langue* and discourse. *Langue* is a system of signs that relate to one another in and through their differences, a significant insight of structuralism, and one consistent with Aristotle's *On Interpretation*. However, when the signification of discourse is collapsed into *langue*, the recasting of discourse in terms of mere *langue* leads to the redefining of discourse as something which no longer communicates something, about something, to someone. Thus Ricoeur, and Aristotle before him, define the sentence as the significant part of discourse. Discourse communicates propositions, which predicate one thing about something else. Discourse is also an event. This dialectic of discourse as

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[223] See chapter 3.
[224] See introduction. Briefly, Ricoeur does not try to reduce personhood to a set of properties. Rather he presumes personhood as the operating space as the precondition of phenomenological reflection, while applying this theory of metaphor and narrative to account for the way we humanly come to understand our personhood in the lived human cultural context.
[225] See chapter 4 and below. In short, Ricoeur argues that human action can be exegeted as wone would a text.
[226] See chapters 5-7. The framework of Aristotelian systems theory opens a way of understanding the relationships between parts and wholes, and permits the exegesis of cause in a way that transcends the reduction all cause to efficient cause.

proposition and event is rooted in the antinomy between *langue* and discourse, but it cannot be collapsed into it. "Discourse considered as either an event or a proposition, that is, as a predicative function combined with an identification, is an abstraction, which depends upon the concrete whole that is the dialectical unity of the event and meaning in the sentence" (Ricoeur 1976, 11). Thus part and whole are drawn together in a sign that is irreducible to other signs while being itself composed of signs. This may be shown in three ways. First, discourse is predicated, which is to say it points to something more than the mere system of its parts, something outside *langue*, defined as a system of signifiers, because the sentence is a new production. Second, the sign of discourse is a time-embedded event which actualises the potential of *langue*. Thus, *langue* signs are the signs of *meaning that could be*. Discourse signifies *meaning that is*. Finally, the parts of *langue* that make up discourse have a polysemy that the whole does not have (which is not to say that the whole, in relation to its parts, has no polysemy). However, the parts of the smallest significant unit of discourse, the sentence, may be used in other sentences, but that does not mean that a part of the previous sentence has been removed. Parts, with polysemy, have multiple functions in discourse.

Thus, the problematising of parts and whole presented in distributed representation goes away with Ricoeur's antinomy between discourse and *langue*. The distributed representation of connectionism may be likened, as I have already done, to the views of *langue* presented in structuralism and poststructuralism. When the signs are considered merely as a system of signs, without reference to the world, they seem to only be a collection of symbols related by differences from one anther. They are different from one another, but nothing more may be known about them. Yet, as the Artificial Life research program has pointed out, the neurological interior must be connected to the outside world if it is to teach itself, and develop the feedback learning loops necessary to function in its environment. This observation is not meant to offer any warrant for a hermeneutic phenomenology of complex systems which relies upon Artificial Life as a support for its claims. Instead, Artificial Life makes clear that the "representation" that occurs inside the life form is only "meaningful" because the life form is connected to the external world. It is embodied. Analogously, for Ricoeur, the representation of discourse may not be reduced to its parts; thus it is not distributed across the parts, as representation must be in a structural or post-structural approach. Rather, like the life of an organism, the parts are summoned into an event, into action. However, for Ricoeur, the representation is composed of parts, which is the great insight of structuralism – an insight which is helpful here.

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[227] This section is almost verbatim what I suggested at the conclusion of Chapter 2. This thesis I will

Furthermore, Ricoeur's observation about the relationship between *langue* and discourse leads to the development of a helpful hermeneutical tool, which will prove quite useful for the development of a hermeneutic phenomenology of complex systems. The single sign of the sentence is composed of parts to which it cannot be reduced. Within the complex system of the brain, as well as other complex systems, the activity of a set of nodes of the system, to be understood in its actualisation, as an event, has a system history that leads up to it., and system future which follows it. This system narrative gives context to the system event.

The process that brings about system states often has feedback loops, which may employ the same structure as the system but in different ways. Nevertheless, these system states still have a system history which leads up to them, and a system future which follows them. Hermeneutic phenomenology (Ricoeur 1984, , 1985, , 1988) then is well poised with the resources to engage the rich information of narrative, which would seem to suggest that narrative has the resources (through the application of hermeneutic phenomenology) to model the feedback loops of complex systems.

But how? Ricoeur argues in minute detail that the polysemy of *langue* is reconfigured by the work of predication, especially metaphorical predication (see below) (1977, 101-133). The creative actuality of discourse reconfigures the signs and system structures it summons for its work without destroying them. Thus, feedback loops are traceable in the history of use (a feature we saw in chapter 3 in neuron action-potential memory, which also affects the behavior of the networks in which those neurons participate), in a way analogous to a history of discourse events, not as mere system states.

So Ricoeur's hermeneutic phenomenology mediates between the semiotics of the rule-based cognitive modeling approach that stresses the importance of symbols, and the semiotics of distributed representation that emphasises the summoning of network (the metaphorical network of *langue*) resources for achieving particular functions. The symbols of langue are problematized by the change of the system, since the only relation that retains the identity of the sign is that of difference. However, discourse overcomes the problem of distributed representation, because the representation of discourse is not distributed over the parts of langue which are in use. The signification of discourse is *not* reducible to the parts. The metaphor of *distribution* is *wholly inadequate*. It is true that each word fulfils a certain task in its use, but the meaning of the smallest meaningful unit of discourse cannot be said to reside in one of its parts, as thought the smallest meaningful unit of discourse had

now support.

a smaller meaningful unit. Such a classification mistake obscures the significant insight of Ricoeur's employment of Saussure and Aristotle.

3.2 HERMENEUTIC PHENOMENOLOGY AND ARTIFICIAL LIFE

Though the study of artificial biology existed before Christopher Langdon gave Artificial Life its name, Margaret Boden (1996) reports that he deserves credit for writing the seminal paper of the discipline, entitled "Artificial Life," published in 1989. As Langdon puts it: "Artificial Life is simply the synthetic approach to biology: rather than take living things apart, Artificial Life attempts to put living things together" (1996, 40). Faster computer technology permits researchers to create (though, even at this point, very simple) artificial organisms that can act with and upon one another and also reproduce. The creation of these artificial organisms, and their relationship to one another in an artificial ecosystem, allows researchers to study their behavior and development in ways they could not possibly do in the real world. Artificial ecosystems allow researchers to "go back" to previous states of development in the system and make small changes just to see what will happen. Such a resetting in the natural world might require massive purgings.

Langton recommends the research program of Artificial Life because among its many benefits, it provides a way to model evolution. Artificial biological models can be made to model ecosystem and population behavior patterns, evolution, breeding, and so on. Langton distinguishes between an organism's *genotype* and *phenotype*. In natural biological systems, "[t]he *genotype* is the complete set of genetic instructions encoded in the linear sequence of nucleotide bases that make up an organism's DNA. The phenotype is the physical organism itself—the structures that emerge in space and time as a result of the interpretation of the genotype in the context of a particular environment" (55). Langton abstracts genotype and phenotype for artificial biological situations. A GTYPE is a *generalized genotype*, or specification, for a set of machines. A PTYPE is a *generalized phenotype*, and Langton defines it as "the behaviour that results as the machines are run and interact with one another" (56). Put briefly, Artificial Life employs three basic categories necessary for its work: GTYPES, PTYPES, and their environment. Langton purposefully keeps things simple, but his simplistic three-part construction evidences the obvious fact that things that are alive are made of parts. Artificial Life simplifies the problem of real-life, and *en masse* it is a model that seeks to remove complexity. He skips from DNA to full organism, as the purpose of these simplistic artificial constructions is to overcome the biological bureaucracy that seems to slow evolution of beached whale's crawl in the physical world.

The Artificial Life model clearly shares some overlap with connectionist model (i.e. some of the Artificial Life forms, or robots, employ neural nets), but its approach of examining the parts in the context of the whole alters the Artificial Life approach to neural networks. According to Michael Dyer, one problem with neural networks is programming them (1995). Neural modeling requires significant attention to detail and clever ingenuity to get a network to duplicate complex behaviors, which is why Artificial Life researchers point to neural net modeling's need to define intelligent animal behavior within *social organisations.* A social interaction thesis gives some direction toward an explanation of how neural networks become conditioned through maturity; networks work as a team. Some Artificial Life theorists, like James Kennedy and Russell C. Eberhart in *Swarm Intelligence*, take the social organization thesis to support a different account of the mind than that given by traditional cognitive science, one critical of cognitivist reductionism[228]: "[Researchers in cognitive science] have not required that minds be human and have not even required that they do any profound information processing, as cognitive science and human vanity tend to present him. Our assumption is that individuals are components of the system that thrives on their participation and nurtures it, too" (2001, 422). Kennedy and Eberhart boldly attack the latent Cartesian egocentric methodology of cognitive science, and argue for a provocative new thesis: that mind, as an individual thing, develops out of community. But we ought not to be deceived. "Mind" does not mean person. The "community" to which they refer could equally be a particle swarm. Be that as it may, one may generalize regarding the Artificial Life research program that, while the connectionist modeler focuses on duplicating the operation of parts in the brain, the Artificial Life modeller focuses on modeling animal behavior.

Artificial Life is too young a discipline to attack for fallacious conclusions. Only a mean father or jealous friend screams at a boy for missing his first T-ball swing. One problem, though, is worthy of addressing, one that has nothing to do with the computer

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[228] James Kennedy and Russell C. Eberhart in *Swarm Intelligence* explain cognitive reductionism in the following way: "The recently fashionable view of cognitive science is a reductionist one that hopes to explain mind in terms of low-level neural events. New methods enable researchers to measure electrical and chemical changes in the brain as it performs various tasks, and it is hoped that the mind can be explained in terms of such things as synaptic dynamics and brain modularity. This is like trying to predict the weather based on the known behaviour of gas molecules. It may be true that the weather is in fact a system of moving molecules, but forecasting must be based on molar patterns of air masses. Local weather is predicted by considering the state of the local weather in the context of the dynamics of weather patterns in other locations. Human conduct may one day be explained in terms of neural firings and the organization of the brain, but it will never be understood in those terms, just as weather will never be understood by examining gas molecules. To understand people you have to know how they participate in social context. You need to know who they care about and who they believe and who the want to be like, and you should know who taught them what they know if

muscle necessary for the swing. This problem rests in Langdon's definition of GYTPE and PTYPE. Recall that a GTYPE is a *generalized genotype*, or specification, for a set of machines. A PTYPE is a *generalized phenotype*, which Langton defines as "the behaviour that results as the machines are run and interact with one another" (56). PTYPE is a behavior, *not an organism*. The GTYPE may result in the behavior of creating a certain change in an organism, but the organism is really left out of the equation. However, it is the organism, all of the sundry processes, that open the possibility for the genotype to express itself as a phenotype. DNA itself is a code which requires the organism in order to express any behavior at all. To go directly from GTYPE to behavior is to miss the organism all together. When Artificial Life is so abstracted, as it is with Langton's early work, with the overly simplistic categorizing of GTYPE and PTYPE, or the like, the results from such abstracted research may be useful to answer some questions, but as a global explanation of how life operates, it may be misleading. This is certainly a danger when, as Langton as suggests, the research program of Artificial Life is intended to come up with more universal principles of life, that transcend all the organic life humans have hitherto encountered. The abstractions of Artificial Life may yield an incomplete data set.

In the above-mentioned scheme for Artificial Life research, it is clear that at the core of the research project the organism has been removed from the central definitions of what makes life, in fact, *life*. This removal does speed up the process of change in the expression of the GTYPE, which does permit an acceleration of species change, but it is also clear that the substrate of life has been removed. However, in physical systems, the development of the organism and especially its parts goes part and parcel with the development of its behavior.

Again, these remarks are not intended as a critique of the Artificial Life research program, but they do show how a hermeneutic phenomenology of complex systems helps to protect complex systems research project from these sorts of perils, the perils that have faced all three of the cognitive modeling approaches which have been discussed in this dissertation (see chapter 3). Ricoeur has an approach to *langue*, and an interpretation that permits an organic unity of the whole and the many in such a way that one is not subsumed in the other. He also draws an indication of his philosophy from Aristotle. Without tying himself to the mere interpretation of Aristotle's texts, Ricoeur does employ several significant Aristotelian ideas (the distinct signification of discourse from the signification of the parts that make up discourse, potentiality and actuality, *mimeses*, the unity of plot that joins several disparate elements, the four causal model, etc). Each of these concepts has been

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you want to understand their thoughts and actions" (2001, 397). The latter part of this passage states

introduced, and will be used in what follows. Thus, as with the computational theory of mind and connectionism, the resources of a hermeneutic phenomenology of complex systems take the core interest of Artificial Life seriously, which is to be able to begin to make sense of the whole and the part without reductionism. Initially, we may say that Ricoeur's hermeneutic phenomenology in dialogue with Aristotle's theory of substance and *meros* (system part), shows some promise for joining part and whole in a way that will not reduce the whole to its parts, or behavior to genes. However, to achieve this, it will be necessary to move to perhaps the thorniest of all topics this dissertation will address – the difficult question of natural teleology, which must be addressed if Ricoeur's model of the text is to be used to model complex systems.

4. STAGE 3: TELEOLOGY IN DISCOURSE AND SYSTEM EVENTS

The next stage will use a correlation between meaning in discourse and function in system events to apply the model of the text to complex systems, which is in its turn necessary if we are ever to develop a hermeneutic phenomenology of complex systems. Recall how the introduction stated that this study takes as a given that *function* is the teleology of *process* as *meaning* is the teleology of *discourse*. Thus, teleology unites the relationship between both *function* to process, and *meaning* to discourse. The application of the model of the text to complex systems requires that the model of the text somehow be able to open complex systems to interpretation. There must be some way to bridge discourse and system process, and I will build such a bridge through the notion of teleology, a very difficult concept to be sure. Here, I am not using it as a metaphysical explanation, but rather as a hermeneutic tool, which draws several aspects of a system, or subsystem, into a totality where cause can be interpreted together. As I discussed in chapter 5, the interpretation of causation is a hermeneutical process, employing a hermeneutical circle like that of textual exegesis. It will be necessary for me to carefully define teleology and then map out its application.

4.1 TELEOLOGY$_1$, TELEOLOGY$_2$, AND TELEOLOGY$_3$

The anonymous author of the ancient Roman oratory text *Ad Herennium* warns that it is a mistake to prove something using something else that is equally in dispute, and in natural science few things could be more disputed than natural teleology, *the purposive-*

a part of the conclusion of the present dissertation.

ness apparent in nature ([Cicero], II. xxv. 41). A proper defence of natural teleology would require a whole dissertation. Here, it is not my goal to take up the ultimate question of purpose in the universe. For the scope of a hermeneutic phenomenology of complex systems, we may proceed from the local to the more global, following the hermeneutic methodology of Ricoeur, who approached metaphysical questions through the longer road of hermeneutics rather than the short road of direct theorising. It will be helpful at the outset to clear up one confusion that may likely be the source of the modern antipathy toward teleology. It is often assumed that by talking of teleology, one must be talking of things having a purpose, authored by a will, as though a particular, impersonal natural process is exercising a will. Or worse still, teleology, might imply the existence of a religious being. The word "teleology" has a complex polysemy, and going to the Greek root word will not help in this case since *telos* simply means "end." We will, then, take a look at its various uses which I will place under the labels $teleology_1$, $teleology_2$, and $teleology_3$ (Wallace 1996, 16-17).[229]

The "end" of something may simply be its terminus, like the end of the table is its edge. If I am making a trip to the capital of Belgium, "Brussels" is the end of my trip. I could also say that Brussels is the teleology of my travelling. This first use, I will call $teleology_1$. One may also say that the point at which an organism stops growing, the end of its growth-- maturity--which is the $teleology_1$ of the organism. $Teleology_1$ here is a sense of reaching an equilibrium point, when an organism has completed the process of growth to adulthood. Another example will help. Take a duck foot. A duck's foot's $teleology_1$, in one sense, refers to the end of the foot, but it can also be used to refer to the end of the process of growth, when the duck's foot has fully developed.

$Teleology_2$ refers to a beneficial product produced through a process--a perfection. The previous example of an organism growing to maturity also gives us an example of $teleology_2$, in that maturity benefits the organism. Returning to the example of the duck foot, it is appropriate to call the fully formed duck foot the teleology of its growth process not merely because it is the temporal completion of a process, but because a foot has been produced. A foot is different from a wing, different from the beak, different from a tail.

The offending type of teleology is $teleology_3$, which "adds to the notion of termination and perfection that of an intention or aim" (Wallace 1996, 16). Again returning to the example of the duck foot, the aim of such a structure is to help the duck walk and swim. The catalyst of $teleology_3$'s offence comes in its polysemy. $Teleology_3$ may referrer to the aim of the structure, of the tool, of a process. It can also refer to the intention of the mind—either human, animal, or "…?..." (the elephant is in the room). Human consciousness is object

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[229] These designations are my own labels, but it should be obvious that I am following the strategy

directed. Consciousness is about something, a quality of consciousness Husserl called "intentionality." Intentionality is teleological, it aims at something, and one can designate the teleology of intentionality as the object of consciousness. Humans have aims, intentions. Dogs, cats, and dolphins probably do too, on some level.

The point being made here is in part similar to, and in part different from, that made in Daniel Dennett's *The Intentional Stance*. Dennett recognizes the effectiveness of treating items in the natural world as though they had a purpose is incredibly useful for understanding their physical system behavior, so he recommends that we treat natural items as if they had purpose, though there is no mechanism to explain how they would have such a purpose, or teleology. According to Dennett

> Here is how it works: first you decide to treat the object whose behavior is to be predicted as a rational agent; then you figure out what beliefs the agent ought to have, given its place in the world and its purpose. Then you figure out what desires it ought to have, on the same consideration, and finally you predict that this rational agent will act to further its goals in the light of its beliefs. A little practical reasoning form the chosen set of beliefs and desires will in many—but not all—instances yield a decision about what the agent ought to do; that is what you predict the agent will do. (1987, 17)

So Dennett advises one treat things as though they had purpose, though they—for the most part—do not. Dennett is close to the mark of what I am calling teleology$_3$. However. Dennett is clear that his strategy is strictly pragmatic. He says that it works, though he also reports that no one can find any good explanation for the extraordinary utility of treating things in the natural world as though they had purpose and teleology.[230] Teleology$_3$ differs from the

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Ricoeur used when approaching the concept of *mimesis*.

[230] On this point Dennett writes, "When we turn to the question of *why* the intentional strategy works as well as it does, we find that the sort of question is ambiguous, admitting of two very different sorts of answers. If the intentional system is a simple thermostat, one answer is simply this: the intentional strategy works because the thermostat is well designed; it was designed to be a system that could easily and reliably comprehended and manipulated from this stance. That is true, but not very informative, if what we are after are the actual features of its design that explain its performance. Fortunately, however, in the case of a simple thermostat those features are easily discovered and understood, so the other answer to our why question, which is really an answer about how the machinery works, is readily available.

"If the intentional system in question is a person, there is also an ambiguity in our question. The first answer to the question of why the intentional strategy works is that evolution has designed human beings to be rational, to believe what they ought to believe and want what they ought to want. The fact that we are products of a long and demanding evolutionary process guarantees that using the intentional strategy on us is a safe bet. This answer has the virtues of truth and brevity, and on this occasion the additional answer Herbert Spencer would applaud, but it is also strikingly

intentional stance in that teleology$_3$ is referential, following Ricoeur's theory of metaphorical referent. A metaphorical predication is occurring in the imputation of teleology in relationship between the primary and secondary systems, such that a natural particular can be treated as purposeful, though it lacks will. Thus, following the Metaphorical Square of Opposition, teleology$_3$ is an A, E, I, and O predication. What causes problems is when the source domain for the model, the willing agent, is collapsed into the particular being modeled such that the natural object is treated as though it actually has a will. Many things have a teleology they know not of, so do many people, and it hurts to watch. The hermeneutic phenomenology of complex systems permits this opening of teleological complexity, without reducing teleology to one corner of the teleology$_3$ to one corner of the Metaphorical Square of Opposition.

So what makes teleology$_3$ (this phenomenological notion that leads one to impute goal-directedness onto things which have no intentionality themselves) into a controversial concept that apparently died with David Hume's internment? A precise answer to that question is certainly beyond the focus of this dissertation. But however controversial teleology$_3$ may be, it is actually one of the most powerful and useful concepts in natural science, specifically as a hermeneutical concept. Let me explain. Teleology$_3$ unites teleology$_1$ and teleology$_2$ together into one gestalt, but one which does not necessitate that teleology$_1$ and teleology$_2$ always be subsumed into teleology$_3$. Thus, (teleology$_1$) the temporal end of a process and the limit of its use of material resources and (teleology$_2$) the perfection of the product are united in one multi-faceted awareness that anticipates the destination of the process. Teleology$_3$ permits one to see the whole in action with, and as, its parts. The goal of human adulthood makes sense of the various morphological and changing-nutritional phases of human development. The notion of malnutrition is an example of this type of thinking. It is no wonder that scientists aiming to explain function in the natural world constantly make recourse to the language of teleology$_3$, because such language hermeneutically opens the causal structure of the world for examination. It is as though, without the language of teleology$_3$, the mind would be blind to understanding the unfolding processes of the natural world. Immanuel Kant makes the same point in his third *Critique* in which he supports the view of a Newtonian universe, operating through natural laws, but in which organisms must be understood through teleology (1951, 265-279). Kant defends teleology in respect to biological organisms because each one of the parts works in service

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uninformative. The more difficult version of the question asks, in effect, how the machinery which Nature has provided us works. And we cannot yet give a good answer to that question. We just do not know. We do know how the strategy works, and we know the easy answer to the question of why it works, but knowing these does not help us much with the hard answer." (1987, 33)

to the rest of the parts of the organism. Thus, in Kant's eyes, the organism must be the teleology of its own growth process, as well as that which is the cause of the perpetuation of its own species. We see that even Immanuel Kant, a pioneer of our deep modern scepticism toward metaphysics, concludes a position coterminous with Aristotle's in *On the parts of animals*. Kant did not know in his time that the organic principles of complex biological systems would also show up in other complex systems in the natural world.

It would make a considerable research project to identify the full relationship between meaning as the teleology of discourse and function as the teleology of process. Instead of positing this connection as an absolute truth, I will instead offer it as a hypothesis. The rest of this chapter will explore the consequences that would follow should such a hypothesis be proved correct.

At this point we now have the resources to draw an instrumental analogy between the function of system processes and meaning in discourse. Through Aristotle's theory of substance and *meros,* which I will discuss below, we may define *function* as the teleology of *process*, corresponding to *meaning* as the teleology of *discourse.* This unity of purpose is opened to us through Ricoeur's model of the text. Whether he intended this or not, Ricoeur draws the structural model of Saussure together with the triadic sign relationship[231] of C. S. Peirce (1955), as illustrated in the figure below.

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[231] Peirce explains, "A *Sign* or *Representamen*, is a First which stands in such a genuine triadic relation to a *Second*, called its *Object*, as to be capable of determining a Third, called its *Interpretant*, to assume the same Object. The triadic relation is *genuine*, that is its three members are bound together by it in a way that does not consist in any complexus of dyadic relations. That is the reason the Interpretant, or Third, cannot stand in a mere dyadic relation to the Object, but must stand in such a relation to it as the Representamen itself does. Nor can the triadic relation in which the Third stands be merely similar to that in which the First stands, for this would make the relation to that in which the First stands, for this would make the relation of the Third to the First a degenerate Secondness merely" [emphasis his] (Peirce 1955, 99-100).

Intentionality

Intentionality

Meaning intention

Mode of intentionality

Mode of intentionality

Meaning intention

(Actuality)
DISCOURSE

"This piece is a knight."

Reconfiguration of polysemy through metaphorical predication

part
rock
queen
ear
not
nose
horse
velvet
knight
piece
sand
king
rook
this
that
is
could
whole

LANGUE
(Potentiality)
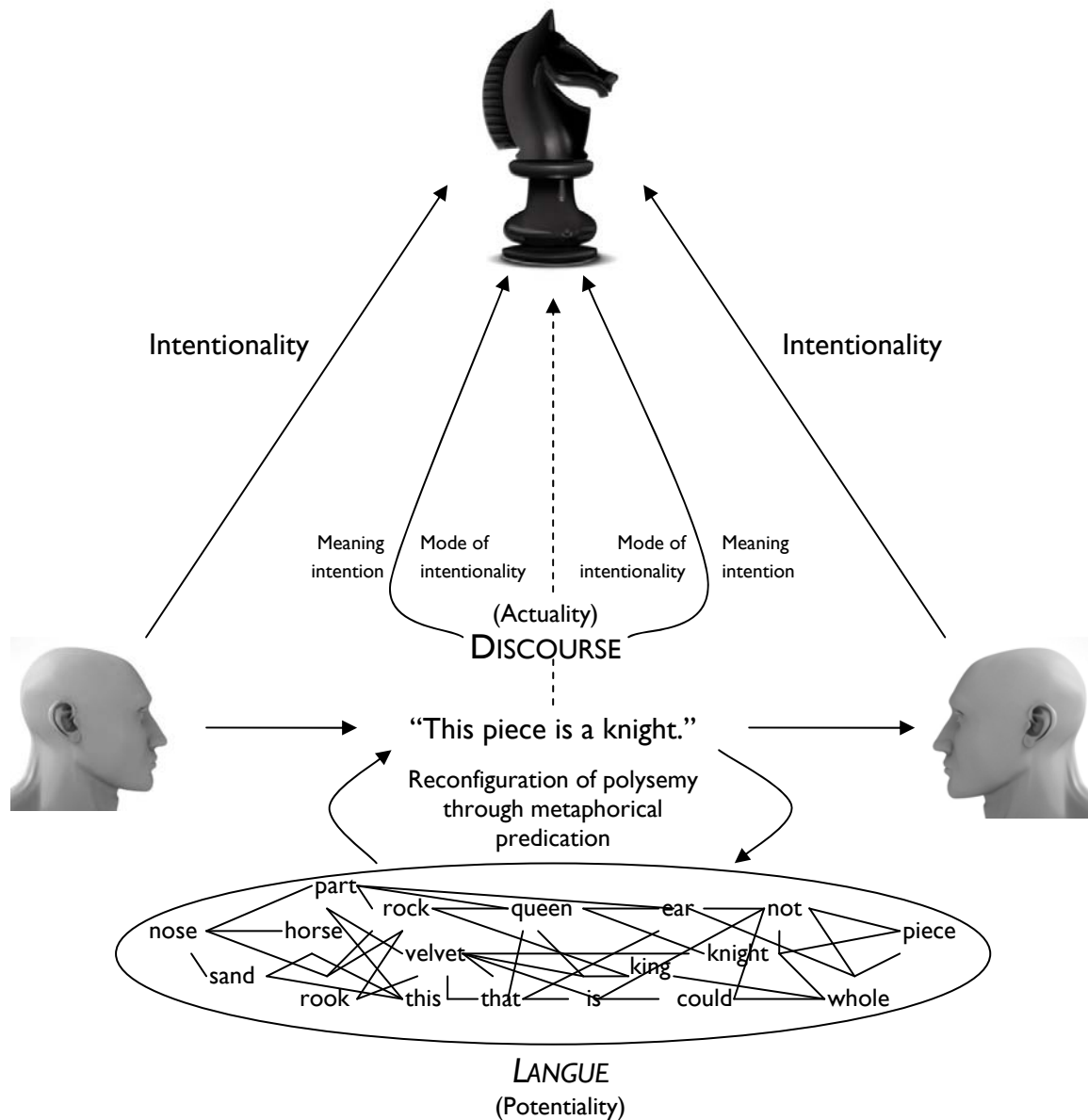
Figure 6.2. This diagram illustrates Ricoeur's use of Saussure's notion of langue and Aristotle's theory of discourse. This drawing also illustrates how the smallest sign of discourse, the sentence, also displays C.S. Peirce's triadic relation. The first, the Representamen is constituted in the sentence token of discourse, separate from its referential function as conceived in the potentiality of *langue.* The second, the Object is the chess piece. Peirce understands the object as a sign itself, where Ricoeur sees discourse as referential. Finally the third, the Interpretant is constituted in discourse in its mode of intentionalility and meaning intention. In the way that Pierce recognizes that the single sign has a three-fold relation, Ricoeur recognizes multifaceted relations of discourse.

However, unlike Peirce, Ricoeur does not understand the intentional quality of the sign as fully constituted in another sign. Through the methods of phenomenology, Ricoeur approaches phenomena as accessible to consciousness; however, not all of being is revealed at once, and must be interpreted though the hermeneutic methods of phenomenology. At the same time, discourse serves the directed function of the mental sign in Pierce's sign theory. Ricoeur accomplishes this by attributing intentionality to the text. Of

course this is fictive intentionality because texts are not people. However, both oral discourse and inscribed discourse are comprised of words, illustrating the power of Ricoeur's idea. Since the text is removed from the speaker through the structure of language, and given its own creative power in discourse, the question of the meaning may be treated without the author present. Said another way: meaning is among the words, not just in the author's mind.

Ricoeur is often misinterpreted on this point. Ricoeur is not saying that the author is not important. Nor is he saying that the author's intentions are not revealed in the text, ever. He is saying that discourse has its own intentionality, a teleology that humans publicly impute to their discourse. This dialectic between authorial meaning and textual meaning is not an opposition between two antinomies. As Ricoeur understands it, the human will, acting with intentionality in living human speakers, makes choices about what words they will assemble into sentences. This intentionality makes possible the "intention" of the text. Thus, in Ricoeur's notion of the intention of the text, we see the human ability to understand through fiction (the fictionalised intention of the text—thus making the text character like), and so this ability to fictionalise is even found in the core of discourse. Narrative has a heuristic function, but the root of its heuristic function rests in the minds ability to productively map conceptual domains upon one another, and this ability makes possible higher level actions which can appropriately be labelled "creative." It should be no surprise to find the human ability, which seems to make the construction of metaphors possible, also seems to apply the conceptual mapping of human intention on to an artefact (the visible or aural signs of discourse), which intern expresses the intention of the person. The artefact of discourse does so by being treated as though it, itself, has intention. Furthermore, we can recognise the corresponding fictive work in both the creation of the intentionality of the text (through the language, organisation, event and word meaning) and the fictive (not fictional) unity of material, work time, nature form, and teleology in the function of a system, interpreted in teleology$_3$.

In both cases, the act of fictionalizing, far from problematising and making subjective the interpretation of meaning or function, opens a distance between subject and the object of reflection at an appropriate "angle of aperture, and depth of field" in which part and whole are open to view and to the work of hermeneutics (Ricoeur 1985, 94). This is the great accomplishment of fiction, which makes it transcend the simple categories if existential truth and falsity, without denying truth. Frodo was the ring bearer, and it would be as much of a lie to say he was not, as to say he really existed. Likewise, human words are not people, but it would be dishonest to purposely obscure the meaning of a discourse which is clear and wise in its application of the resources of *langue*. This fictional distance places a discourse before

the interpreter at the proper aesthetic distance, to borrow Merleau-Ponty's terminology. Thus, human embodiment in its special context is a precondition for both the development of discourse itself *and* the interpretation of it, from the perspective of hermeneutic phenomenology.

In what follows I will show how the model of the text both unifies but also opens the elements of a complex system along lines analogous to the creative activity of discourse, wherein the whole signifies more than the parts.

4.2 THE METAPHORICAL SENTENCE REFIGURES THE POWER OF WORDS

In what follows, I will show that discourse exhibits the properties of complex systems. It does so because predication has the power to reconfigure the polysemy of its parts, stretching polysemy, adding to it, without necessarily destroying the parts themselves. I will then use Aristotle's theory of part and whole from *On the parts of animals* to develop this view more carefully so that it has the subtlety to engage with the natural sciences.

In *The rule of metaphor* (1977) Ricoeur returns to the source of the Western tradition's taxonomy of metaphor and shows the metaphor's roots are in both the mimesis of poetics and the heuristics of rhetoric, a rhetoric bolder and brasher than Aristotle's treatise *Rhetoric* would suggest. From Aristotle's work Ricoeur also shows the intuition that metaphor is more than a mere trope as I explained in detail in chapter 1. Ricoeur warrants a different approach to metaphor within the contemporary work on the semantics of discourse, making a detour through structuralism. Ricoeur develops the signification of discourse as distinct from that of *langue* and leans on the work of Max Black and Mary Hesse, among others, to discern in the operation of metaphor more significant than mere deviant predication (see chapter 1). Metaphor is irreducible to either its primary or secondary term and exists in the tension between both; a tension that exists in discourse not in *langue*. Furthermore, the relationship between the metaphor and the scientific model shows that metaphor can speak to a metaphorical referent (see chapter 1). Thus metaphor retains the significant quality of discourse; it says something about something, to someone.

When the metaphorical sentence predicates, its power relies on the polysemy of *langue*, but it also stretches and adds to the polysemy of the words it uses. The creative predication of metaphorical discourse builds polysemy into the *langue* system. Because Ricoeur does not compress the signification of discourse into *langue*, a curious situation occurs. Within structuralism, and post-structuralism for that matter, the increased polysemy to the parts of the system of *langue* requires that the system, on the synchronic level, be altered. The only possible relationships of signification are those of difference; a change in

the system changes the web of differences in which a sign participates. Above, we saw Ricoeur's case for why this follows from structuralism's premises, and we saw how Derrida extends these premises.

On Ricoeur's terms, a polysemic model of *langue* would require a multi-dimensional space for the words to interact with one another as they do in natural language. In this multidimensional space (generated only through word relationships—thus its ontology is solely the bounds of the creative production of discourse) the addition of new polysemy to a word does not necessarily eradicate the older elements of polysemy. The illusion of destruction occurs when the signification of discourse is artificially theoretically constrained according to the system and signification of *langue*.

Furthermore, the creative act of discourse requires that words be present, and potentially available, for the act of predication. This need is further evidence that discourse and *langue* must be distinguished. One cannot simply creatively speak, although many out-of-work poets in coffee houses in college towns the world over seem to think so. If one wants to discourse metaphorically, the deviant predication of metaphor will be lost on the recipient of the discourse if the *langue* used is not familiar to him. Metaphor pleases in that it says something in a new way, a way of expression that the recipient of the discourse might not have anticipated. The parts supplied by *langue* may be used in ways that surprise and thus reconfigure the polysemy of the parts used (see chapter 4). But the reconfiguration must retain continuity with the past use of the linguistic sign.

4.3 THE SUBSTANCE AND *MEROS* OF SEMIOTICS

We find, then, a reciprocal relationship between *langue* and discourse. *Langue* provides the power for creative discourse, and discourse provides the creative act necessary for building and maintaining *langue*. This curious feature of *langue*, highlighted in metaphorical discourse, provokes Ricoeur to ask the important question: what ontology[232] does metaphorical discourse suggest? The relationship between power and act observed in the interplay between *langue* and discourse suggests something approximating the Aristotelian ontology of potentiality and actuality. *Langue* is the potential power for the creativity of discourse. To be clear, using Ricoeur's terms, the significant event of discourse instantiates the meaning of the words in a predicative act, a single signifier, toward the object of discourse, whatever matter to which the sentence "speaks." The sentence then refigures the potentiality of *langue*. Ricoeur quickly points out that in Aristotle's ontology of

potentiality and actuality, neither is ultimate. As Ricoeur summarizes: "ontology says hardly more than this: potency and actuality are defined correlatively, that is to say in a circular fashion" (1977, 307).

The sympathy between *langue*/discourse and something like Aristotelian metaphysics should provoke us to look deeper into what makes this sympathy possible. The parts are relating to the whole, contributing to the unity of the whole. This is exactly the relationship that we find described in Aristotle's *On the parts of animals*, a relationship so strong that Kant must grant its teleology in the *Third critique* (Kant 1951, 265-279).

It will help to briefly review the ground covered in chapter 5, which developed the framework that be employed in our discussion of teleology below. Aristotle carefully develops his model of the four causes in terms of biological organisms. He designates the entire organism as a "substance," a thing indivisible. Indivisibility is not the same thing as immortality. Sure a substance can be destroyed, or become corrupt (see Aristotle's *On generation and corruption*). If part of it is severed and dies, the dead part is no longer the substance. Furthermore, if the parts cease to function as a whole they are no longer the parts to the substance. Aristotle has a strong view of the unity of the organism. Within that strong view, Aristotle is able to apply his model of the four causes. His view also precludes substance dividing as a substance.[233]

But Aristotle goes further to apply the model of the four causes to the *meroi*, the parts, of an organism. Within Aristotle's biological treatises *meros* does not mean *mere part*. It refers to a living part of a living substance. This means that the operation of the four causes in and through that part imply the action, structure, material and teleology of that part work toward the service of the organism. Furthermore the teleology of a part will not be the teleology of the whole – the heart pumps blood, people seeking satisfaction and happiness in life. Hearts do not seek such things.

As I explained in chapter 5, in the interrelationships between the various *meroi* of an organism, there will be *meroi* that serve other *meroi*, and thus the whole organism. Aristotle does seem to have anticipated the need for a different kind of relationship, not expressed in the model of the four causes, because he calls the unified organism "*organon*", which in Greek means *instrument* (642a 11-13). As I explained above, the instrumental cause calls up all four causes in such a way that it cannot be fully reduced to any one of them (see Chapter 5). According to Aristotle, the organism is its own material cause, formal cause, efficient cause, and teleological cause, and we may also add instrumental cause. In the

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[232] I am not specifying a particular domain for ontological discussion, for instance *the mind*, because Ricoeur applies this ontology broadly, and thus he does not specify a particular domain.
[233] Riceour is no enemy of mitosis.

sections that follow, the substance and *meroi* will be treated as phenomena that can be hermeneutically pursued, and interpreted through Ricoeur's development of *mimesis* and *muthos*, which are of course built upon substantially the same metaphysical framework as Aristotle's systems theory. As I illustrated above, teleology is the hermeneutical tool that draws both the domains of discourse and process together to be understood.

The hypothesis, then (that a strong analogy between the teleology of *langue* and the teleology of process is constituted in the fictive work of both, which puts each at the proper hermeneutical distance), has borne fruit. What is this fruit? That neither the meaning of discourse and in the function of systems are reducible to their parts, yet both analogously employ a directedness, or purposive-ness. Upon this analogy, we will now move on to develop a hermeneutics of complex systems.

5. STAGE 4: THE HERMENEUTICS OF HUMAN ACTION AND COMPLEX SYSTEMS

Though we have not yet arrived at a hermeneutic *phenomenology* of complex systems, this section will show that a hermeneutic of complex systems develops out of Ricoeur's model of the text. A move from text to world could be made in short order because mimesis need not only redescribe human action but can redescribe natural actions as well. However, to make clear the effectiveness of a hermeneutic of complex systems, I draw on Ricoeur's work to sketch the interconnections of discourse, text and finally, human action. Through the analogy of function and meaning, based in the hypothetical teleology of both system and discourse respectively, we may extend the model of the text to complex systems through the hermeneutics of human action to the causal relations in natural phenomena, because the exegesis of human action is, in large part, an exegesis of cause. Human actions require exegesis because their causes are hidden to immediate observation, and we find this same need in understanding the nodes of complex systems.

In chapter 4, I introduced the application of Ricoeur's model of the text to human actions. Ricoeur (1991, 145f) identifies four distinct properties that distinguish discourse from *langue*:

> 1. Discourse is an event, but *langue* is "virtual and outside of time." (145)
> 2. Discourse refers back to a speaking subject, but *langue* lacks a subject.
> 3. Discourse refers to the world symbolically, whereas linguistic signs per se distinguish themselves only in contrast to other signs.[234]

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[234] For more on this point see chapter 4.

4. Discourse speaks to someone, while *langue* only makes communication possible. Ricoeur can distinguish between discourse and *langue* by recognising structuralism's observations on the level of individual words, but using Aristotle's theory of discourse to redeem the poverty of the structuralist account of predication.

I went on to show how the inscription of discourse as text transforms discourse in ways that extend beyond the distinction of discourse from *langue* through to text itself. My argument can be summarized briefly:

1. While the event of discourse occurs and is lost in the changing stream of the past, writing fixes the discourse event, so an interpreter may return to it and often its context.

2. While the event of discourse refers back to a speaking subject, the act of writing distanciates the message from the writer. A text may allude to a world beyond itself, but it does so by being enclosed, and this fact guides the proficient writer to choose words carefully. A text can escape its immediate situation and, in new contexts, mean things that the author did not necessarily intend.

3. Also, while discourse reveals a particular situation in which it is spoken, inscribed discourse reveals *its own world*. It follows that a text distanciated from its author by a thousand years can reveal its world, for instance *Beowulf* or *The Iliad*.

4. Finally, while discourse is addressed to a conversation partner present in the discourse situation, written text is addressed to anyone who can read. "In escaping the momentary character of the event, the bounds lived by the author, and the narrowness of ostensive reference, discourse escapes the limits of being face to face…. An unknown, invisible reader has become the unprivileged addressee of the discourse." (150)

Ricoeur develops the model of the text a stage further, following these four lines of transformation through to human action, treating human actions as things to be exegete and developing the model of the text as a warrant for such an exegesis.

1. Like the inscription of discourse in text, human action inscribes what is done in time. Before the event of action a person can choose from a selection of options, but a human act delimits these possibilities in an event which an agent performs, an action in time. Once completed, the action is in the past, and it becomes an item that can be studied, parsed, examined—or, more broadly, interpreted. The fixation of an action in time makes action text-like, in its having propositional content. Actions have *noema*. They mean something.

2. When an agent performs an action, that action leaves the agent. While it may be that the action was subjectively contemplated before its performance, the action cannot be retrieved after it is performed. Over time, actions even become institutionalized, in that the actions *may* have meanings that the actor did not intend.

3. In a way analogous to a text's revelation of its own world, a human act reveals a world of itself. "Not only does a work mirror its time, but it opens up a world that it bears within itself" (Ricoeur 1991, 155). It does so because discourse is referential, it passes beyond the immediate code of *langue*. This feature is keenly seen in fiction, in which the author has control over both the setting and the action of the characters. In fiction, the author crafts the actions of others, but the action of crafting the discourse also reveals information about the author, and about his or her time. But it does so not because of letters or grammatical structures (though those might be a part of the process of this revelation). Rather, it does so because the action of the author is the product of the author (as authorial action), which lets one see into the mind, will, character, and circumstances of the author and the author's audience.

4. Finally, like text, human action is an open work with meaning "in suspense." "Human action, too, is opened to anybody who can read. In the same way that the meaning of an event is the sense of its forthcoming interpretations, the interpretation by contemporaries has no particular privilege in this process." (Ricoeur 1991, 155)

So we see that Ricoeur develops the distinction between *langue* and discourse through various transformations to arrive at a text model for the interpretation of human

actions. In the rest of this chapter, I will extend the features of its application to human actions through to complex systems.

In the summary above in this chapter (and also in the overview of Ricoeur's ideas in chapter 4) distanciation played a crucial role. This basic idea Ricoeur adopts from Gadamer, who initially developed the idea of distanciation to refer to the way in which the text is removed from the occasion of its production. Though this removal may be a physical one, as when one sends a letter, Gadamer uses "distance" metaphorically to refer to the cultural removal of the text from its origin. Distanciation is the odd phenomenon that requires later writers to mediate between the cultural productions of different eras.[235] "This history of hermeneutics confirms this if, for example, we think of Augustine, who sought to mediate the Gospel with the Old Testament; or early Protestantism, which faced the same problem" (Gadamer 2004, 292). For Gadamer distanciation problematises interpretation because the interpreter in a new time, place, and culture must try to fuse together his own time with that of the text. Therefore, Gadamer looks upon distanciation negatively (Simms 2003, 39).

Ricoeur holds a different view of distanciation. For Ricoeur, distanciation leads to creative production. Without making an appeal to an absolute perspective, in which all cultures and all texts can be interpreted in the same interpretation space, he holds that distanciation of texts and cultures testifies to "the positive and productive function of distanciation at the heart of the historicity of human experience" (Ricoeur 1991, 76). Distanciation is at work, even at the primitive level of discourse, where the speaker's intention is rendered into an event by the act of speaking. This act also makes discourse a *work*, and a work *produces* something. When work generates a product, this product is an individual, a thing, an artefact. "In labouring upon discourse, a man affects the practical determination of a category of individuals: the works of discourse" (81). When discourse is inscribed as text, it takes on an even greater character of "work", for the precision and artisanship required to author a text leads to a heightened production.

The distanciation of texts permits a different encounter with text from that of mere discourse. The encounter with a text draws the reader into the world of the text, and "[t]he world of the text is... not the world of everyday language. In this sense, it constitutes a new sort of distanciation that could be called a distanciation of the real from itself" (Ricoeur 1991, 86). Ricoeur here is speaking about the encounter with fiction, but his observation applies to all occasions when the one discourse encounters another. In principle, such encounters are productive, not alienating as Gadamer sees them. Distanciation, then, is the quality that allows for one to come to know oneself through the encounter with the text and the

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[235] For Gadamer's explanation of how this occurs, see Gadamer (2004, 291-299).

subsequent return to oneself, a key theme that Ricoeur returns to in his work. The human is not known through the Cartesian *cogito*. Instead a human comes to know himself or herself through the mediation of the productions of culture (see chapter 4). One returns to oneself bearing "the world of the text"; the sweet elixir which memorialises the encounter:

> Ultimately, what I appropriate is a proposed world. The latter is not *behind* the text, as a hidden intention would be, but *in front of it*, as that which the work unfolds, discovers, reveals. Henceforth, to understand is *to understand oneself in front of the text*. It is not a question of imposing upon the text our finite capacity for understanding, but of exposing ourselves to the text and receiving from it an enlarged self, which would be the proposed existence corresponding in the most suitable way to the world proposed. So understanding is quite different from a constitution of which the subject would possess the key. In this respect, it would be more correct to say that the *self* is constituted by the "matter" of the text. (Ricoeur 1991, 87-8)

Put another way, distanciation takes away the opportunity for the constructivist claim that meaning is created in the minds of author and reader. Discourse, and particularly text as cultural artefact, are distanciated both from the author and the reader[236], and this quality of distance permits *the encounter* with the text. We see then, the greater distanciation of texts is creatively productive (see above), so Ricoeur is warranted in disagreeing with Gadamer.

When Ricoeur applies the model of the text to human action, as we saw above, human action opens a world of the action. The opening of this world depends upon the distance between human beings. We each are not immediately privy to the thoughts of the other. When someone acts, that person hermeneutically opens to us. In interacting with people, there is no list of rules for making perfect interpretive guesses as to the meaning of a human action, "[b]ut there are methods for validating guesses" (Ricoeur 1991, 158). Human actions confront us with an open world, one like a text, unified and open to appraisal, and the fact of this is readily apparent in works of history and fiction. History and fiction have this quality because texts have *plurivocity*, a quality found in literature, and even found in this chapter. At this point, the present chapter and the dissertation in which it finds itself are unfolding before the reader. Even when the work is completed, it will provoke new questions; as I have already promised at its outset, it will be incomplete. This general openness is a

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[236] For how this occurs see Ricoeur (1991, 84-88).

quality of texts in general, but especially fiction.[237] However, this openness is not unlimited--*plurivocity*, not *infinito-vocity*. A text cannot be made to mean anything. So it is with human action. Here Ricoeur makes an observation that is decisive to the development of my argument:

> That the meaning of human actions, of historical events, and of social phenomena may be *construed* in several different ways is well known by all experts in the human sciences. What is less known and understood is that <u>this methodological perplexity is founded in the nature of the object itself</u> and, moreover, that it does not condemn the scientist to oscillate between dogmatism and scepticism. As the logic of text interpretation suggests, there is a *specific plurivocity* belonging to the meaning of human action. Human action, is, a limited field of possible constructions. (*emphasis his*, <u>emphasis mine</u> Ricoeur 1991, 160).

Meaningful actions reveal human character, but the nature of human actions, namely that they are performed by humans, gives them a plurivocal quality. Human actions, when viewed outside of their context, can have multiple meanings attributed to them, a reality which can lead to the untimely dissolution of friendship, and the separation of lovers. Narrative limits this plurivocal quality, while at the same time using that quality in the development of the narrative. It does so by uniting these possibilities into a single structured whole (which somehow also retains its openness). Narrative derives its power in part from possibilities becoming definite events, which in turn create possibilities that lead to other events, and so on. This feature of narrative is made possible by the nature of narrative itself, that it is no just the imitation of the world through text—more precisely, it is *the imitation of human action*! Aristotle makes this point quite clear (1448a 1). This is why Ricoeur advocates that the best history is done long after the events have occurred, when the distanciation of time permits a greater comprehension of the factors involved. It is this kind of historical reflection that leads to wisdom. What is critical for us to understand at this point is that the opportunity to narratively reflect on human action is "founded in the nature of the object itself"; human actions reveal something hidden because we do not know what a human will choose. From the outside, a human is a body with a face. Character is rarely revealed in a camera flash. Human participation in narrative reveals the internal hidden qualities, but in a plurivocal way, a way that requires further narrative to understand.

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[237] For a brief description of why this is the case see Ricoeur (1991, 86).

Narratives can accomplish this clarification because of their own *plurivocity*, which depends upon the unity of plot. A narrative can have many voices because it is a narrative; the human action of a narrative opens not only the action of the main character, but also the author, and the secondary characters, or the central characters relationship with the natural world, or any combination, or permutation of these possibilities. Narrative makes possible renarration of the same story from "another point of view." It permits one to ask what the unity of the plot would have looked like from the perspective of the antagonist, or another character. The narrative is a single unity that favours diversity, yet is drawn to fulfilment.

6. STAGE 5: IGNORANCE TO KNOWLEDGE: SYSTEM BOUNDARIES AND THE EXEGESIS OF CAUSE

Ricoeur's study of distanciation with human actions applies directly to the phenomena of complex systems. I will now *trace* through his four applications of the model of text to human actions and *apply* each in turn to complex systems. I will first begin with the *meros*, move to the substance—the system—and then conclude with some observations on the hermeneutics of parts and wholes. I will also tackle the difficult question of delineating a system even when its boundaries are difficult to identify. I will then conclude the chapter. (The expositional text which follows will generally restrict the illustrations to the field of brain science, however, several of the footnotes for this section feature examples drawn from history and economics, and may serve as helpful examples to illustrate the theory in the main text.)

An organic part or *meros*, in Aristotle's terms, performs the four themes in Ricoeur's model of the text in the following ways:

1. An e*vent action not only fixes the event in the system, but it also perpetuates the system.* This feature is correlation of the instrumental cause and the work of discourse upon *langue*, which relates to the quality of discourse as an event, but also permits the importance of an event to pass beyond the event itself into the system, which exists, not as the sum, but at *the production* of the parts. It is true that a system can eradicate previous states of the system, but previous system elements leave "traces" at times, which help to reconstruct the system. [238]

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[238] This is the standard problem for historians of ancient economics, because the event-relative information of economic transactions and market reporting becomes irrelevant as events pass. However, economic events have effects on other systems, kings, armies, religious practice and the like. These events serve to retain economic-state information that allows researches to "reconstruct" ancient economies. For example, there's no place (that I know of) in ancient literature that says that Egypt was a major economic player in the Roman republic and empire. However, N.T Wright (1992, 113) observes that ancient Rome was politically motivated to keep peace in Palestine because of its nearness to Egypt which grew the grain they needed to maintain their armies. This observation, which

Far from events occurring and leaving *nothing* but traces in a system of differences, these events richly inscribe themselves upon the system in which they occur, creating the future states of the system possible. Their participation in the system also makes possible the reconstruction of the events through narrative, because of the limits that that system participation places on the events by their nature and context.

2. *The effect of the event is distanciated into the system through local interactions, but the effects, like text, may be significantly distant from the events which cause them.* System participation makes this distanciation necessary, and productive—productive because events may be used in new ways, leading to new products. Metaphorical predication does this to *langue*, but a similar feature appears emerge from complex systems. In a complex system things can happen and their immediate significance may not be felt at all, but the long-term systemic effects may leave the system thunderstruck.[239]

3. *The* meros *opens the world of the system*. The lines comprising the representations of neural models in textbooks and journal articles, if taken without careful reflection, will deceive us. The activity of one *meros* in the system cannot be separated from the rest of system, for it acts only because the rest of the system feeds it, empowers it, gives it its necessary structural support, and a system determined (and maybe determining) role, so long as it functions as an instrument in service to the other *meroi*. This means that the *meros* hermeneutically opens the system, not the whole system, but the correct interpretation of its causal relationships, both delimits the nature of the *meros*, and opens other *meroi* to interpretation.[240] *Practically, one may explore the phenomena of the system*

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draws on the well-known agricultural history of grain growing in Egypt also explains why Herod the Great would court the favour of Egypt and Caesar and Mark Antony would be so interested in Cleopatra. While it may not appear at first that the Roman use of the grain is important to understanding economics, we must grasp that there are many kinds of customers. The Roman army was a significant consumer, among others, which accounts for why Alexandria retains its significance as a trading city (and a university town, but we're going a-field) even though the nation's torch of military significance had all but extinguished. Of course Egypt would retain cash flow to support an important and economically vibrant culture during this period!

[239] The above example of the Egyptian grain economy illustrates this as well. The sustenance of Egyptian grain fueled the Roman army, which in turn made possible the economic effects of particular Roman companies on local town economies throughout the empire, as well as the history-defining military action of the Roman Empire. This second point is obvious enough.

[240] To return to the example of economics, the rebellion of the aristocracy in Jerusalem in AD 66 (see Price 1997) did aim at power, but also for religious reasons. This move had several consequences. Some Jerusalem residents with wealth bought food to hoard in Jerusalem knowing that there would be a siege, and that everyone in the city would starve. A city under siege is a great market for food. This entrepreneurial effort could anticipate the Roman action to retake the city. However, the Roman action had no entrepreneurial aim. Rather, they had to keep the stability of the empire in the region that provided a substantial portion of the food for their army. The event of the rebellion opens the world of the action that helps us to understand the questions, symbols, praxis, and myths (for the source of this four category framework see Wright 1992, 1-144) of the aristocrats in Jerusalem. But the Roman choice to leave the Jews to keep their previous questions, symbols, praxis and myths and changing that strategy after the rebellion shows that the rebellion threatened something outside the

by hermeneutically working out the implications of each of the five causes from any meros *in the system and iteratively come to a growing knowledge of the whole.*

This principle can be illustrated from neural anatomy, but the neural example will best be introduced by the appetizer of an example from economics using the subject of price calculation. A price is a number. However, prices open a world of the *meros*, in this case a "world of the price." An economic system is information rich. There is too much information for any one person to keep in mind. Thus, the price reduces the amount of information that a person needs to function within an economy. Follow what we have discussed above regarding the relationship between langue and discourse in hermeneutic phenomenology, discourse acts as an irreducible surface under which and through which *langue* operates. Prices are acts of discourse, they affirm something about something, namely what a thing costs. Because a price is discourse, if follows If one has some access into the underlying factors of what goes in to making the price (like the structural notion of *langue*), and also an applied price (an act of *discourse*, "This costs x."), then one may open the world that constructed that price.

This happens all the time in business. For example: suppose that a vice president at Hewlett Packard, responsible for the notebook computer division of HP, notices that Apple is selling a new high end Macintosh notebook for only $1800. The vice president in a comparative field, with access to what goes into the *act* of making a notebook computer and pricing it competitively, will receive a mountain of information by those four digits. There might be plenty of things he does not know about how Apple was able to make their fancy new computer so cheaply, but the price would guide him to ask the right questions. The price opens a "world of the price," because it is a form of discourse.

The detour through economics was just a way set up for the real example. We may find a strong duplication of the "world of the price" in the word of the neuronal *meros*. The neuron will serve us well as an example. According to our best research, a neuron averages the action potential that it receives. A neuron's means of setting the "weight" of the neuron functions somewhat analogously to the price in an economic system, in that it reduces the amount of information that needs to be processed. However, that general principle (which of

conditions as they had been. That thing that was threatened was the peace of the realm that permitted Roman military power to be preserved. The destruction of the Temple by the Romans shows that they understood that the questions, symbols, praxes, and myths were the cause of Jewish hostility, so they destroyed the supreme political and religious symbol of Judaism, the Temple. Their success at this provoked a crisis in Jewish theological questions, praxes, and myths; the crisis was so great that Josephus believes that the God of Israel had gone over to the Romans. This account points to the significance of Egypt's act of supplying grain to the Roman army. It also shows how the event opens a world of the system. It does so when one hermeneutically opens the phenomena of consideration through the applications of the five causes.

course is applied differently in different classes of neurons) permits a human researcher to open a world of the neuron, the system in which it participates. If one were to understand more data points from the pathway in which the neuron participates, understanding properties of the surrounding neurons, the value of the neuron, like the price of the Macintosh, opens a world of knowledge to the researcher, so long as he can trace causal relations (in the fuller Aristotelian sense) into the system.

Notice that unlike the structural approach, which requires that one study "system states" in order to understand the system, a hermeneutic phenomenological approach does not require one to exhaustively understand the whole system. The creative act of discourse neither requires one to exhaustively know the whole system, nor every last word used by a single unit of discourse. The use of the parts in discourse opens the meaning of the parts in their use. The operation of system parts in actualisation permits them to be known as acting system parts that open the system to being understood. Thus, at least in complex systems, Quine's famous reference[241] to doing philosophy as being like building a ship adrift in the water is right, with the exception that the boat is floating in the middle of a shipyard (1992, 79).

4. *Finally, as human action is an open work with meaning in suspense, so is a* meros. *We must add that the open causal possibilities of interpretation narrow the farther one traces the causes from a* meros. This feature of a *meros* is also strongly analogous to the polysemy of *langue* signs. Words have multiple uses, or meanings within the distinctions of *langue*. However, when these actualise in the event of discourse they find new uses, without dropping the old uses. Within complex systems, this feature is a common trait, noticed at nearly every level of brain organization. When individual cells or neurotransmitters are considered in their own properties, it is very difficult to tell what they do, but taken systemically, the ambiguity is cleared up. However, the same part may be used for different things in different processes. Earlier we observed that neurotransmitters and neuroregulators are substantially interchangeable. On the level of the neuron we notice considerable plasticity, depending on the activities of surrounding neurons. The further one places ones vantage point from neuron to the pathway in which it participates, the clearer the use of the pathway.

The hermeneutic phenomenology applies to the parts of complex systems, but it also illuminates wholes in some surprising ways. I will develop the substance—or system—along the same four themes:

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[241] Of course Quine actually references Otto Neurath.

1. *The substance is the event space for a* meros*'s action, in which the action of a* meros *may be demarcated; however, the action of the* meros *is at the same time wholly dependent on the resources of the whole, such that the individual event cannot be understood as a system event without reference to the system. Thus, individual action is dialectically a participant in substance life, an irreducible action.* In other words, a system event must be understood in terms of the action, resources, and structure of the system as a whole. And if a system is part of a greater system, this point also helps to open the inter-system and intra-system relationships. We saw this same situation in discourse. When *langue* is summoned into the single significance of discourse, each of the parts functions toward that whole in the act of discourse. Each sign does its part to make the single significance possible. In hermeneutic phenomenology, words act toward the single signification of the sentence (which may be plurivocal in its single significance), hence the action of the parts summoned, is the one act of the whole. It is true that the individual words serve different roles according the prescriptions of grammar; however, in these roles, they serve the single act of sentence signification. Thus, hermeneutic phenomenology finds common ground with Aristotle's distinction between the teleology of a substance and the teleology of a *meros*. The action of a meros is part-action not whole action. But it equally true that a *meros*, is moving in the whole, acting as the whole.

2. *Relatedly, at the boundary between part and whole is a horizon of transformation: an event of a* meros *affects other* meroi *and thus affects the substance. The event of the whole is a second distanciation, for the substance is acting as a* unity *of causes, not the sum of them.* Complex systems require us to make a demarcation between the action of a part and the action of the whole. Depending on the nature of the system, this demarcation can be a clear barrier, like the skin of the human body.

Sometimes the demarcation can be more difficult to define, say when someone tries to demarcate the boundary between an ecosystem and an economic system (Limburg 2002). Of course, the line of definition between the two systems is that one is comprised of inter-human property transactions, while the other involves more than human property transactions. However, pollution, is an economic impact on the environment, as pointed out by Limburg *et al.* (2002). One system affects another.

The problem of boundaries arises most starkly when one considers the nature of a *meros* that is in itself composed of other *meroi*, a part which is also itself a part.[242] The arch-*meros*, if we can call it that, demonstrates the need for this second application of Ricoeur's model of the text. The arch-*meros* relates to its own interior as substance to *meros*,

however, at the lower stages, a *meros* may bypass affecting the whole through its arch-*meros*, and directly affect other systems. We find this in the brain, to some degree, in the interchangeable relationship of neurotransmitter and neuromodulator (see chapter 3). At any rate, at the boundary between the system and the "outside," the system behaves differently; it behaves like a whole, and thus can be distinguished *like* a substance. Admittedly, this means that one needs to be very careful when identifying the systems one wishes to describe, especially when trying to model human systems, and human behavior in a population. One ought to be careful not to confuse substance and *meros* in human social systems. Beyond the biological and institutional realms, human cognition depends upon language to function, and language, though it might have a subjective impact, is a public artefact; it reveals humans as social creatures, interacting with one another, not with solely social *behaviors*, but also cognitive and emotive function. This is nothing but a hermeneutic phenomenological extension of the same fictionalizing, the mapping of intention, upon the aural and visual artefacts of discourse, which was discussed above.

However, even when a system's boundaries are fuzzy, like the boundaries of an economy, it can still be identified distinctly from other systems and also from its own parts, as John Warden demonstrates[243] through his five-ring model of for the strategic targeting of

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[242] Economics is one subsystem of human social organization. In economic systems literature this question is treated in the context of world-system analysis. For more see Shannon (1996).
[243] This is clear because it is possible to discern how to injure, or inhibit system function, which is done in business and warfare. John Warden argues that enemies in war may be modeled as a system of five rings, each ring standing for a certain sub-system within the enemy, with each ring acting as a necessary conduit between the ring before and the one after it (1995, for both business and war applications see 2001). Working from the inside out,

- The first ring, at the centre, is the *leadership*. Leadership is a system. While an individual leader, maybe a Stalin- or Hitler-like dictator, may appear to have all power, leaders always require others in order to function. As Louis XIV understood, even absolute monarchy is an illusion that requires many puppeteers.
- The second ring is the *process* ring. The process ring is what the leader uses to get his will communicated to the rest of the system. Warden explains that the process system also gives guidance as to how the leadership should behave in relationship to the other parts of the system.
- The third ring is the infrastructure. To prosecute war, a nation must have roads, electricity, ways of transporting things, supplies, etc.
- The fourth ring is the population. No war can be prosecuted without the support of the population. There must be people who can keep the system going while the troops are engaged in war. World War II exemplified the need for a strong population. While the allied soldiers fought in World War II, it was the population bases in Europe, America and other parts of the world that supplied the troops with the resources they needed to fight. If those populations had been neutralised, World War II the Allies could not have won.
  Warden counter-intuitively argues the least important part of the enemy system is the last ring, the fielded forces, because disabling any of the other four rings will shut down the fielded forces. Clearly, if the population is either killed, significantly injured, or persuaded to work rigorously, then the fielded forces are effectively shut down. If the infrastructure is crippled, the fielded forces will not be able to get the resources they need to continue fighting, nor will they be able to move supplies to where they are needed, etc. If the process that joins the leadership to the rest of the system is

enemy systems in a warfighting context (2001). Thus, if the systems of an enemy can be defined (even though an enemy is an entity that obscures itself and changes in order to make modeling it a difficult task), it seems that the task of defining fuzzy boundaried systems is more plausible that one might think. Thus, we have pointed to the outline of a horizon of transformation that distinguishes the teleology of a part, or subsystem, from the whole. The same quality is demonstrated by the human brain and is, in part, the subject of schema theory in cognitive science (see chapter 3).

One last observation here: by mentioning Warden's ring theory I do not mean to suggest that one system has to work through another system in order to affect the whole, though this often occurs. The internal anatomy of different systems means that they do internally operate in different ways, and the wise modeler of complex systems must take this into account.[244]

3. The *significance of the part must be read in terms of the whole, but the whole opens a world that is different from the world of the parts.* This feature corresponds to the world of the text in discourse and the world of the action opened when humans act. Humans have internal contours that do not necessarily organize themselves into specific organs or systems in the body. Phrenology's great mistake was assuming that subjective states of mind directly correlate with brain regions. By making this observation, I am not suggesting that anatomy, especially neural anatomy, has nothing to do with inner psychological states. I am suggesting that the model of the text helps us to understand the relationship between those parts and the whole. For example, current research seems to suggest that serotonin has something to do with the "feeling" of happiness. Does this mean that happiness is serotonin? Most certainly not. To claim that happiness *is* serotonin is to misunderstand that

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crippled, it has the same function on the rest of the system as if the leadership were killed. The rest of the system does not know what to do. Finally if the leadership is neutralized, the enemy no longer functions. So Warden is vindicated when he says that the fifth ring is the least important.

Even though each of these five rings, in practice, is intermixed with the other rings, Warden correctly distinguishes the nature of each subsystem within the enemy system. One may wish to argue that the categorising of these various systems is merely his exercise in labelling, arbitrarily creating fictions out of an un-demarcated whole. But this objection has been refuted in practice. Col. John Warden used his systems analysis of enemies to develop the strategy used to win the first Gulf War (see Olsen 2007) in what he calls "fast time" (see Warden III 2001). The enemy systems model, nicknamed "Warden's Rings," is now the standard model that United States operations planners use in choosing their mission targets. So it is that we find that even in situations where system boundaries are difficult to identify, it is possible, through careful interpretation, to identify the nature of the system, its constituent parts, and the causal relationships between them. It is true that there are many different complex systems in the human world, and in the universe for that matter. However, I use Warden's Rings to show in a system that works to conceal its own system (as an enemy does), those systems can still be defined.

[244] Warden observes this, and comments about the "fractal" quality of ring theory—it applies at all levels, from the system viewed as a whole and its subsystems, on down to the individual soldier, who, when acting as an enemy, unconsciously must organise himself according to these five rings (2001).

the power of serotonin depends completely upon the system in which it is present. As we saw above, neurotransmitters can also function as neuromodulators, which, in turn, change the function of certain neural networks. Serotonin does not do just one thing. Its power to act on the system is location specific to certain regions. Happiness[245] (*eudaimonia),* according to Aristotle, is the teleology of humans.[246] Whether Aristotle is right or not, Aristotle is wise to see that happiness like "love is a many splendid thing" (Luhrmann 2001) . The world of the substance is the world of the whole.

4. *The* meros *in a substance has a polysemy of function, but a simple substance is hermeneutically closed.* For example, consider an axe, devoid of context. Once one knows (1) its shape and design, (2) its purpose (to chop), (3) its material composition, (4) and how their made, one has more or less exhausted what can be known about the axe. But what if that same axe is found at a terrible crime scene? Under such circumstances, the axe is now a *meros* in a substance, and becomes open to hermeneutic reflection in a much more significant way. However when the axe is only considered as an axe *per se*, as a simple substance, it has boundaries that help to limit the possibilities of interpretation. The application of the four causal model may be applied simply and briefly: humans come into being through being born of sexual reproduction. They walk upright, with two arms, two legs, and a one head. They are sustained by eating food drinking water and breathing air and are all made of the same kind of stuff. They seek to live and be happy. These four statements do not totally define everything about a human being, obviously. They do allow us to designate, through discourse, that we are referring to human beings. Hearts cannot produce other hearts through sexual reproduction. Brains do not walk upright. My liver does not seek to be personally fulfilled. If it did, I would face a great hardship. Each of these parts – heart, brain, and liver – has its own function, defined in terms of the system. However, that cannot be said of my body as a whole, unless one defines my body in terms of another system. I can be part of a government, a family, a society. It follows then that I am a substance and a *meros*, depending on which real system is the subject of discourse.

This closure of interpretation permits a new interpretation upon the world, a dialectic, limiting distanciation—while multiplying it. Once again, consider the example of the crime scene and the axe. Outside the crime scene, the axe's interpretation is closed. Only so much can be known about it. Once the axe is part of the crime scene, its definite identity as an axe, as apposed to a marshmallow, a gribble, a quill pen, or cigarette smoking dame in a red dress. The axe is what it is, in once sense, and interpretation closes with its limitations

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[245] Aristotelian *eudaimonia* is certainly more than what the English gloss "happiness" designates. For a discussion of the definition of *eudemonia* see chapter 5.
[246] This chapter neither defends, nor requires it to be true, that the teleology of humans is happiness.

peculiar to its nature as a substance. However, its context opens new possibilities. For instance, what happens if the axe at the crime scene was not the murder weapon, but was used as a doorstop? If it were so, it would seem that someone stretched the use of the axe in this new environment, giving it a polysemy of function. In doing so, one must ask, *why would an axe be employed so peculiarly*? A detective will have to ask in what narrative would the axe have come to be used in such a strange way. Thus, the placement of the axe, as a *meros* in the substance of the crime scene, distanciates new possibilities from itself into the world of the crime scene. Furthermore, such a *meros* may change the interpretation of the scene itself, leading to a different interpretation of the whole.

This very simplistic illustration helps to point to a more complex point. When one moves from the interior to the surface of a substance (substance used the Aristotelian sense of these last two chapters), the surface of the substance acts as a transition point, at which the whole must be understood in a different way that the parts. This point has a significant implication for the relationship between the body and phenomenology. It is this point, this dialectical limiting of distanciation to the surface of the substance that also multiplies distanciation which so phenomenologically transforms the surface of the human body, beyond the simple physics of skin/brain intercommunication. The body is not just a house for the organs of the body, it is a threshold, a boundary between what is of the body and what is not. The surface of the body is the phenomenological field upon which, and through which, humans act. The eyes, the ears, the sense of touch, the smell of roses, the mental image of the perfect circle which somehow we imagine as though it were at the perfect distance, each testify to the surface of the body as the phenomenological field, which acts as the threshold between the interior events of the body, and the body as the substance of the individual and the natural *meros* of human community. As a substance, the body breaks down the brain/body distinction because the body is the tether end of the brain, moving upon the natural world, and the brain is the tethered end of the body, permitting all the body to unify its own experience and map itself onto the world. In this way, like human discourse fictionalizes the artefacts of discourse with intention, the phenomenological field of the body permits the human to fictionalize body upon the natural world. Thus, the model of the text makes it possible to fictionalize the body physical extension, so say the world is made flesh, to draw on Merleau-Ponty (1968, 248).

Humans interact socially as total beings in their embodiment, not merely as mere neural networks firing in regulated patterns timed to coincide. I have already discussed this point in the context of Artificial Life, so I will not belabour it here. But that social work of interacting in human embodiment is facilitated through actions which themselves are hermeneutically "open". What Ricoeur calls the "open work" of human action results from

distanciation of the level of system from the level of *meros*. The narrowing of distanciation within the system translates into a multiplication of distanciation outside of it. As John Searle observes we can do more than the immediate, small number of actions our body can perform (1984, 57-70).

7. CONCLUSION: WHAT IS A HERMENEUTIC PHENOMENOLOGY OF COMPLEX SYSTEMS?

This chapter developed the initial stage of a hermeneutic phenomenology of complex systems, for the purpose of situating brain science within hermeneutic phenomenology. We now have the tools to deal with Changeux's "advances" which he portrays as giving neuroscience a hegemony over phenomenology, but I will wait till the conclusion of the next chapter to enumerate a reply. This chapter brought together Ricoeur's model of the text to terms with complex systems

This chapter had but one ultimate purpose, to show how to extend Ricoeur's hermeneutics of human action to complex systems. As I promised at the opening of this article I outlined how this is possible by proceeding through five stages of argument, each building on the previous stage.

First, while chapter 3 developed the notion of functional polysemy which brings neuroscience to terms with hermeneutic phenomenology, in this chapter I brought hermeneutic phenomenology to analogous terms with *cognitive science* by showing how Ricoeur sympathetically engages with concepts at the joints of the three major approaches to cognitive modeling, namely the computational, connectionist, and Artificial Life models. The work of Paul Cilliers, who finds an analogy between neural networks and the relationship between signs in natural language, proved to be a decisive help at this stage.

Second, I detoured through structuralism and poststructuralism, via Cilliers's work, explaining how Ricoeur's theory of discourse adds a second signification that cannot be reduced to the interplay of signs in language, while at the same time being made from parts in the system of language.

Third, following the discussion of the second signification of discourse, I suggested an analogy be made between function as the teleology of an event in a system and meaning as the teleology of discourse. I suggested this move, rather than offering a full demonstration, because an extended defence of teleology is beyond the scope of this already lengthy chapter. Instead I gave warrant for this by tracing its success when applied to complex systems. This analogy was vindicated in part by showing that the attribution of teleology to system function was justified the same way that intent is attributed to text, through a fictive but productive attribution which permitted hermeneutical reflection into

causes. In the case of text, the attribution of intentionality to the text made possible an examination of the intent of the author. In physical system, the fictive attribution of teleology opened the possibility of interpreting causal relations and function.

At the fourth and most decisive stage, I showed how Ricoeur's warrant for applying the model of the text to human actions also applies to the events in complex systems. The whole of my case rested upon this move. I showed that the move was warranted because the hermeneutics of causation, distanciation, and the polysemy of function each operate with respect to complex systems in the ways that they do with regard to human action.

Finally, I addressed the problem of establishing the boundaries of complex systems, showing that it is possible to characterize a complex system and its functions without having exhaustive knowledge of the system. I then applied the model of the text through the framework of human action both the substance and the *meros* of complex systems. This application of the hermeneutic phenomenology of human action proved fruitful in that it showed how the teleology of the *meros* of complex systems contributes to a teleology of a whole that wears a different face. It follows that the model of the text permits a union of part and whole that does not collapse one into the other, a union in which the whole is a significant hole, irreducible. I applied this observation to the body arguing that the principle of distanciation, when understood through the framework of substance and *meros*, turns the body into a surface, a phenomenological field which is a unity, upon which the phenomena of conscious life play out. Through this idea is found the work of Merleau-Ponty (2006). I made my case not from his work, but instead, point by careful point from the hermeneutic phenomenology of Paul Ricoeur while in dialogue with Aristotle's systems theory.

The following chapter will apply the model of the text though narrative to complex systems, so that hermeneutic phenomenology can bridge the gulf between phenomenological time and the aporia of time through narrative. The conclusion of the next chapter will apply this hermeneutic phenomenology of complex systems to Changeux's five advances of neuroscience.

CHAPTER 7

The model of the text as a model of complex systems: part 2

Moreover, this kind of progress is not only unrewarded with prizes and substantial benefits;
it is not even the advantage of popular applause.
For it is a greater matter than the generality of man can take on,
and its past could be overwhelmed and extinguished by the gales of popular opinions.
And it is nothing strange if the same not held in honour does not prosper.
Francis Bacon , The New Organon (1960, 90)

1. INTRODUCTION

In the previous chapter, I explained the purpose of these twin chapters: to reply to Jean-Pierre Changeux's (2000) reduction of the human person to brain function by disclosing a hermeneutic phenomenology of complex systems, which is implicit but undeveloped in the work of Paul Ricoeur. I have already developed the initial stage of a hermeneutic phenomenology of complex systems. The three major models for interpreting brain activity – the rule-based model, the connectionist model, and the Artificial Life model each honour an aspect of the problem of modeling complex systems, but each also shows itself lacking in areas where Ricoeur's hermeneutic phenomenology is admittedly strong. Furthermore, a hypothetical analogy between function as the teleology of systems and meaning as the teleology of language permitted an initial development of a hermeneutics of causal relationships in complex systems, by Aristotle's causal model and his theory of the

relationship between a substance and the *meroi* that comprise it. I then extended the model of the text, through human action, to both the part and the substance. This comparison proved fruitful in that it showed how the teleology of the parts contributes to a teleology of the whole, which wears a different face. It follows that the model of the text permits a union of part and whole that does not collapse one into the other, a union in which the whole is a significant whole, an irreducible one. In the next part of this chapter, the hermeneutic of complex systems that I have developed so far will become a hermeneutic phenomenology of complex systems.

This chapter will disclose the remainder of an initial step toward a full hermeneutic phenomenology of complex systems. In the same way that the previous chapter focused on discourse as the locus of discussion, especially with regard to ideas covered in *The rule of metaphor* (Ricoeur 1977), this chapter will apply Ricoeur's narrative theory (developed in *The rule of metaphor*'s three volume companion *Time and narrative*) as a tool for the modeling of complex systems. For that exploration, I will aim to bring Ricoeur's discussion of narrative in *Time and narrative* to terms with complex systems theory through the kinship between the model of the text and complex systems discussed in the previous chapter. In the process of bringing complex systems and narratives to terms with one another, we shall find an overlap between discourse and narrative, which we should expect. But that close relationship will also prove to be an important link between the model of the text and complex systems.

2. NARRATIVE AS MODEL OF THE TEXT BETWEEN PHENOMENOLOGY AND CAUSATION

The model of the text is more than just an analogy. Model, in its metaphorical function, is the "metaphorical redescription of the domain of the explanandum" (Hesse 1966, 157). The model of the text, then, does not aim to reproduce the entire system by creating a semi-identical artefact; rather, through the process of redescription the model of the text opens the lived world to be *interpreted as text*, *not* because *it is text*. This model proves itself quite resilient for the task because it was developed (1977, Ricoeur 1976, 1980b) in conversation with the theory of models discussed by philosophers of science like Max Black (1962) and Mary Hesse (1966). Black and others point to the heuristic epistemic value of models, which are *instrumental* in moving human understanding from ignorance to knowledge. Mary Hesse has shown that models are not self-contained, but redescribe a primary system through a better-understood secondary system (1966, 157-177). In the terms of the previous chapter, the primary system is its own substance (in Aristotelian terms), with its own *meroi*, qualities and boundaries. The same applies to the secondary

system. However, a model unites the two by channelling the heuristic-affecting resources from the secondary system to the primary system, but in a way consistent with the model's boundaries. One would be hard pressed to find a model that applies to everything. Therefore, a model functions like a *meros*—as an instrumental cause. The model of the text fits this function as well.[247]

Hesse develops her approach to modeling with a wary eye on positivistic science, which aims to base science on empirically-backed sentences only, from which strict logical content can be deduced univocally. Here the concerns of Ricoeur and Hesse meet cordially, and both of their approaches ally against the anti-causation attitude of early 20th century philosophy of science, as represented by Russell (1918, 180), Pearson (1957, 119-20), Ayer (1936), and many others, who find their inspiration in the work of David Hume (1978, 1935). Hume views perception atomistically, reducing the flow of perception to a collection of momentary points.[248] On this basis, he suggests that the positing of connections between moments of phenomena is the imposition of an internal attitude, and not something found in nature. Hume argues that whether or not there is causation in nature is immaterial, the problem is—according to Hume—that we cannot know whether or not there is causation. We have a deep, inescapable, *epistemological* problem according to Hume. In reply to Hume, I have argued above that Hume reaps the rotten fruit of a self-fulfilling prophecy, and that he must assume causation even to begin his argument against causation, and hence the interpretation of causation would seem to be hermeneutically circular. To begin to address it, one must assume it. Hesse also recognizes the poverty of the project that began with Hume, and for that reason she supports the view of scientific model as metaphor as an improved philosophy of science.

If Hesse is right about the scientific model and its metaphorical function, then one ought to be clear on the various types of models and what aspects of reality they pinpoint, for, in so doing, one learns what things metaphor has power to describe. Returning to the connection between the *meros* and the model, I noted above (Chapter 5) that *meros* functions like substantial being, because it can be analyzed in terms of form, matter, agent, and *telos*. If it can be analyzed as a substance, then, both *meros* and substantial being can be analyzed in terms of the causal model. Since part and whole can be understood through the causal model, then this situation leads to additional *instrumental cause*, which I suggested, in biological systems, results from a *meros* participating in systemic function. In the previous chapter I argued at length that the unity of the five causes in the interplay of causal relationships between substance and *meros* stretches a bridge across the chasm

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[247] For more on all this, see chapters 1 and 6.

between physical systems and the model of the text since strong analogies exist between both when the model of the text is considered in light of human action, giving a place for complex systems to come to terms with hermeneutic phenomenology; for poetic mimesis corresponds "point by point" (Ricoeur 1977, 38) with the distinctions in Aristotle's causal model: material, formal, efficient and final cause. "[T]hree of [the six parts of tragedy] have to do with the object of imitation (*muthos*, *ethos*, *dianoia*), two others concern the means (*melos*, *lexis*) and the last the manner (*opsis*)" (38). *Katharsis* functions as the *telos*—the goal of tragic *mimesis*, but the goal is not internal to tragic mimesis, so tragic mimesis also functions as an instrument to bring the spectator or listener to *katharsis*.

The added complexity of the instrumental cause permits us to situate the causal model within a complex environment, and appropriate useful insights from Black who catalogues the various types of models in his essay "Models and Archetypes" (1962, 219-243). A review of the various models[249] shows that models embellish, in the classical sense (see [Cicero] 1989, II. xxix. 46), one or more of the five causes. As I explained in greater detail above (chapter 5), *scale models* retain the form, but contract or expand the material of the model. *Analogue models* find points of formal sympathy between unlike things. *Mathematical models* aim to reduce form to formulae, which is not too far from the later Plato's characterization of form. *Metamathematical models*, depending on whether the model is viewed as the mapping assignment or the model that determines the assignment, we have numbers treated as matter or form. *Scientific heuristic models* are instrumental causes that lead toward understanding. *Scientific existential models* aim at an accurate description of what is, which is the aim of the causal model to begin with, thus the causal model is one of these. *Scientific theory as "model"* acts as an efficient cause to reconstrue data, for better or worse. Hopefully for the better. *Paradigm models* are teleological, giving examples or goals of what will be, where the process is headed. "Model," then, shows polysemy, both in the functional sense that we observed neural systems in Chapter 2 and in the semiotic sense because its use applies across all five causes.

Model making can specify any cause to emphasize, or draw collections between causes by its labour. Furthermore, it organizes its own labour according to the categories of the causes. Thus, we see that the modeling enterprise and the objects being modeled have corresponding resources and action potentials (to borrow a neural metaphor) without needing to be identical. The products of modeling suggest that the enterprise is suppler, more willing to meet the "objects" that humans model, be it a form or a goal to be aimed at,

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[248] For more discussion of Hume see the previous chapter.
[249] This summary draws not only from Black but also from Hesse (1966), Lloyd (1998), Wartofsky (1979), and Harre (1970).

etc. All the types of models referred to by Black and others point to the broad, subtle and possibly unlimited potential for modeling.

This feature of the modeling enterprise applies also to Ricoeur's model of the text. The model of the text has the resources to model complex systems, not because it identically reproduces a specific complex system, but because, as a complex system itself, it shares corresponding resources as well as the referential power of discourse in that models are in some sense metaphors. Notably, it approaches propositional content differently than the truncated propositions of the positivists. A hermeneutic phenomenology of complex systems would ask us to approach the natural world the same way, to find the multiple causes in play "underneath" appearances, precisely because we are privy to *more* than a moment's mere appearances. *When the insights of Black and Hesse on the metaphorical function of scientific models are developed and extended by Ricoeur's narrative theory, the new production provides an approach to time and space that opens the relationships of causation to us, and characterises the objects of our world, both phenomenological and natural, without appealing to naïve realism.* Furthermore, the same features present in the model of the text, at its focal point in discourse, are also found to encompass the field of narrative. A careful development of these features will first be necessary before presenting a decisive reply to Jean-Pierre Changeux.

3. THE CRISIS OF FORM AND MATTER IN MIMESIS DEFINED AS THE IMITATION OF ACTION

Aristotle sets aside the Platonic dichotomy between "narrative by *mimesis*" and "simple narrative" defined in the third book of Plato's *Republic*. For Aristotle, "Imitating or representing is a mimetic activity inasmuch as it produces something, namely, the organization of events by emplotment" (Ricoeur 1984, 34). Plato's dichotomy is rooted in his belief that the artisan twice removes the art from the ideal model which is the true object of imitation (34). Aristotle circumvents this problem by defining poetic mimesis by its act of ordering events, and as such, poetic mimesis and muthos may be conceived in terms of one another, because plot imitates action and thus organises events which are actions.

This distinction immediately puts our fledgling project of developing a hermeneutic phenomenology of complex systems into a crisis. Complex systems in the natural world, and arguably everywhere else, are composed of things of some sort, be they prices, people, or particles. If narrative imitates action, then it would specify efficient and teleological cause, but not the full richness of Aristotelian causal interaction. Thus, narrative would seem to have too few of the resources needed for modeling complex systems. Narrative is an imitation of human action, as Aristotle observes, not an imitation of nature (1448a 1). In

Aristotle's development of the causes related to the parts of animals, he specifies the efficient and teleological causes as the most significant, but he does not neglect the other two as though they were not important (639a 11-21). From the outset, then, it is absolutely necessary that the mimetic action of narrative find common ground with the two causes it apparently neglects.

Narrative would appear to be incomplete, and, admittedly, it would if construed as mere narrative. However, narrative requires one to see action as agented, and the agent must be definable, which is why narrative theory is unintelligible without characters. Without agented action, narrative is merely description, without plot. "The notion of a character is solidly anchored in narrative theory to the extent that a narrative cannot be a memesis of action without being at the same time a memesis of acting beings" (Ricoeur 1985, 88). Narratives that provoke fear often do so by having a hidden agent, whose actions are known but who has not been revealed. This type of plot is so common I need not give examples. Plots require characters, and characters *can* be defined, which does not mean that they must be defined, nor that there be some fixed method for defining a particular nature of some agents in a given plot. Beyond the characters and the plot, one also has some access to the *thought*, the meaning in some way encompassed in the character's actions and also in the relation of those actions sequentially to one another and to other characters. So, we find that narratives bear with them not only plot, but character and thought—which both Ricoeur and Aristotle affirm. It follows that, though narrative imitates action, it does so through and among agents of action and meaning of action.

Narrative then draws on more resources than just efficient and teleological cause. In this way we, find strong sympathy between narrative and system function as described in *On the parts of animals*. More concretely, specific examples of narrative show narrative to draw on both formal and material cause. The narrative of history generally requires a knowledge of maps to be intelligible. Literary narratives require descriptions which take on the role of the visual image, or spectacle, which a film or play has recourse to employ. Narrative in science requires measurements and diagrams to establish the nature of the agents involved. Film gives an image, one that moves locating its motion in space (see Collender 2007). We see that poetic *mimesis* moves through things it does not self-contain in order to become emplotment.

A further example will help. The Hebrew Bible has extensive descriptions of dimensions and places, especially cultic places, to emplot the relationship Israel has with her deity. Many of these spaces, and particularly the Temple, were locations to which only a few had regular access to participate in the cultic drama. The emplotment of that relationship requires time/space provided by the descriptions of places, things, and the order of time in

the cultic calendar. In this, time/space and her deity perform acts for one another permitting a sacred plot. The narrative of sacrifice and feast, which plays out with in those dimensions, acts as a model for the relationship of the people to their god. The need for vigorous attention to time/space in a narrative-based tradition points to its necessity for narrative in general.

Ricoeur recognises the significant interplay of time/space with narrative, especially in the development of a narrative point of view (1985, 88f). Ricoeur distinguishes between the point of view of the first person and the third person in narrative, and identifies the narrative itself as the discourse of a narrator who speaks of the characters in the plot, and in the second book of *Time and narrative,* he is, of course, referring to fictitious characters. However, even in the fictitious narrative, a narrator cannot escape narrating from a certain point of view. This would seem to compromise narrative, because it makes narrative perspective subjective—and thus, Karl Popper is apparently vindicated in his concerns regarding how stories become "merely wishful boasting (as in fisherman's tales)" (Popper 1999, 34). But Ricoeur shows that "point of view," while pointing to the perspective of the character or even the author himself, actually confirms narrative's ability to transcend the merely subjective. He also suggests that narrative presumes a spatial and temporal arrangement beyond the internal state of the character or narrator. Ricoeur supports his point by insisting

> (t)he spatial and temporal plains of expressing point of view are of prime
> interest to us. It is first of all the spatial perspective, taken literally, that serves
> as a metaphor for all the other expressions of points of view. The
> development of a narrative always involves a combination of purely
> perceptual perspectives, implying position, angle of aperture, and depth of
> field (as in the case for film). The same thing is true with respect to temporal
> position, that of the narrator in relation to the characters as much as among
> the characters themselves. What is important once again is the degree of
> complexity resulting from the composition involving multiple temporal
> perspectives. (1985, 94)

Ricoeur, then, understands the phenomenon of narrative not to be fully *in* a written text, as such, but in the text, understood in terms of Ricoeur's model of the text presented thus far in this dissertation. Narrative expresses a "point of view." But Ricoeur is saying point of view cannot be understood without also an understanding of space and time. This does not mean that one has a little narrative knowledge, and to it adds some Kantian like mental constructs

of space and time. Narrative assumes "external" space and time. It stands in between the space of subject and object, between the author and the referent of his or her discourse. This quality of narrative moves it beyond the text as such, into a rich system of information for modeling (redescribing) special-temporal relationships. A narrative may have multiple layers that each are worthy of careful study. Among these, though, one finds multiple temporal perspectives that fit together in complex ways, but which do assume temporal and spatial relationships. Ricoeur's observation here echoes Max Black's "archetypes", in that the spatial and temporal environment, which imbues our perceptions, inhabits the productions of poetic *mimesis* (Black 1962, 241). The natural world then operates as archetypes for the constructive art of *mimesis*. Because of the referential quality of discourse, this work returns back "upon the world" in the process of narration. This will prove useful to the modeling of complex systems since it engages a phenomenology of perception and thus necessitates the following development.

Ricoeur's observations on the spatial-temporal level through which narrative moves, a level which even informs the metaphor of point-of-view, brings Ricoeur's analysis of narrative close to Maurice Merleau-Ponty's phenomenology of perception. In his classic study, by the same name, Merleau-Ponty initiates his study by cordially overthrowing Hume's reductionist "phenomenology" of perception. While Hume thought it was possible to refer to perceptions as bare sense data, Merleau-Ponty (2006) shows that even common perceptions do not present themselves in bare uninterrupted bits. Rudimentary perceptions bear on relations, even in animals, and not on absolutes, but such a state of affairs does not justify one "distinguishing within experience a layer of 'impression'" (Merleau-Ponty 2006, 4). To illustrate his point Merleau-Ponty gives an example:

> Let us imagine a white patch on a homogeneous background. All the points in the patch have a certain 'function' in common, that of forming themselves into a 'shape'. The colour of the shape is more intense, and, as it were, more resistant than that of the background; the edges of the white patch 'belong' to it, and are not part of the background although they adjoin it: the patch appears to be placed on the background and does not break it up. Each part arouses the expectation of more than it contains, and this elementary perception is therefore already charged with *meaning*. But if the shape and the background, as a whole, are not sensed, they must be sensed, one may object, in each of their points. To say this is to forget that each point in its turn can be perceived only as a figure on the background. When the Gestalt theory informs us that a figure on a background is the simplest sense-given

available to us, we reply that this is not a contingent characteristic of factual perception, which leaves us free, in an ideal analysis to bring in the notion of impressions. It is the very definition of the phenomenon of perception, that without which a phenomenon cannot be said to be perception at all. (Merleau-Ponty 2006, 4)

Merleau-Ponty derives, from this most fundamental clarification of the smallest bit of perceptual phenomena, that anything perceived "is always in the middle of something else, it always forms part of a 'field'" (Merleau-Ponty 2006, 4). Perception always comes to us in the context, of other perceptions. Based on this analysis, Merleau-Ponty famously concludes "[t]he structure of actual perception alone can teach us what perception is" (4). We may also observe. In the above quotation that Merleau-Ponty identifies the bits of white phenomena as having a "function" namely that of forming a shape, and that this function charges the elementary shape with *meaning*. Merleau-Ponty anticipates a relationship between function and meaning, which we explored in the previous chapter.

Upon this basis, Merleau-Ponty argues powerfully and convincingly that perception, though obviously a relationship between world and sense organ on some level, is at the same time a perception of the world surrounding humans. The human perceives nature, though not with the artifice of purity, as though there were such a thing as pure nature, devoid of the human person. But humans perceive a physical embodiment through their own embodiment. Merleau-Ponty uses human depth perception, and its ability to perceive the spatial relationships between observer and object as evidence of this.

> More directly than the other dimensions of space, depth forces us to reject the preconceived notion of the world and rediscover the primordial experience from which it springs: it is, so to speak, the most 'existential' of all dimensions, because... it is not impressed upon the object itself, it quite clearly *belongs to the perspective and not to things*. Therefore it cannot either be extracted from, or even put into that perspective by consciousness. It announces a certain indissoluble link between things and myself by which I am placed in front of them.... (Merleau-Ponty 2006, 298, emphasis added)

Depth perception moves one to re-evaluate one's "preconceived notion of the world and rediscover the primordial experience from which it springs," yet this movement to challenge one's assumptions comes (metaphorically) out of the space between the observer and the

object. Paradoxically then, the eschatology of *perspective* is greater objectivity. Perspective establishes the relative position of things to one another and to the observer.

We may summarize Merleau-Ponty's contribution to this present discussion in the following way: depth perception forces us to re-evaluate our own judgments about the world around us. Yet the things we perceive are always perceived in a context such that the concept of a pure sense "impression" is an *abstraction* not *grounded in perception*. What follows is easy enough to anticipate: objects extended in space before us are not bundles of unrelated sense data, but are rather items before us. While the senses may be deceived, depth awakens us to look again, or as Merleau-Ponty puts it, to re-evaluate.

So we will bring Merleau-Ponty's observation about space into conversation with his insight regarding the gestalt of part and whole in the phenomenology of perception. For Merleau-Ponty, the human world is not a world of sense impressions only; it is a world of objects, a *place* (in the strong sense) in which humans live and move and have their being. The human world is a place where objects relate to each other in context, where objects metaphorically relate to the body and interact with the senses in a way that transcends the skin as a barrier and opens the body to participate in the interpretation of the world. This brief description of Merleau-Ponty's philosophical program is readily apparent on almost every page of *Phenomenology of Perception*.

Now, let's return to Ricoeur's narrative theory. When Merleau-Ponty's observations are united with Ricoeur's observations about the spatial-temporal nature of narrative, the world of the text opens to us in a new and startling way. Since the phenomenology of perception opens objects to us to be understood in context, objects may now be interpreted along similar lines as the world of the text which opens to the reader of history or fiction. The foundation for this move was established in the previous chapter. Recall that the discussion of complex systems near the close of chapter 6 addressed the way that the model of the text can be applied, through human action, to the substance and *meros* of complex systems. There a case was made for the hermeneutics of causation, wherein the five causes can open the world of the substance to inquiry. I purposefully used the example of a crime scene, and mentioned that tracing the various relationships (at least in the example of the detective trying to understand the crime scene) required the careful construction of a narrative, which is the work of tracing the various the interpretive causal model into the entire situation. The close of chapter 6 approached this subject from the systemic relationships and their interrelated ontologies. Here, I am approaching the same domain from the direction of narrative, looking at the resources of narrative to model complex systems. It then should be no surprise to find the world of the text opening the interpretation of physical object through history or fiction.

Human awareness of the past in history (*mimesis$_1$*) is spatially dependent, and temporally dependent for that matter. Human imaginary investiture (*mimesis$_2$*) creatively imbues the world with new possibilities. In the practice of hermeneutics, the world of the text and the world of the hearer intersect (*mimesis$_3$*), and in this process human awareness of the past and its human imaginary investiture are working together to reconfigure a human's view of the world (Ricoeur 1984, 70-1). Ricoeur also applies *mimesis* to human's understanding of himself and others (1992). However when the three forms of *mimesis* are applied to the subject matter of Merleau-Ponty's (2006). *Phenomenology of perception*, a narrative approach to extended objects opens before us. Furthermore, Merleau-Ponty's insight about the relationship between wholes and parts confirms that the gestalts of perception seem well-suited to meeting the physical world through the mimetic process of reconfiguration.

Ricoeur wrote *Time and narrative* as a companion to *The rule of metaphor*, so we should not be surprised to find that spatial embodiment pervades not only "point of view" with respect to narrative (1984, ix). Embodiment pervades metaphor as well. George Lakoff and Mark Johnson show that the development of metaphor is integrally connected to the body, and they develop this view of metaphor in conversation with cognitive science (1999). They maintain that the brain takes one domain and "maps" it on another domain, and this cognitive mapping is the creation of metaphor (1999, 57-58). They then take this insight and throughout the second half of their book *Philosophy in the Flesh* they create a revisionist commentary on the history of philosophy, arguing that philosophy is just the development of metaphors to explain the world, but each attempt really confirms the Lakoff-Johnson cognitive metaphor thesis (1999, 337-568).

Though Lakoff and Johnson assume the architecture of a computational theory of mind, their insights on the bodily nature of metaphor are illuminating, once freed of the "computational" framework. While they might object that their approach is computational, because they offer a critique of the thinking as computation metaphor, they still approach metaphor as the interrelating of two-bodily invested, signifying *brain states* (Lakoff 1999, 16-44). These states are then manipulated through a cognitive unconscious, thus metaphor (like the dream for Freud) reveals a cognitive unconscious, that is not available for study without something like the analysis of metaphor provided by Lakoff and Johnson (Lakoff 1999, 9-15). They want to make their theory more acceptable, and a good way of doing that is to root it in the developments of cognitive science. Thus, metaphor must be the conflation of two "domains," some sort of representation, in the brain that signifies some state of affairs. That domain is "mapped" onto another "domain" and the result is the formation of a new concept. So far, Lakoff and Johnson seem to echo the work of Mary Hesse and Max

Black and their treatment of metaphor. However, Lakoff and Johnson take their work a step further in trying to legitimate it by interpreting the metaphor as the relation of representational cognitive states. In Ricoeurian terms, the reduction of metaphor to merely bodily invested cognitive states carries with it an eschatology—the reduction of the history of philosophy to cognitive-metaphorical brain activity. It's no wonder their book ends the way it does.

As is often the case with brilliant pioneers, Lakoff and Johnson share the enthusiasm of the prospector whose whole human world contains only the gold he finds. While the brain is most certainly involved in the creation and interpretation of metaphor, the move to reduce the metaphor to cognitive brain activity as way of explaining its work actually removes the discursive quality of metaphor from metaphor itself. Having offered this critique, the examples and insights that Lakoff and Johnson offer regarding metaphor are most helpful, especially their emphasis on the importance of the body, strongly reminiscent of the work of Merleau-Ponty. They help to show how the body in its extension and contact with the world indwells human cognition so as to point out the total fiction of Descartes's vision of the disembodied mind.

The first chapter of this dissertation discusses the theory of scientific metaphor developed by Theodore Brown (2003b) who takes the work of Lakoff and Johnson beyond the mission of reducing philosophy to metaphor. He takes metaphor as the premiere tool for the investigation of the physical world in *Making truth: metaphor in science.* Through case studies on the classical model of the atom, the modern model of the atom, molecular models in chemistry and biology, the folding of proteins, metaphors that refer to the cellular level and even the trendy topic of global warming, Brown shows that metaphor is not only used to come up with helpful heuristic analogies; metaphor illumines experimental data and interprets it. For Brown, the work of scientific metaphors makes the work of science possible. Referring to his own case studies, Brown writes:

> I have described several case studies that illustrate how scientific explanations of observed properties of the natural world are built on metaphorical models. The models are created through a process of reasoning that is tied inextricably to bodily capacities, everyday experiences of physical surroundings, and gestalts drawn from experience in the social domains of life. (2003b, 183)

Brown argues from many different examples that metaphor is an *epistemological necessity* in science, since the metaphor enables the conversion of sometimes very abstract data into the three-dimensional structure of the physical world. Brown explains:

> We see the microscopic world of the molecule, from simple ones such as aspirin to large biological molecular complexes, with the aid of powerful experimental methods such as X-ray diffraction. But the data obtained in diffraction experiments consist of tables of angles and relative intensities of X-rays scattered by the sample. In themselves the data tell us nothing; only through the agency of models and theories can we convert raw observational data into something that makes sense. [Brown here is referring to only specific kinds of observations] The three-dimensional structures that prove so useful are obtained by application of theoretical expressions based on metaphorical models for how X-rays are scattered and detected. (2003b, 183-4)

Science is so pregnant with metaphor that we easily forget how metaphorical scientific descriptions truly are. Lakoff and Johnson present an excellent example of this common trend. In seeking to accurately describe the cognitive activity of metaphorical creation, they must resort to describing what Mary Hesse calls the primary and secondary systems of the metaphor as separate "domains" as though they were two geographical regions. They then describe the compilation of these two regions, one upon another, as "mapping." The metaphor of mapping is quite useful for it allows the mind to dwell on the particular relationships of detail in the corresponding qualities that are aligned between one domain, and that onto which it is "mapped". However, one must ask whether mapping actually occurs in the brain the way that the metaphor of "mapping" suggests. Someday we may approach the answer to that question. But the appeal to cognitive science and fancy terminology does not remove the referential necessity of metaphor that must be as important as its ontology in bodily states. Brown's insight applies directly to the case of Lakoff and Johnson, since they aim to use cognitive science as a way of expressing that metaphor is related to brain events in some way. Brown shows how a wisely-chosen metaphor leads to further discoveries about the physical world. The scientific use of metaphor does not somehow create "truth" where there is none; rather metaphor incrementally discloses the being of nature through the relationship of parts and wholes.

Though he did not develop his theory of metaphor in conversation with Ricoeur (an inference made on my part since Ricoeur is not cited in the index of his book), Brown

describes a hermeneutics of science that is identical with what Ricoeur calls *mimesis₃* – the *mimesis* which incorporates both history and fiction to bring together the world of the text and the world of the reader. If Brown is correct about the necessity of metaphor in science, should we not also expect to find the necessity of narrative in science?

Far from finding a crisis of form and matter in *mimesis*, we find the strong possibility that narrative has the resources to unite complex systems along the trajectory of the scientific use of metaphor.

4. HERMENEUTICS AND THE *MIMESIS* OF COMPLEX SYSTEMS

Merleau-Ponty has shown us that Hume's construct of bare impressions, without gestalt, is mistaken. Phenomenologically, perceptions are structured. Furthermore, Brown as evidenced that metaphor operates through gestalts. We may continue now with Ricoeur's observation that narrative is the mediator between gestalted phenomena (which to even write is of course redundant) and the spatial-temporal aporia, in which natural time space, and phenomenological time space both have evidence which support conceptualizing them as such. Narrative draws both frameworks into a single whole. In this mediatorial function, narrative releases the interactions of causation from the problematised prison of Hume into the light of hermeneutical reflection. Hermeneutic phenomenology is free to consider the interpretation of causation underneath appearances, as though nature were human action. One can treat the surface of the physical world as the single surface of discourse, and exegete the causal relations and functions underneath appearances. One may trace the various interrelationships in nature through the five causal model. Narrative then becomes a tool that humans use to hermeneutically access causation in the aporia of the natural (and human) world, incrementally—unlike the direct approach of Heidegger. But how is this accomplished?

Discourse, like narrative, reveals the world of the text and then passes away, but the world of the text remains. A reader may forget the turns of phrase along the way, but the world revealed remains, and this feature of narrative is what makes plot intelligible. In fiction, this revelation is equally the author's *creative* act; in history this revelation does not create anew rather, the revelation is encompassed in the project of *excavation*. These two features, creation and excavation—which feature prominently in fiction and history respectively – intermingle as Ricoeur points out in *Time and narrative*, even when one limits oneself to writing only one of these types of discourse (1988, 180-192). History uses the tools of fiction and vice versa.

Now we may turn our attention to science. The scientific method reflects fiction in that it *creates* a hypothesis. However, the creation of fiction is not enough. Scientists then conduct an experiment, testing the hypothesis by establishing conditions and letting the natural world play itself out within those conditions. A record is then made of the outcome. When put this way, it is abundantly clear that scientists test the fiction of a hypothesis by *creating* a history. We may define an experiment then as the creation of a natural history for the purpose of evaluating a hypothesis. If the created history contradicts the invented fiction then the fiction is counted as false. If the created history agrees with the fiction, and the fiction and the history hermeneutically meet, then we call the result a confirmed hypothesis. If it were not such a four letter word we might even be tempted to say the hypothesis was "true."

If science does give us something approaching knowledge, it seems to result from the procedure of creating histories in order to test fictions. Once this is accomplished, the confirmed fiction, or hypothesis, leads to more fictions—more hypotheses – which in turn lead to the creation of more test histories—more experiments. However, these fictions are not mere fictions that never refer to the natural world; this hermeneutic circle of science is productive through the human creation of experiment-history. The creation of experiments is possible because hypotheses are creative *referential* fictions, which have yet to be tested. The testing them in the physical world, in the causal nexus of nature, and the subsequent affirmation or denial of a proposed hypothesis statement, is confirmation of the referential nature of the creative referential fiction of the hypothesis.

The great danger of discoursing in this way is that it appears that science may be collapsed into narrative. I am sort-of saying that. However, I deny that narrative and fiction are always equivalent. Stories, as just tales, seem to have no corners, no edges for the rigorous mind to grasp. The flow of the narrative comes and goes. Narrative has its beginning, middle, and end, and throughout the whole process it moves slowly at times, like a greased sumo wrestler, quickly at other times like a greased pig—yet, at all times, the precision of science and the imprecision and even flights of fancy of fictional narrative make it appear that the twain shall never meet. Yet the key word in the above description is "seems." Narrative, like metaphor, is information-rich, and we have more tools to access that richness than one might expect.

In chapter 4, through an admittedly silly illustration, I introduced the *Metaphorical Square of Opposition*, which shows that far from being anti-logical, metaphor is logic-rich. The fictional debate that I described in chapter 4 pointed to the richness and clarity of metaphorical meaning, which becomes obvious when debate arises in response to a particular metaphorical meaning. These types of arguments are common in political

rhetoric, but they are also common in the sciences, as Brown illustrates (2003b). Metaphor is logic-rich, and we should expect it to be so, considering Ricoeur's analysis of metaphor. Furthermore, Ricoeur connects the metaphorising of metaphorical predication and the *mimesis* of *muthos*. If Ricoeur is right about the strong relationship between metaphor and narrative, we should expect to find in narrative the same logical richness found in metaphor, illustrated by the Metaphorical Square of Opposition.

Narrative does have the same logical richness, which can be demonstrated in the following way. Let us return to Aristotle's insight that arguments, even in their smallest form, require more than one proposition. Furthermore, it is well known that Aristotle demonstrated propositions through a middle term, one that justifies the relationship of predication between the major and minor terms (77a 5-9). Aristotle is helpful here because the further development of logic after Aristotle, especially during the latter part of the 19th and the beginning of the 20th century, did not overturn Aristotle on logic so much as it built upon his basic insights.[250] Also, Aristotle's work on the middle term has been echoed by logicians in the Indian and Buddhist traditions (see Chandra Vidyabhusana 1978), which almost certainly had little to no interaction with Aristotle whatsoever. By returning to Aristotle for my demonstration of the logical richness of narrative, I aim to develop support for the logical richness of narrative without appealing to anything too controversial.

In *Posterior analytics,* Aristotle sets out the theoretical framework for a research program that opens the natural world, as well as other subjects, to understanding. Aristotle believes that scientific demonstration is done through the middle term, since the middle term demonstrates the relationship of predication between the major and minor term. Aristotle holds demonstration necessarily implies "…the possibility of truly predicating one of many; since without this possibility we cannot save the universal, and if the universal goes, the middle term goes with it, and so demonstration becomes impossible" (77a 5-8). So the middle term is necessary, for without it "demonstration becomes impossible." An example may be helpful. Aristotle offers the example of a demonstrating that the moon actually receives its light from the sun (something obvious to a contemporary readership, but possibly more doubtful among ancient audiences. Aristotle offers the following demonstration illustrating the critical need from the middle term, which in his example is term *B*: "Let *A* represent 'bright side turned sunward,' *B* 'lighted from the sun,' *C* the moon. Then, *B*, 'lighted from the sun,' is predicable of *C*, the moon, and *A*, 'having her bright side toward the source of her light,' is predicable of *B*. So *A* is predicable of *C* through *B*" (Aristotle 89b16-20). To conclude this middle term, one would have to predicate one of many. One

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[250] For further discussion of this point see the first part of Devlin (1997).

would have to observe the position of the sun and the moon over many nights, and also probably realize that the moon is a sphere. One must be able to predicate one of the many to make this demonstration possible.

However, the opposite is also true. If one finds the middle term, then demonstration is possible. If someone has a mind that can identify middle terms quickly, knowledge will be an easy acquisition for that person, for "Quick wit is a faculty of hitting upon the middle term instantaneously" (89b 10-11) (for an example see below). Aristotle does not give a procedure for hitting upon the middle term, only the method of deduction found in *Prior Analytics*, and the general, though unsystematic, approach of induction found throughout Aristotle's work. It is also clear that Aristotle did perform experiments, but these experiments did not seem to be submitted to a kind of rigorous procedure. Perhaps the reason why there is no formal procedure listed in Aristotle's work is akin to the reason why a brilliant mathematician's problem notes may be sparse–Aristotle has the same faculty of quick wit that he describes.

So, Aristotle gives a helpful example. He suggests this faculty of quick wit "would be exemplified by a man who…. observed somebody in conversation with a man of wealth and divined that he was borrowing money, or that the friendship of these people sprang from a common enmity" (89b 11-14). In Aristotle's example, a man is presented with a scene of a man going to see another man. Aristotle further clarifies two different options of interpretation; either option aims to answer a question: why are these men speaking to one another? Thus, it should be noted that Aristotle's example aims at the middle term that will account for the cause of the two men speaking to one another. The faculty of quick wit will be able to determine what the cause is—that thing which brings these two men together.

We must now ask how one settles the dispute. How would one know whether the two men were speaking to one another because one wanted to borrow money, or because these two men were friends because they both had a common enmity? If we were to identify how one would know this, we would understand the source of knowledge that guides one to relate the major and minor terms. Given the scene that Aristotle paints for us, the information present offers itself to at least two interpretations. There is one man speaking to a second man, and it would appear that the second man has more means that the first. That's all we know. What extra information needs to be added so that we know one way or the other which of the two situations the man is witnessing?

Let us suppose for a moment that Phaedo, a newly married young man is seeking to build a house, and we also know that he has run out of money to finish the house, and his

new bride pesters him day and night about the condition of their home. We see him speaking to the famous and wealthy Alcibiades in the marketplace. Phaedo gestures eagerly, Alcibiades listens with narrow eyes and more reserve. Which of the two possibilities apply? Need I write more?

How about another scenario? Menon, the spurned lover of Pericles' new consort, Aspasia, speaks quietly in the corner of the marketplace with one of Pericles rivals. Again, need I write more?

In either case, narrative arbitrates. Aristotle calls it "quick wit" to be able to intuitively grasp the middle term; however, the middle term is pretty obvious if one has the right story as a context for the major and minor terms. What follows naturally from this may be somewhat surprising: *narrative mediates between the major and minor terms.* As we observed above, far from being mere fiction, narrative provides the middle terms. It follows that a mind that understands narrative will more quickly hit upon the middle term. The rich spatial and temporal information, as well as other information—matters of quality, quantity, even states of pathos, comes to inform the cognitive logical processes which accomplish syllogistic reasoning. The same qualities which make narrative able to model complex systems also permit narrative to be the universal middle term.

I have based my demonstration of the utility of narrative on the work of Aristotle. The emphasis on deductive demonstration in Aristotelian science has led many to attack Aristotle on the grounds that Aristotle's method does not open science up to everyone. Francis Bacon was one such critic. Bacon argued that science should have a method that permits anyone, brilliant or not, to follow an experimental procedure that will end in discovery. Bacon writes:

> [T]he course I propose for the discovery of sciences is such as leaves but little to the acuteness and strength of wits, but places all wits and understandings nearly on a level. For as in the drawing of a straight line or a perfect circle, much depends on the steadiness and practice of the hand, if it be done by aim of hand only, but if with the aid of rule or compass, little or nothing; so it is exactly with my plan. (1960, 58-9)

Bacon clearly is positioning himself against Aristotle, but more specifically he is arguing against the very text in Aristotle that I am citing in support of the logical richness of narrative. I must address Bacon's concerns.

Bacon appeals to the need for a procedure that will guarantee knowledge of nature, and thus he insists that the road to scientific knowledge is that of the experimental

procedure, for "the best demonstration by far is experience, if it go not beyond the actual experiment" (Bacon 1960, 67). By learning to develop the right experimental procedures, Bacon believes knowledge can belong to the many, not just the brilliant.

In reply to Bacon, my argument about the logical richness of narrative is in no way harmed by Bacon's point. I explain above that *mimesis*$_3$, when applied to science, involves a hermeneutic circle that comes to understand the natural world through the interplay of history (experiment) and fiction (hypothesis). When that observation is applied here, we find that Aristotle and Bacon are not far from one another. Bacon is approaching the narrative containing the middle term from induction, not knowing what that narrative is, he is forced to create it. And the development of a method for creating the narrative that mediates between the major and minor terms is an important inductive work. Aristotle, on the other hand, assumes that that narrative is already in place, and the faculty of quick wit is the one that can see the major and minor terms in light of that narrative. Bacon looks forward to the narrative with a "good ground of hope" (Bacon 1960, 96). Aristotle looks back to the advent of the narrative with the aim of interpretation. Therefore, both Bacon and Aristotle support my presentation of narrative as the mediator between major and minor terms.

The creation of natural histories in the laboratory is not quite the same procedure that a historian or a literary critic might use in their respective fields. Experimental science aims to render natural history as a univocal plot, such hat it more directly fits into a univocal application of logic. If I am correct that narrative mediates between the major and minor terms, the artificial separation of science from history or literature should have some practical consequences, and it does. Several 20th century philosophers of science position their work in opposition to narrative; Karl Popper is one famous example. This hostility led to the need for complicated ways of transitioning from experiment to conclusion, missing the function of the experiment: *to translate the properties of a natural system or thing into in narrative so that logic can speak to it. Narrative opens the being of nature to logic.*

Narrative's mediatorial function between the major and minor terms accounts for the ubiquity of narrative in almost all disciplines. It is no wonder that psychology, law, chemistry, biology, theology, philosophy, history, literature, political science, and many more each use narrative. Narrative's special place as the mediator between major and minor term closes the distance between history and natural science. We see a similar observation quietly resonating in the thought forms of Ancient Greek culture wherein the Greek word for "research" from which we now derive the English word *history* may be used in the title of Herodotus' *History of the Persian wars* and Aristotle's *History of animals*.

We may now also trace another important development in the use of narrative. A basic narrative has a simple beginning, middle, and end, like a human life. But this same

structure also describes many events in the natural world, evidenced by the electron transport chain, the Kreb's cycle, photosynthesis, the firing of a neuron's action potential, the development of a baby from conception to birth, cellular mitosis, star formation, protein synthesis, the list goes on. The natural world is full of processes the have a beginning, middle, and end, and that also relate to one another in complex nonlinear ways. Narrative, which according to Ricoeur's analysis envelops but transcends Aristotle, opens a way for relating a natural world full of complex relationships. Narrative then becomes a hermeneutic tool of the natural sciences, and, in this function, it opens up all available middle terms for research in complex systems.

5. CHANGEUX'S FIVE "ADVANCES" OF NEUROSCIENCE[251]

Our hermeneutic phenomenology of complex systems can now engage the five "advances" of neuroscience. I put "advances" in quotations, because of their rhetorical function in Changeux's dialogue with Ricoeur. Changeux uses them to situate neuroscience, to naturalise phenomenology within a potential "physics of introspection" (Changeux 2000, 67). While neuroscience has made many useful advances, a hermeneutic phenomenology of complex systems is not threatened by them, because the unity between part and whole is preserved without the reduction of one to the other. I will summarise all five rhetorical evidences for the hegemony of neuroscience, and reply to each in turn. We will now turn our attention to (1) whether the brain can be called a "projective system," (2) neuropsychology, (3) brain imaging, (4) electrophysiology, and finally (5) the relationship between chemistry and mental states.

5.1 THE BRAIN AS PROJECTIVE SYSTEM

The first major evidence Changeux presents is the apparent discovery that the brain is a projective system (2000, 41-47). By this he means that brain science has somehow discovered that *the brain* projects *itself* into its environment. He introduces this "advance" by discussing Edward Tolman's (1932) work on the intentional behavior of animals and humans as the beginning of a reply to John Broadus Watson's (1913) behaviorism. Tolman studied the behavior of rats in mazes and concluded that the behavior of rats could not be accounted for merely on a stimulus-response model. Rats seemed to project their minds out into the environment, exploring when they were not hungry. They would then use the

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[251] The subheadings in this section are identical to the subheadings from Changeux (2000, 41-63).

knowledge gained by exploration to move through the maze more quickly when they were hungry. Through his research, Tolman concluded that animals, and humans for that matter, project their minds onto the environment around them. Changeux and others take this move as the initial step toward cognitive science, since Tolman was opposing Watson's approach; furthermore, also Tolman's work opened a direction of research that led both to the development of cognitive science and research in animal intelligence.

Viewing the brain as a projected system, helps reductionist neuroscience to meet phenomenology at one of its best fortified towers, that of *intentionality* - the evident ability of the mind to *point* at *things*. If the ability of the mind (the phenomenological seat of human motive and cognitive capacities) to designate objects can be reduced to brain (the central organ contained inside the human skull) electrochemical states, then it would seem that a physics of introspection is possible.

However, the evidence does not suggest that *the brain* is projecting itself into its environment. In Changeux's subtle move, the brain is given the same qualities that belong to the whole creature, the organism in its full embodiment. When neuroscientists do this, they give the false impression that animals and humans are brains—with bodies attached. They insinuate all the parts of the organism work to serve the brain. The heart pumps blood for the brain, and for the brain's body. The eyes don't see, the brain sees (Changeux 2000, 49). People aren't art connoisseurs, brains are, and so on (49). The body is just an information source, but the processing of that information all happens in the brain. And it would seem that reductionist neuroscience has a point. Isn't something happening in the brain that is the *sine qua non* of thought? Isn't the brain the critical part? It's like the noun in a sentence. How can you have a sentence without nouns?

A hermeneutic phenomenology of complex systems appropriates the good observations of brain science without the *interpretation* of reductionist neuroscience, without reducing discourse about mind, as defined above, to discourse about the brain, as defined above. In the previous chapter, I explained that the model of the text permits a distinction between system and the irreducible unity of the sign of discourse. Discourse summons all the parts into a different signification in which the distinct work of the parts is not removed. This unity between parts and whole permits part and whole to be preserved distinctly, without separation. One need not somehow prove that the signification of discourse has nothing to do with *langue*. To separate *langue* from discourse is to rupture both. They are in a marriage, which no one should separate. Likewise the parts of the organism, and the action of the organism, the distanciated surface that becomes the phenomenological field of the body, should not be reduced a single part, however critical to its function.

Furthermore, the development of this model of the text within a hermeneutical approach to ontology makes common cause with Aristotle's notion of substance and *meros* developed in *On the parts of animals*. Of particular interest here is the direct application of the model of the text to the parts of animals, and the brain is undeniably such *a part*.

Aristotle applies his theory of the four causes to the various parts in an organism, concluding that each supports the other parts by fulfilling its various functions, consistent with its role as a *meros* in the system. We observed that different parts have different functions, and that if one reduces the function of the whole to a part, one fails to understand the system. We also developed the theory of the four causes beyond Aristotle adding a fifth cause, the instrumental cause (the cause of facilitation, see chapters 5 and 6), which some have tried to reduce to the other four causes. However, we observed that it really partakes in all of them without being reduced to any one. We also observed that any *meros* can be understood as an instrumental cause in the system, though the significance of their instrumentality will depend on what they accomplish in the system, which will depend on the various other *meroi* that they interact with and the causal relationships in play with them.

It follows then, since the brain is a part of the animal, that it is both a *meros* and an instrumental cause. The brains participation in facilitating the mind is not self-sufficient in the least. The brain as an organ will grow like any other organ in the body, but the brain, in its instrumental function, develops because it facilitates the body's interacting with its environment, because it facilitates a child interacting with other children, and so on. A brain, in its purpose, its instrumental function, *matures* not because it is given the correct stimuli by a state-licensed "care giver," or scientist, or whomever, but because the children who possess them are loved by their parents. When phenomenology is naturalized then certain "scientific" absurdities begin to make sense. Little Albert comes to mind.[252] Within a hermeneutic phenomenology of complex systems, the brain is the instrumental cause of a person's body meeting the person and itself. Clearly then the person cannot be reduced to their brain. As Ricoeur argues, a person possesses his body, but cannot be reduced to a part of the body, nor simply to the body as a whole (1992). The phenomenological aspect of personhood cannot be separated out, such that the body fully encompasses personal identity. This is the logical consequence of the hermeneutic phenomenology applied to complex systems as discussed in the previous chapter and developed so far in this chapter. The brain is not a home for the neurons which are the person, rather the brain facilitates the embodied life. The person is more than the organ of the brain, but the brain is a decisive

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[252] Little Albert was an 11 month old boy who had psychological experiments performed on him without the consent of this mother, which were designed to condition fear responses. This type of experimentation is deemed unethical today. For more on this experiment see Harris (1979).

instrumental cause of the meroi of the body distanciating their effects to the body's surface. Thus the brain is decisively instrumental in facilitating the phenomenological field of the body.

So we find a hermeneutic phenomenological approach to neuroscience further extends the basic observations of Tolman's work, without extending the reductionism that unintentionally flows from the context of Tolman's research. Tolman's reply to Watson showed that the rats were not taking action to get rewards. However, only when the brain is viewed as a black box (i.e. Watson), and Tolman's research viewed as an opening of the black box, do the interpretations of animal behavior seem to be interpretations of brain states alone. Creatures act upon their environment, as embodied organisms, with histories of development that fit the niche of their species (one of the most helpful observations of the Artificial Life research project).

Humans have brains, but they cannot be reduced to their brains, even though the brain is the decisive instrument for the body to know itself with and move through its environment. The brain is, in one sense, the conference room of the body where the parts meet to inform one another and act together, but that does not mean that the conference room is the company. In business, those conceptual mistakes kill companies. The brain does not possess intentionality; the system of the whole creature possesses intentionality both in humans and many animals. So we find it is a mistake to attribute intentionality to the brain. Whether intended or not, it is a kind of sleight of hand to attribute to the brain what belongs to the whole organism.

5.2 NEUROPHYSIOLOGY

The next advance of brain science that supposedly enables it to naturalise phenomenology is the development of neurophysiology, which Changeux represents as locating mental activities in the brain. Paul Broca established the basic idea in 1861 when he presented his findings, that speech loss, or aphasia, would result from a lesion of the middle posterior part of the frontal lobe temporal region (see Kandel 2000b, 10f). It is now thought that Broca's area plays a significant role in speech processing. This discovery conclusively established a correlation between brain anatomy and brain function. Changeux takes this discovery and others like it as confirmation that mental activities are located in specific areas of the brain. Even one's own perception of one's body seems to correlate with certain regions of the brain. Lesion studies show that a loss of function results from the interruption of system processes at critical points in the system. It would seem to follow that such areas, where injury leads to a decisive loss of function, must be the cause of that function, or at

least a conduit or step somehow involved in a preserving that function. Great progress has been made through lesion studies and other techniques (discussed below) that map the correlations between brain events and apparent functions performed by them. This information informs doctors who treat brain cancer and head trauma—further confirming that brain science has made some important discoveries.

This aspect of neurophysiology allows for a powerful rhetorical appeal for the reductionist position, for it permits one to imagine that the interruption of function positively designates the location of causes, and this apparent pinpoint accuracy gives reductionist rhetoric the appearance of precision and clarity. It allows the reductionist rhetor to tell a powerful story, with charts and diagrams about how the "subject" is the object in his head

A hermeneutic phenomenology of complex systems also appropriates the data of neurophysiology without reducing the person to neurophysiological states. Returning to the model of the text, recall that the sentence – the smallest signifier of discourse – is composed of parts, while its total function cannot be reduced to those parts. This same quality we also observed in Aristotle's treatment of the parts of animals. Given a hermeneutic phenomenology of complex systems, one should not be surprised that parts can affect wholes. The destruction of certain parts in a system will affect the health of the system, injuring it, crippling it or possibly killing it. But the destruction of a part does not overturn the thesis that the substance is an irreducible whole. The interplay of the five causes make that impossible, because the substance is not the sum of its *meroi*. Each part must function as the instrumental causes to other parts in of the whole, while the whole functions as the instrumental cause of the parts. When viewed in the context of the distanciation between the *meroi* and the surface of the substance discussed in the previous chapter, the person cannot be reduced to any one part, but is distantiatiated from the parts toward the whole as humans in human action.

At this point we may make appeal to some unexpected evidence. Recall the discussion of narrative above. A narrator tells a story from a certain point of view, a view which assumes the interplay of the senses in establishing that point of view. It should be no surprise then to see that multiple brain regions seem to be used by the body when a person is trying to understand a narrative, whether it be his own or another's (Fink 1996). We should expect that much of the brain is involved in helping a person narrate. This feature should make one leery of massively modularizing the brain (see Fodor 2000) into regions that may be pinned down to one specific role especially when the brain as a meros is an instrumental cause as explained above.

Since the brain is an instrumental cause, we should also not be surprised when it inhibits the body from communicating to itself. We find that when a person does not want to

remember something, the brain as instrumental cause inhibits certain of its own regions, which being located within a complex system are also instrumental causes within an instrumental cause. Thus, one ought not to prioritize the brain and the decisive instrumental cause, and then use the framework of the dissertation to build a case on the brain as some sort of conscious, special instrumental cause. Such a move would miss the direction of argument in this dissertation. The brain itself is comprised of an extensive interconnection of instrumental causes, and this fact is illustrated when the brain act to limit some of its instrumental causes depending on the need. For example, when the body has been submitted to great pains, say in cases where people have been tortured, the brain inhibits its mediating function (Ray 2006). For instance, it seems that the brain decouples the cortical language area from the front affective processors. Ray *et al.* interpret the brain as doing this because torture victims with dissociative experience seem also to generate slow abnormal brain waves in the left ventrolateral frontal cortex, which often follows from a localized portion of a neural network being deprived of good amount of input. It would seem that the brain is working hinder its instrumental function, as a psychological defence mechanism.

Without the knowledge that these people were tortured, it would be impossible to interpret these findings. They are both the product of the brain working to inhibit the creation of a narrative, and also understood only through a narrative that is not found merely in an external observation of neurophysiology (a point which corroborates what I explained about scientific research earlier in this chapter). We find two important supports to my argument in this example. First, it supports the view of the brain as an instrumental cause made of instrumental causes, and it will act upon itself to inhibit its own function as such for the health of the person. Second, it confirms the argument made earlier about the relation between history and fiction in the brain science. The phenomenological point of view is a necessary precondition to have this evidence, and the resultant explanation is also the result of the interplay between history and fiction in the process of studying nature. Therefore, this example supports my overall argument and my case in this chapter.

5.3 BRAIN IMAGING

The impressive advance of neural imaging technologies promises early diagnoses of many brain related medical issues, and is one of the most philosophically intriguing developments of modern science. Neural images from a CAT scan, or the newer methods of PET, MRI, fMRI, and SPECT, permit the observation and recording of signs of brain

activity. From these signs, through our conceptual models of the working neuron[253] it is possible to get a good idea what parts of the brain are active in any one event. fMRI is particularly useful, in this regard, for it allows us to watch brain events with a shorter time horizon.

These imaging techniques would seem to aid the reductionist project of a physics of introspection, since neural imaging can be turned on to someone's brain while they are introspecting. Introspection can be "located" this way, because a person's limbs no not need to move during introspection. A person's body may remain completely still. Only the brain appears to be active. It follows then, since brain imaging reveals a busy brain at times when the body is at rest and a person is thinking, it follows that brain imaging produces a snapshot of what a physics of introspection aims to understand, the physical processes in the brain which physically are a persons experience. However, according to Paul Ricoeur a physics of introspection is not possible, and he is adamant on this point (Changeux 2000, 67-69). He insists that introspection is not understood through pictures of neural behavior, but through introspection, and dialogue with those who do the same.[254] But how does one overcome the "photographic evidence"?

Brain imaging may seem like an open and shut case, supporting the reduction of the human person to a physics of introspection, but actually brain imaging is a confirmation that the hermeneutic phenomenology of complex systems is experimentally vindicated. Ricoeur's model of the text makes a distinction between the structure of the system, and the summoning of the resources of that system in the creative production of discourse. Brain imaging captures the *meros* of the brain at work in its mediatorial function in the body. Furthermore, brain imaging captures an image of the brain acting out its mediatorial function as instrumental cause. Therefore the active regions of the brain, working in schemas, may be likened to the creative production of discourse that draws on the potential resources of language (Arbib 2003c).

This analogy between discourse, and the pictures that result from neural imaging, is well-founded when considered through Theodore Brown's work on the use of metaphor in science (2003b). The images seem, at first glance, to be direct images of brain activity. However, to extract information about brain activity from those photos it is necessary to "read" them both in front of "the text" of human lived experience and before the texts of

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[253] One can apply Brown to neural net models (2003b, 19-22).
[254] Once can not learn of consciousness from a brain image. However, a brain image is an image of the physical processes at work in some way. Thus, on a reductionist view, the image is *closer* to the truth of what is actually going on than the phenomenology of experience.

previous neuroscience research. Therefore, there is strong common ground between the work of discourse interpretation and the work of PET-camera or fMRI-image interpretation.

Again, the application of a hermeneutic phenomenology continues to be productive, when the model of the text, through human action, is applied to brain imaging. Before the advance of this kind of imaging, researchers had little access to the instrumental workings of the brain. Brain imaging inscribes the event of brain activity in time, thus it translates brain events into a kind of text which will distanciation it from their source and permit interpretation that might not be intended. For instance, some have suggested taking fMRI images of people who might be lying, and the results of that test would likely be much more reliable than a traditional lie detector test. Another form of distanciation would be the comparative studies done between different brain images of different people doing related things, or even doing similar things with slight variations, so that the instrumental activity of various brain regions can be better understood. In the first case, the brain's work distanciates beyond itself, such that the "testimony" of other studies involving human brain studies and relevant human testimony can establish an official "text" (see chapter 6) against which the inscribed record of the brain image may be interpreted. The second case it the hermeneutical procedure by which such "texts" may be developed. But notice the product of such a research project will have distanciated beyond the immediate findings of any one test subject.

Before a reductionist neuroscientist gets too excited about these brain imaging comments, we ought to keep in mind that the only reason this procedure of treating brain images as text is even possible is that brain events are human actions. They occur inside the human body and are instrumental in serving a human to act upon his or her world. Furthermore, humans, not mere brain regions, have the ability to narrate and exegete their world, if the hermeneutic phenomenology of complex systems is correct. It follows then that the human as irreducible system is necessary for the exegesis of the discourse-like event recorded by brain imaging. Also, this image is being interpreted through narrative, both in the sense of being a record of an experiment, a natural history, but also in the sense of an autobiographical or empathetic narrative. The event of brain activity can be interpreted because it has been translated into an experimental record, one kind of history, and a human historical event. Exegesis of the event depends on the paradox of bringing these two perspectives (in the strong sense that I discussed above) together while keeping them separate (a kind of procedure common to Ricoeur's hermeneutic phenomenology).

So we find that the study of brain imaging is a further confirmation of the success of a hermeneutic phenomenology of complex systems when applied to brain science. This is confirmed because the relation between complex systems and the model of the text was

fruitful in accounting for what is happening during the human work of studying brain images. Furthermore, the analysis of the relationship between history and fiction in the process of scientific inquiry proved fruitful in accounting for why a person is a necessary source of testimony and the necessary exegete for the interpretation of brain images.

5.4 ELECTROPHYSIOLOGY

The fourth evidence for a physics of introspection is electrophysiology, which directly, and at times invasively, studies the electrical activity of the nervous system. In some experiments, researchers have inserted a fine electrode into a single neuron to study the electrical activity of a single brain cell. This type of research helps somewhat to confirm the accuracy of neuron models.

Electrophysiology is a second witness confirming that brain imaging is indeed recording signs of brain activity. Thus, it gives the impression that the brain's activity is totally composed of its electrochemical impulses, and that recording electrical stimulus is, on some level, a record of thought, if consciousness is *in* the brain. I will also move on to the fifth advance because a hermeneutic phenomenology of complex systems approaches both electrophysiology and the chemical influence on mental states the same way, in terms of system.

5.5 CHEMISTRY AND MENTAL STATES

The discovery of the influence of chemicals on mental states suggests that both emotional states as well as the brain's regulation of its processes, its own network adjustments, are substantially chemical. Several neurotransmitters have been identified and studied (see Chapter 2) and the results of these studies suggest that subjective states, especially emotional states, seem related to chemical states in the brain and human body. This research is the scientific basis for the billion-dollar psychiatric drug industry that uses the information from brain research to find artificial ways of regulating brain chemistry.

The cherished subjectivity of emotions gives this discovery strong rhetorically support for the physics of introspection, as Changeux maintains (2000, 61-63). There is reason for some confidence that contemporary neuroscience has discovered something because chemical states in the brain often correspond with the symptoms of depression in the bodies of hurting and disturbed people. Thus, Changeux concludes that these chemicals in the brain are, in some way, the physical subsistence of human emotions.

Again we find that a hermeneutic phenomenology of complex systems helps to account for the relationship not only of parts, but various kinds of parts with very different properties. Aristotle did not discuss electrical signals, but his theory of substance and *meros* permits a hierarchy of different parts relating to one another. By hierarchy it does not follow that an ascending scale must exist with some top down dictatorial cellular totalitarianism in the body. I discussed this in chapter 3 with regard to the relationship between neurotransmitters and neuromodulators and their effects on the networks in which they participate. I also explained how different neural networks may activate a neuromodulators to alter a network, giving it a different behavior, and that these changes can have a global impact on the systems that they affect.

A hermeneutic phenomenology of complex systems helps to guide this talk of part and whole so that happiness is not reduced to serotonin. Pain is not merely an electrochemical impulse, though it certainly is related to electrochemical impulses. Modern science offers powerful tools to open *meroi* to view, and because of that may be tempted to think that the substance is simply a collection of *meroi*. As discussed above, the process in a *meros* is not the same as a subsystem's behavior or a system's behavior. The model of the text gives us an artefact that operates on different levels of signification, different gestalts. On the model of the text, mind belongs to the embodied whole and not to the parts even though some parts can play decisive roles, as *langue* does for discourse.

This hermeneutic phenomenology of complex systems corresponds to the position Ricoeur takes in *What makes us think?* I maintain that

> [I]n humans a function is not reducible to an observable behavior. It also—
> and often mainly—involves verbal reports or accounts. These accounts
> concern what the observer feels, which is to say sensory phenomena,
> whether motor or affective, that the scientist labels mental states or events….
> But no matter how careful an experimenter may be, he will still need to have
> recourse to other verbal reports to develop his analysis. When he attempts to
> establish a correlation between neuronal—or, more broadly, cerebral,
> humoral, or corporeal—structures and a mental function, we will have to
> consult ordinary experience. (67-8)

In the previous chapter, I offered an account through the hermeneutic phenomenology of complex systems for why Ricoeur is right to insist that "in humans a function is not reducible to an observable behavior" (Changeux 2000, 67). This chapter has also, in part, defended

the human interpretive perspective, and the need for human testimony in the process of doing brain science, both neuroscience and cognitive science.

Ricoeur also distinguishes between the actions of living creatures and physical bodies, a critical distinction in the meeting of phenomenology and neuroscience. And his comment confirms the note on which John Searle concluded our previous chapter: "[L]iving creatures organize their environment, something physical bodies cannot be said to do" (64).

6. CONCLUSION

In partnership with the previous chapter, this chapter continued the development of a hermeneutic phenomenology of complex systems. In the previous chapter I developed Ricoeur's hermeneutic phenomenology as a theory of the relationship between parts and wholes in the system. Through the model of the text I showed how parts and wholes can function, but in such a way that the whole possesses a different significance from the parts.

In the present chapter, I have shown the special significance of the work of discourse in metaphor and narrative. I showed that both depend upon the embodied life, extending Ricoeur's definition of discourse as a human activity into the space in which physical systems subsist. I further extended Theodore Brown's thesis that metaphor is epistemologically necessary for the project of science, through Ricoeur's theory of narrative, showing both that narrative mediates between the major and minor terms of the syllogism.

This chapter also showed how scientific study is the use of narrative, specifically history and fiction, which join together in the process of scientific knowledge and wisdom regarding the natural world. It follows then that the scientific method of hypothesis and experimentation follows the hermeneutical circle of $mimesis_1$, $mimesis_2$, and $mimesis_3$—delineated by Ricoeur.[255] This finding is quite useful, in that it helps to bridge the natural sciences and the human sciences, by showing their similarity of method. It also helped to close the distance between Aristotelian science and Baconian science.

I concluded by applying a hermeneutic phenomenology of complex systems to the data set of neuroscience, working through each of Changeux's five advances of neuroscience. It was shown that the hermeneutic phenomenology of complex systems is robust enough to situate brain science within hermeneutic phenomenology. This was made possible through a hermeneutic approach to the relationship between parts and wholes, a distinction which may at times lost on supporters of reductionist neuroscience.

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[255] This would seem to account both for the ubiquity of narrative in almost all disciplines and its power to model complex systems.

I finally closed the chapter with textual references from *What makes us think?* showing that that the conclusion at which I arrive through careful argument supports the general direction of Ricoeur's own thoughts on the human interpretation of data of brain science. In doing so, I showed also how Ricoeur's work anticipates this hermeneutic phenomenology of complex systems, though an articulate expression of it was beyond the time to which Ricoeur could lay claim.

CONCLUSION

The introduction to this dissertation stated its primary and secondary goals. The primary goal was to vindicate Ricoeur's hermeneutic phenomenology in its dialogue with neuroscience. For that purpose I took up Ricoeur's case against Changeux's reductionism in a way that engaged the experimental data of neuroscience. Moreover, this study limited the scope of the dialogue to Changeux's articulation of the reductionist position, because Changeux's prominence in the field made it so my interaction with him could be emblematic of interaction with the field as a whole, while still remaining faithful to the limit of scope imposed by this dissertation project. This goal was clearly met because this dissertation was able to provide a Ricoeurian account of the five "advances" of neuroscience which Changeux uses as his leverage in his debate with Ricoeur.

My secondary goal, one that served the first, was to develop a hermeneutic phenomenology of complex systems (HPCS). This HPCS was developed to bring Ricoeur's thought to terms with neuroscience, and also with economics, patent law, philosophy of science, strategic modeling, and many other fields that engage the study of complex systems. This HPCS then was a tool invented for the work of this dissertation, which should by no means be restricted to the domain of the dialogue between hermeneutic phenomenology and neuroscience. The success of the HPCS in moving brain science within the domain of hermeneutic phenomenology, which has been the major project of this dissertation, is one indicator to its probable success in other fields and discourses.

Along the way this dissertation has covered a number of diverse subjects: scientific modeling, complex systems theory, neuroscience, structuralism and poststructuralism, and Aristotle's theory of substance and *meros*. At each step hermeneutic phenomenology has

kept pace to arrive at a hermeneutic phenomenology of complex systems, through Ricoeur's theory of discourse and narrative. *Most importantly, hermeneutic phenomenology may approach neuroscience without being reduced to neuroscience. The brain then becomes an object of study for hermeneutic phenomenology,* because the long route to ontology through Ricoeur's model of the text was able to establish that the brain is a human *meros*, which an instrumental cause of embodied life. Moreover, the project of science was shown to be the application of *mimesis₁*, *mimesis₂*, and *mimesis₃*, which also clearly locates brain science within hermeneutic phenomenology. This was done by showing that the project of testing a hypothesis is another way of combining and applying the various forms of *mimesis*. I have used Ricoeur longer path to show how science as accomplished by humans is another form of hermeneutic phenomenology, if one is careful to consider the interpretive process by which scientific research is done, as I argued in chapter 7, when I used Ricoeur's narrative theory to harmonize Aristotle and Bacon. Phenomenology has approached the object of the brain successfully, without having been reduced to just a dataset for neural modeling. However, nine other observations were made that, put together, suggest that a hermeneutic phenomenology of complex systems is also a useful tool for other applications.

First, I established through a survey of the various kinds of models how the activity of modeling has a kind of polysemy to it. Through applying Aristotle's causal model, it was possible to show that each type of model is a *mimesis* of an application of at least one of the elements of the causal model, showing that modeling shares characteristics with language, not least of which is a metaphorical function.

Second, many, but not necessarily all, the parts of a complex system have a polysemy of function. This quality was observed at all levels of neural anatomy, and it was suggested that this is the nature of many complex-system parts.

Third, and possibly the most decisive point for building my argument to its conclusion, the model of the text can be extended, through human action, to complex systems, because the exegesis of human action reveals what is hidden. It reveals the interior of character and the causes of action. This stems from the way human actions are similar in structure and character to discourse (see chapter 4). Furthermore, human actions unify a number of underlying factors into a unifying event, as discourse summons the resources of langue to predicate. Similarly, the parts of a complex system may be pulled together into one signification, and may be interpreted through the model of the text, as was discussed in chapter 6.

Fourth, Aristotle's theory of substance and *meros* in *On the parts of animals* helps to bring complex systems to terms with hermeneutic phenomenology. This is because *langue* and discourse relate to one another like *meroi* and substance relate to one another. Thus,

we see the notion of whole and part brought together, and this is no wonder since Aristotle is the primary basis for Ricoeur's theory of discourse. Ricoeur shows how Aristotle's notions of potentiality and actuality play out in the development of the single signification of discourse. This general ontological outlook of potentiality and actuality is also behind Aristotle's systems theory. Furthermore, the teleological quality of Aristotelian substance and the referential quality of discourse supported one another to bring systems theory to terms with hermeneutic phenomenology, for now the relationships of cause and the category of teleology may be more accurately applied to complex systems, and with some hermeneutical warrant. Which leads to the next observation.

Fifth, it was hypothesised that function is the teleology of system event as meaning is the teleology of discourse. This was not proven, but rather evidenced by the success of hermeneutic phenomenology if this is assumed. This hypothesis proved quite productive, in two ways. First it bridged the distance between the exegesis of meaning in texts and the exegesis of cause in physical systems. Second, it opened the way to integrate narrative into the hermeneutics of complex systems, without loosing the precision of natural science (the application to natural science as a whole will be its own point below).

Six, the model of the text opens a way to understand the distanciation of the effects of an event internal to the system and second signification of the whole system. Since tokens of *langue* as such do not constitute the single signification of discourse, it was shown that discourse is a unity which cannot be reduced to its parts. Furthermore, the event of discourse distanciates from the event to cause other events, which may use the products of the event in new and unintended ways. This principle is helpful in understanding physical systems, since the internal event distanciates from itself to the surface of the substance. It was suggested based on the model of the text that when this principle is applied to physical systems, that the body, which is the individual human complex physical substance, is a whole, a unity, which becomes the phenomenological field for the unity of mind. Thus it is hermeneutically inappropriate to locate consciousness in the brain, but this principle may also be applied in other contexts.

Seven, narrative bridges phenomenological time and the aporia of time/space, opening a hermeneutics of cause in physical systems. This was accomplished through the spacial/temporal nature of narrative referent, through bringing Ricoeur's study of narrative into the domain of Merleau-Ponty's phenomenology of perception, specifically his insights on depth perception, and it way to locate the viewer in an extended environment which moves the viewer beyond his or her own body and perspective. This development led to building a connection between *mimesis₃* and physical system, such that they could be opened by narrative. This development was particularly significant because it opened a way to develop

a framework for hermeneutic phenomenology to engage the natural sciences, drawing Aristotle and Francis Bacon into a single framework.

Eight, it was shown through Changeux's five "advances" of neuroscience that the hermeneutic phenomenology of complex systems could engage neuroscience. In fact, it was shown that each "advance" bears a host of assumptions, and that the actual observations offer no bulwark against hermeneutic phenomenology. More to the point, Ricoeur's philosophy opens each to being better understood. Ricoeur observes (see the extended discussion in chapter 4) that explanation and understanding make a hermeneutical circle, in which one informs the other. The physical data set of neuroscience provides us with a great deal of useful information, which should not be depreciated. Cognitive science also provides helpful models, though it is one way of interpreting the neuroscientific data, hermeneutic phenomenology should not be perceived as being at war with either neuroscience or so-called cognitive science. Ricoeur's objection is that the attempt to explain the human mind, in a way that neglects the understanding which comes from hermeneutical reflection, will at best be incomplete. However, with hermeneutical understanding comes the ability to understand *into* nature. This is what I endeavored to show in the last chapter of the dissertation, by arguing that neuroscience already follows some of the method of hermeneutic phenomenology, when neuroscience researchers work within the testimony (discourse) given by human neuroscientific test subjects.

Finally, I will now reveal an intentional conceit throughout the dissertation. A careful read will reveal that I have used the word "significant" in two ways. The first has to do with things weighty and important. I have also used "significant" to refer to the quality a thing has when it signifies something else. This polysemy of "significant" has been intentional, for I think natural polysemy of his word points to something humans know through experience in the human life world. Intelligible (but unfathomable) complex things are often weighty, important, revealing, even earth-shaping sometimes. Often they define who we are, define the quality of our life. For these reasons I have eagerly pursued this research because it seems, to me, that the hermeneutic phenomenology of complex systems opens other avenues of research to benefit humankind. While this dissertation has focussed on neuroscience, a hermeneutic phenomenology of complex systems clearly has many applications.

This work opens many future research projects. For one, the relationship between the teleologies of meaning and function should be worked out in greater detail. This relationship seems natural enough, but the more it can be pinned down, the more it may be possible to model abstract domains through well-aimed univocal symbol operations. In other words, it may be possible to computer model more conceptual realms, if the models are

aimed properly through the informing work of a hermeneutic phenomenology of complex systems. Which leads to a second research project: using the hermeneutic phenomenology of complex systems in conversation with formal definitions in medical ontology (Barry Smith Forthcoming) to see if abstract conceptual systems can be modeled like organisms in a computer program embodiment, within a limited scope if the organic relationships are defined formally.

Also, the use of the model of the text to understand economics looks quite promising. It answers the question of what a price is. A price is a unit of discourse, predicated from a system, which makes it intelligible and permits the development of a hermeneutics of the world of the price. This approach to price calculation is consistent with Mises, and meets the problem of having to establish system value, because the price, which is the creative event of predication, makes the market, while those who set the price do not need to know the market exhaustively. At the same time, the price may be hermeneutically interpreted as I describe above.

Fourth, in military strategic modeling a mathematical model is too complicated for battlefield solutions. Models like Warden's Rings are helpful for giving immediately useful theories that can become models and open causal interpretation in a war-fighting situation. Hermeneutic phenomenology of complex systems could be quickly brought to terms with non-mathematical system modeling for military application. It can do this because it employs teleology, and not just the application of formal rules in a computer program embodiment, Combatants in warfighting situations will alter their plan once they know that their enemy has modeled their behavior. The approach proposed in this dissertation permits a warfighter to ask the right questions, guided by the hermeneutic phenomenology of complex systems to interpret the changing field of battle, understand the development of the system based on the model of factory, and discover the right targets for the assignment of military assets, (see Collender 2008).

Fifth, the insight that metaphor and narrative are logic-rich, which made possible my the metaphorical square of opposition and mediation of narrative between the major and minor terms suggests that a hermeneutic phenomenology of complex systems may have different resources from methods like Bayesian probability, and that effort is worth the labour, if it develops more prudent approaches for interpreting causation. The applicability of $mimesis_3$ to science seems a fruitful start. The application of $mimesis_3$ employs both $mimesis_1$ and $mimesis_2,$ showing that the analysis of natural causal factors at which laboratory research often aims applies the causal hermeneutical circle. Because both the natural sciences and the human sciences both use $mimesis_1$, $mimesis_2$, and $mimesis_3$ it

follows that we should expect narrative to be used in many if not most of the academic disciplines.

I have offered several arguments in support of a hermeneutic phenomenology of complex systems robust enough to dialogue with neuroscience, but there is one last reason, one at least as significant as those I have already mention.

About the time I began writing my dissertation, a friend's father, who had been an accountant much of his life, began to struggle with adding, which led him to seek medical attention. This man was diagnosed with an aggressive form of brain cancer. To stop the formidable advance of the cancer, he underwent aggressive chemotherapy and eventually brain surgery. His surgeon normally operated on infants, and his great precision enabled him to remove more of the cancer than most could. He also closed the blood vessels that fed the inoperable parts of the tumour. The surgery was a success, but as he recovered from his surgery, this man noticed a change in his field of vision. The phenomenon of red was bleached into a light orange or yellow. This man continued his regimen of chemotherapy.

From the beginning, my friend's family knew that the survival rate for this particular cancer is very low, so they were not surprised to find in the coming months, after a peaceful reprieve, that the cancer returned, overpowering the aggressive chemotherapy. This man underwent Gamma knife radiosurgery, which destroyed much of the tumour, but did not destroy all of it. The doctors informed this man that only one option remained, to undergo a second brain surgery. His family was very apprehensive, because of the dangers of opening up the brain a second time, but he was cheerfully all for it. This man survived the successful surgery, an operation which removed much of the cancer, but also proved that a good portion of the cancer had become inoperable. As I pen this conclusion, just a few months after the second surgery, the cancer has reached the final stages.

A couple days ago I received word[256] here in Leuven that my friend's father is not doing well. He is overwhelmed with pain. The doctors have said there is no reason to have visits anymore and the most important thing now is to make him comfortable. He is on a number of good medications for the pain but he is still visibly suffering. He is now back at home, and the nurses from the hospice, where he stayed for a time, have visited and increased his pain medications. They have also given my friend's mother a wheel chair so that she can take her husband on walks and get some fresh air. He is not completely bed ridden but he is house ridden.

His balance is way off and he had his first fall this week. His world has become the house and it seems that he does not even know that there is world outside of his home. He

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[256] Some of the text that follows is word for word or paraphrased from the email from my friend's wife.

is constantly getting in and out of bed and is obviously agitated and confused. He thinks that he lives in a chicken coop and cannot understand how the chickens walk on their slippery wood floors. About a week ago one could follow his train a thought for the most part, but now it is hard to know what he is saying. His family has been able to spend a lot of time with him and they are very thankful for that time.

Senility, which comes upon so many of us in our winter years, has a way of revealing character. The strength of mind to guard our deeper secrets from the gaze of others wears away with time, and the overflow of a person's interior escapes through the cracks. My friend's father has faced this problem in a deeply empirical way. The cancer has eaten his brain, piece by piece. My friend's uncle was telling me that when they went into a coffee shop, his brother took out of his pocket an amount well in excess of the cost of the coffee. The former accountant, with unaffected humility, had to ask the barista "Is this enough? I don't know. You'll need to tell me." My friend's father has faced something few men do—the incremental consumption of his brain, with full consciousness of what happening to him. One would expect that this cancer would have undone him, that he would not have retained his character, through the changes of capacity, and personality that he has gone through, but through all of it he has shown all those who know him something very remarkable, that the same strength of character has remained through all the changes. He has not complained, not asked "Why me?", not milked the pity of others, not made a last grasp for some secret unfulfilled desire. Rather, he has shown that the same character he possessed with his full strength remained when his power was stripped from him. The same character led him to invest himself in his wife, in his children, and in other people, as people. He cultivated a life of wisdom, a wisdom all the more evident as his mind is taken from him.

One might ask how this world could be so cruel as to put this merciless hardship on such a great man—and that rant would miss the point. Ricoeur, with Aristotle, observes that the meaning of a human life is not evident until its conclusion, and more precisely till distanciation has permitted it to be viewed in the context of other events, especially its own effects.[257] As this man's life drew to a close, two things become clear. First, that he poured his strength of character into others, most notably—his family. Second, though his brain lost functions incrementally, his actions facing each loss of his powers opens a world of its own, which cannot be reduced to mere brain function. Those actions reveal that the man presented publicly was the man he was through and through— irreducible to what has been

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[257] Bruce Farley died in the fall of 2007. I personally attended his funeral. At his funeral, the unanimous testimony of everyone, especially his family and close friends who spoke to him from the outset of the cancer till his final passing, was that he never complained, not once. Though they also

taken from him. It takes a lifetime to die as he is dying. A "brain" is not dying nobly. Bruce Farley is dying nobly, in a way that makes evident his life of integrity.

From a hermeneutic phenomenology of complex systems, Bruce Farley was not losing himself. He was not a brain crumbling. Rather some of the instrumental causes for powers of his embodiment were injured, inhibited, or removed because of the cancer and the needs of its treatment. We must speak of his nobility, his courage, and his integrity as virtues because he is not a brain—he is an embodied person. This dissertation has been a defence against one way of assailing the significance of his life and death, and those with similar character.

I have argued that hermeneutic phenomenology has the resources to engage with complex systems. Through a hermeneutic phenomenological approach I have shown a way of approaching parts and wholes that preserves both the detail of the parts and the operation of wholes so that neither category is reduced to the other, nor are they separated. The model of the text accomplishes this through the information rich epistemological power of metaphor and narrative that opens knowledge in many disciplines and complex systems, but especially the neurosciences, to illumine them without reducing humans or dismembering what, in this life, gives them the capacity to narrate.

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recognized this was consistent with the character he had actively cultivated over his life, they still marveled.

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