The Third Culture: Exploring the Relationship between Biology and Philosophy

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Introduction

The following outline is for three seminars on biology and philosophy presented to the biology faculty at Western Washington University in July and August of 1995. The purpose of the seminars was to acquaint those interested with some of the current issues in the field of Biology & Philosophy. The three seminars had a common theme in showing how science and philosophy contribute to our view of the world. What was new, however, was the growing belief that scientists had taken the intellectual high road in answering the most basic philosophical questions of our times. This theme is expressed in the combined title for the three seminars used in this paper.

The idea of a third culture comes from C. P. Snow. In his book *The Two Cultures and A Second Look*, Snow recognized the origin and growth of a "third culture", a combination of science and the humanities. At the time Snow published his book there was little to say about this phenomenon except that it should prove "profitable to all of us" (Snow 1969, 70-71).

John Brockman, editor of the book *The Third Culture: Beyond the Scientific Revolution*, gives this definition of the third culture:

> "The third culture consists of those scientists and other thinkers in the empirical world who, through their work and expository writing, are taking the place of the traditional intellectual in rendering who and what we are."
> —Brockman 1995, 17

The question of who and what we are is the common thread that ties the topics chosen for the three seminars.

Seminar One — Materialism and Science

Darwin's Revolution In Thought versus *Darwin's Dangerous Idea*: The Philosophical views of Stephen Jay Gould and Daniel C. Dennett

Seminar Two — The Growth of Biological Complexity

A critique of *The Major Transitions in Evolution* by John Maynard Smith and Eors Szathmary

Seminar Three — Ontology and Science

The Species Question as exemplified in *Taking the Naturalistic Turn or How Real Philosophy of Science is Done* by Werner Callebaut

What follows is a text version of the seminars.

"In no society, Eastern or Western, Chinese, Roman, medieval, or contemporary, have science and rational speculation long survived the imposition of absolute dogma—religious or social. If today we want to find relief from the uncertainties of a changing world in some cozy arbitrary doctrine, then we had better face the likelihood that tomorrow the Dark Ages will return."—Bronowski 1977, 253

Seminar One

Materialism and Science: *Darwin's Revolution In Thought* versus *Darwin's Dangerous Idea*—The Philosophical Views of Stephen Jay Gould and Daniel C. Dennett

Abstract: The general public in America maintains an active reluctance toward accepting modern evolutionary biology. This has important implications for the teaching of biology at all levels, including higher education. One explanation for this reluctance can be found in the implicit materialism of Darwinian natural selection. This situation makes it problematic whether it is possible to reconcile modern science with dogmatic religious beliefs. Stephen Jay Gould has taken the position that it is possible to do so, but other prominent scientists and philosophers, such as Daniel C. Dennett, disagree.

Keywords: materialism, naturalism, naturalistic fallacy, sociobiology, algorithm

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"materialism—a theory that physical matter is the only or fundamental reality and that all being and processes and phenomena can be explained as manifestations or results of matter"—Webster's 1989

"Naturalism as a philosophical movement claims that whatever exists or happens in the world is susceptible to explanation by natural scientific methods; it denies that there is or could be anything which lies in principle beyond the scope of scientific explanation. Although naturalism is firmly rooted in the philosophical tradition (materialism, empiricism), a thoroughly naturalized philosophy of science is only being developed now."—Callebaut 1993, xv

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What follows is a review of Stephen Jay Gould's video lecture *Darwin's Revolution In Thought* which is taken from his 1977, book *Ever Since Darwin*. Gould is one of Brockman's primary representatives of the "Third Culture", and it is important to understand how well he does in the dual role of scientist and philosopher. —It's tough working both sides of the street.

[From the video]

What Gould does that is "right" #1) Gould, as philosopher, points out that our ability to understand scientific concepts is constrained by our worldviews. As the philosopher of science Larry Laudan has put it: "we find ourselves in a situation where our only contact with the world is mediated by our concepts. We posit certain beliefs or theories to make sense of that mediated world." (Laudan 1990, 165-166). This is Gould's hypothesis as to why, even if we accept evolution, we still have trouble understanding natural selection. This is epistemology, and it is philosophy in the service of science.

What Gould does that is "right" #2) Gould, as philosopher, defines natural selection as a simple "syllogistic inference" that follows from three irrefutable assumptions, over-reproduction, variation, and inheritance of some of that variation. As we shall see, without naming it so, Gould has portrayed natural selection as a simple algorithm. This is ironic given Gould's position on other issues where he ignores the power of "syllogistic inference."

What Gould does that is "right" #3) Gould, as scientist, points out that modern science has taken over from religion as the only reliable source for knowledge about "matters of fact." This is rationalism in the service of philosophy.

In the video, Gould recounts how Darwin was able to destroy the argument from design that Fitzroy, captain of the Beagle on Darwin's famous voyage, felt proved the existence of an intelligent, omniscient, benevolent God. What Gould does not make explicit is that the destruction of the argument from design was the destruction of the last rational argument using empirical observations from nature to prove the existence a god. Jacob Bronowski makes this clear in his essay *The Fulfillment of Man*. "More than a hundred years have passed since Charles Darwin in 1859, reluctantly, and after twenty years of labor, published *The Origin of Species*. The storm which Darwin had foreseen and feared broke punctually." "Yet today these distant heroics hardly raise a yawn." "Why? Because Darwin and Huxley routed those who tried to challenge them on their own ground [rationalism] with such finality that, alas, we can no longer muster an interest in their historic victory." "Religion as it existed up to and in the nineteenth century is dead. Nineteenth-century rationalism killed it, ..." (Bronowski 1977, 249-251).

What occurred with the publication of *The Origin of Species* was the destruction of the last rational arguments for the literal God of the Bible. As Bronowski puts it "The issue of fact has been yielded to the experimental scientist. Whatever issue is now paraded, whatever kind of truth is now claimed for ancient dogmas, truth which is accessible to rational inquiry has been abandoned [by religion]." (Bronowski 1977, 250). What religion is left with today is a retreat to the irrational. I think that Gould accepts this conclusion. His failing is in not making it explicit.

What Gould does that is "wrong"—The "Dean of Spin Doctors" puts his own spin on the question as to whether science and religion can be reconciled (see Gould 1995b).

What Gould does that is "wrong" #1) Not all religions are the same even if Gould would like to treat them as such. This is bad philosophy.

Gould does not make a distinction between conservative, dogmatic religions and spiritual relativism—the belief in a personal god. By definition a conservative, dogmatic religion does not allow a received view to be questioned by its followers. In contrast, it is possible to have an individual set of beliefs about a god, in which case one's spiritualism is a personal and, therefore, relative belief.

What Gould does that is "wrong" #2) Conservative, dogmatic religions are concerned with "matters of fact" about this world and take great offense if it is suggested that they shouldn't. This is an empirical observation and Gould could be accused of being a bad social scientist.

Steven Weinberg the Nobel Prize laureate in physics has taken note of this problem with Gould's stance. "One often hears that there is no conflict between science and religion. For instance, in a review of Johnson's book [*Darwin on Trial*], Stephen Gould remarks that science and religion do not come into conflict, because 'science treats factual reality, while religion treats human morality.' On most things I tend to agree with Gould, but here I think he goes too far; the meaning of religion is defined by what religious people actually believe, and the great majority of the world's religious people would be surprised to learn that religion has nothing to do with factual reality." (Weinberg 1992, 249; Gould 1992).

Weinberg offers us an explanation of why the difference between types of religions is important. "In another respect I think that Johnson is right. He argues that there is an incompatibility between the naturalistic theory of evolution [which Gould supports] and religion as generally understood, and he takes to task the scientists and educators who deny it. He [Johnson] goes on to complain that 'naturalistic evolution is consistent with the existence of 'God' only if by that term we mean no more than a first cause which retires from further activity after establishing the laws of nature and setting the natural mechanism in motion. (Johnson 1991)'" Weinberg continues: "The inconsistency between the modern theory of evolution and belief in an interested God does not seem to me one of logic—one can imagine that God established the laws of nature and set the mechanism of evolution in motion with the intention that through natural selection you and I would someday appear [which Gould stringently argues against]—but there is a real inconsistency in temperament. After all, religion did not arise in the minds of men and women who speculated about infinitely prescient first causes but in the hearts of those who longed for the continual intervention of an interested God."

From this Weinberg draws the observation: "The religious conservatives understand, as their liberal opponents seem often not to, how high are the stakes in the debate over teaching evolution in the public schools." In this case religious conservatives want to preserve a belief in an interested God that does continually intervene in human affairs. But it should be obvious that a belief in evolution, Darwin's radical idea, is rationally incompatible with such beliefs.

"The naturalistic perspective implies that *matters of fact* are as relevant to philosophical theory as they are relevant in science."—Callebaut 1993, 1

"ethical naturalism holds that 'there are no values in the world that are not reducible to or explainable away in terms of the naturalistic conceptual scheme of things'"—Callebaut 1993, 1

What Gould does that is "wrong" #3) Ethics and morality are not the exclusive province of religion. Many philosophical naturalists would take great exception to Gould's views on ethics. Again, this is bad philosophy.

Leaving Gould's argument for the proper role of science aside, what of his argument that "religion" should concern itself not with "matters of fact" but with questions of human morality. Note that Gould cites only the role of morality in his reconciliation of science and religion leaving aside all other issues that divide science from religion, not the least of which is the issue of materialism versus spiritualism. He does this at the same time he points out that Darwin's most revolutionary and radical idea is the implicit materialism of natural selection.

Gould goes on to use the naturalistic fallacy which states that you can not logically go from "what is" to "what ought to be", as his unspoken argument for separating science from ethics. But note that Gould lumps philosophy with theology and does so almost under his breath when he makes the division of responsibility between science and "religion". So we go from philosophy, humanists, and religion that should be concerned with moral questions to only religion being responsible for moral truths, all in one breath.

The point I would make is: Can philosophy in the form of a completely materialistic, naturalistic philosophy provide us with a moral system (ethical naturalism) to guide us? Or, out of necessity, must we have recourse to irrational spiritualism in order to find our moral bearings? Gould of course evades this issue completely in his attempt to find a common ground for science and "religion".

I will also point out that even while he is exhorting humanists to debate the questions of moral truth, he himself holds out no hope for answers—"I don't believe there are any answers." To give him credit and to clarify, I think Gould is referring here to the existence of *a priori*, absolute moral principles.

Here are some of the logical questions that could be put to Gould at this point:

• Is human behavior a proper subject of study for science?

• Does the human behavior we observe today have its causal origins in our evolutionary history?

• Is human moral behavior a proper part of the scientific study of human behavior?

• Does human moral behavior have its causal origins in our evolutionary history?

As Bronowski puts it : "today [the] distant heroics [of Darwin and Huxley] hardly raise a yawn." "This would be a matter for no regret if in fact the battle of rationalism had been won. If the pioneer work of the last century had established, once for all, that rational thought is welcome to examine all human origins and institutions and human conduct [including moral conduct], I should not ask you to be alarmed at the neglect of the pioneers. But of course nothing of the kind has occurred." (Bronowski 1977, 250).

Does Gould still fear the specter of sociobiology—that is, the direct extension of Darwinian thinking to human behavior, including our moral behavior?

And finally, what Gould does that is "wrong" #4) The "Dean of Spin Doctors" spins himself. Gould's ideological bias against the application of Darwinian thinking to human behavior, including our political and religious behavior, has made it impossible for him to see clearly the position of other evolutionary biologists, the so called ultra-Darwinians.

Enter Daniel C. Dennett and the Ultra-Darwinians

From Dennett (1995, 264): "Gould has been a defender of his own brand of Darwinism, but an ardent opponent of what he has called 'ultra-Darwinism' or 'hyper-Darwinism.' What is the difference? The uncompromising 'no-skyhooks-allowed' Darwinism I have presented is, by Gould's light, hyper-Darwinism, an extremist view that needs overthrowing. Since in fact it is, as I have said, quite orthodox neo-Darwinism, (John Maynard Smith is the primary example of one of Gould's ultra-Darwinists.) Gould's campaigns have had to take the form of calls for revolution." "Gould's ultimate target is Darwin's dangerous idea itself; he is opposed to the very idea that evolution is, in the end, just an algorithmic process."

By Dennett's definition an algorithm has:

"1) *substrate neutrality*: The power of the procedure is due to its *logical* structure, not the causal powers of the materials used in the instantiation.

2) *underlying mindlessness*: Although the overall design of the procedure may be brilliant, or yield brilliant results, each constituent step, as well as the transition between steps, is utterly simple.

3) *guaranteed results*: Whatever it is that an algorithm does, it always does it, if it is executed without misstep. An algorithm is a foolproof recipe." (Dennett 1995, 50-51)

"What Darwin discovered was not really one algorithm but, rather, a large class of related algorithms that he had no clear way to distinguish. We can now reformulate his fundamental idea as follows: Life on Earth has been generated over billions of years in a single branching tree—the Tree of Life—by one algorithmic process or another." —Dennett 1995, 50-51

In a letter to Charles Lyell and quoted by Dennett, Darwin states "I would give absolutely nothing for the theory of Natural Selection, if it requires miraculous additions at any one stage of descent..." "If I were convinced that I required such additions to the theory of natural selection, I would reject it as rubbish...."

"According to Darwin, then, evolution is an algorithmic process. Putting it this way is still controversial. One of the tugs-of-war going on within evolutionary biology is between those who are relentlessly pushing, pushing, pushing towards an algorithmic treatment [read the ultra-Darwinists], and those [such as Gould] who, for various submerged reasons [Gould's aversion to Darwinian thinking applied to our moral behavior], are resisting this trend. Darwin has convinced all the scientists that evolution *works*. His radical vision of *how* and *why* it works is still somewhat embattled, largely because those who resist can dimly see that their skirmish is part of a larger campaign [of rational materialism against irrational spiritualism]. If the game is lost in evolutionary biology, where will it all end?" "This idea, that all the fruits of evolution can be explained as the products of an algorithmic process, is Darwin's dangerous idea." (Dennett 1995, 60)

Darwin's Universal Acid

"Darwin's idea had been born as an answer to questions in biology, but it threatened to leak out, offering answers—welcome or not—to questions in cosmology and psychology. If *re*design could be a mindless, algorithmic process of evolution, why couldn't that whole process itself be the product of evolution, and so forth, *all the way down*? And if mindless evolution could account for the breathtakingly clever artifacts of the biosphere, how could the products of our own "real" minds be exempt from an evolutionary explanation? Darwin's idea thus also threatened to spread *all the way up*, dissolving the illusion of our own authorship, our own divine spark of creativity and understanding."

"Much of the controversy and anxiety that has enveloped Darwin's idea ever since can be understood as a series of failed campaigns in the struggle to contain Darwin's idea within some acceptably 'safe' and merely partial revolution. Cede some or all of modern biology to Darwin, perhaps, but hold the line there! Keep Darwinian thinking out of cosmology, out of psychology, out of human culture, out of ethics, politics, and religion!" (Dennett 1995, 63)

I will end here with the observation that Dennett might be seen as putting the words of the last two sentences into Gould's mouth.

Seminar Two

The Growth of Biological Complexity: A critique of *The Major Transitions in Evolution* by John Maynard Smith and Eors Szathmary

Abstract: The empirical observation that biological complexity has increased through time is a continuing source of confusion in evolutionary theory. To eliminate that confusion it is proposed that the issue be viewed from the philosophical perspective of causality. By doing so it is possible to see that the evolution of life on earth is only a part of the larger process of the evolution of the universe. From this view the major transitions in evolution proposed by Maynard Smith and Szathmary can be shown to be transitions from one natural hierarchical level of stability to another.

Keywords: natural algorithm, complexity, causality, historical systems, natural hierarchy, stratification of stability

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The central focus of this second talk is evolutionary theory. But I want to make it clear that I will be using philosophy to clarify some of the important issues in that body of theory. Why? Because many of our problems with evolutionary theory stem from the way we look at things. So the point should be clear, in order to make progress in evolutionary theory we must begin to look at biological evolution in a new way. We need this new perspective because, in the words of Mark Ridley in his review of Dennett's book *Darwin's Dangerous Idea*, "Never in the field of scientific endeavor can so great a theory [evolution by natural selection] have been misunderstood by so many with so little reason." And if I need a second justification for using philosophy to address biological questions it is Dennett's book itself. As Ridley puts it: "[Dennett] argues with a philosopher's care and erudition" and his book "is a marvelous corrective [for misunderstanding evolutionary theory]."

Having defended my methods, I wish to draw my topic from John Maynard Smith's and Eors Szathmary's new book *The Major Transitions in Evolution*. This work can justifiably be said to be at the leading edge of evolutionary theory, and it very quickly brings out one of the important issues that makes evolutionary theory so difficult to understand. The issue arises from the empirical observation that biological complexity has increased throughout the evolutionary history of life on earth. The issue is: How can we understand this increasing complexity without inferring that evolution is somehow progressive, and that human beings represent the end point of that progression? We are, after all, very complex. Biological complexity is, then, where I propose that we should begin in bringing a new perspective to biological questions. To do so I will again use Dennett as my guide. I will begin building this new perspective by using his concept of an algorithm.

Defining an Algorithm

Again, by Dennett's definition an algorithm has:

"1) *substrate neutrality*: The power of the procedure is due to its *logical* structure, not the causal powers of the materials used in the instantiation.

2) *underlying mindlessness*: Although the overall design of the procedure may be brilliant, or yield brilliant results, each constituent step, as well as the transition between steps, is utterly simple.

3) *guaranteed results*: Whatever it is that an algorithm does, it always does it, if it is executed without misstep. An algorithm is a foolproof recipe." (Dennett 1995, 50-51)

What Dennett does not clarify until later in his book is that, as it concerns evolution by natural selection, we are talking about *natural* algorithms—algorithmic processes in nature that have the above characteristics but do not have an end directed goal. They exist and operate but they are not algorithms for producing particular outcomes. They have no teleological purpose, no "final cause". This is Aristotle's fourth division of causality and as Gould points out "final not in the temporal sense of coming last, but in the Latin meaning of a purpose" (Gould 1995c, 68).

As Dennett puts it, "Algorithms, in the popular imagination, are algorithms *for* producing a particular result. As I said in Chapter 2, evolution can be an algorithm, and evolution can have produced us by an algorithmic process, without its being true that evolution is an algorithm *for* producing us." (Dennett 1995, 308)

To me the best example of a natural algorithm is natural selection itself. Gould's description in his video of natural selection as a simple "syllogistic inference" that follows from three irrefutable assumptions, over-reproduction, variation, and inheritance of some of that variation is a very good description of a natural algorithm (Gould 1995a). It is a logical statement of deductive reasoning in the form of: if you have A, B, and C, then D always happens. That is, D is the logical outcome of the circumstances of A, B, and C.

The next step in creating a new perspective from which we can understand complexity is to define what complexity actually measures.

Defining Complexity

1) Norman Packard in Roger Lewin's *Complexity: Life at the Edge of Chaos*, pages 130-149.

"Biological complexity has to do with the ability to process information."

2) Murry Gell-Mann in *The Quark and the Jaguar*, pages 227-231.

"Recall that effective complexity is the length of a concise description of the regularities of a system."

3) John Maynard Smith in *The Major Transitions in Evolution*, pages 5-6.

"A possible answer [to how to measure biological complexity] is in terms of the DNA content of the genome, which can be thought of as instructions for making the organism: more complex organisms require lengthier instructions."

4) A Causal Definition—The key to understanding complexity is to ask what parameter it is that complexity measures. The definitions above all have in common that it is information in some form or another that complexity measures. I submit instead that complexity is a measure of the number of types and the number of each type of causal interactions that are necessary to produce a given phenomenon. The greater either of the number of types or the number of each type of causal interaction that is necessary to produce a given phenomenon, the great the complexity of that phenomenon.

Causality

Causality can be defined as the study of the relationships between causes and their effects. But I must add that what I am defining is a naturalistic causality. The important distinction is that the relationships between causes and effects that we observe in nature have no purpose.

Causality as a part of philosophy goes back to Aristotle's four categories of cause—material cause, efficient cause, formal cause and final cause. (see Gould 1995c, for a more complete description of Aristotle's analysis) But if you are not familiar with classical philosophy, as I am not, you will still appreciate that the language of causality is familiar. The terms random, deterministic, probability, historically contingent, and chaos all define different types of causal relationships. In evolutionary theory such terms as proximate and ultimate cause are used by evolutionary biologists such as Ernst Mayr (Mayr 1982, 67). And Stephen Jay Gould's entire position on historical contingency is one long causal argument.

However, all these examples touch only lightly on the subject of causality when compared to chaos theory. It is a major revolution in our view of cause and effect. And it has undermined the foundations of our notions of predictability and given us instead a view of reality that at its very core makes our world uncertain. This has only served to reinforce the unease we have had with modern physics, which in the nineteenth century provided us with a rock of certainty, but in the twentieth century has become as uncertain as Heisenberg's famous principle. All of these currents and events in the recent history of the physical sciences revolve around questions of causality. It is now time for biology to follow suit. I will add here that an algorithm, either natural or constructed, is yet another type of causal relationship, which leads us quickly to the point I wish to make.

My reason for introducing the concept of causality is that I believe viewing natural phenomena from the perspective of the causal relationships that produce them is the correct perspective that will lead to a greater understanding of evolutionary theory. I will go even further and propose a new conceptual framework that can be used to integrate the causal perspective into evolutionary theory. (From more about causality see my *Essays on the Nature of Causality* http://fire.biol.wwu.edu/trent/alles/papersindex.html.)

Historical Systems

An historical system is one whose past will shape the course of its future. Such systems are characterized by a unique chronological sequence of events that gives rise to unique initial conditions in the present. They are unique in the sense that they happen only once, never to reoccur again.

Historical systems have the following characteristics.

1) Change is inherent in historical systems. The expansion of the universe is the fundamental source of change for all historical systems.

2) Historical systems are closed systems where the output of the processes of the system becomes the only input to the system. This can be modified by saying that it is possible to define a system as historical if it is in some way an "effectively" closed system. In this way it can be seen that life on earth is a closed system, while at the same time acknowledging that there is external input to the system in the form of energy from the sun and an occasional meteorite. The point is: there is only one truly closed system and that is the universe itself. And, indeed, the universe is the only truly historical system by my definition. But life on earth is a "closed" system in one very important sense -- after its origin, life can only come from life.

3) Novel phenomena arise in the system from the time dependent interactions of pre-existing types of phenomena.

4) The generation of novel phenomena occurs in a unique causal and temporal sequence that produces the directionality of time—time's arrow.

5) Historical systems are characterized by increasing causal complexity as the result of a combination of increasingly complex temporal interactions of pre-existing types of phenomena, and the generation of new, novel phenomena.

6) The production of new, novel phenomena is cumulative and therefore through time increases the total number of interacting types of phenomena in the system. This doesn't imply that phenomena aren't lost. It simply means that the total number of phenomena increases through time even though some phenomena must be lost in the process of creating new phenomena. e.g. 1) There are no free quarks in the universe today. e.g. 2) The origin of the first cellular life on Earth precluded the possibility of a second origin of life from prebiotic macromolecules. e.g. 3) The evolution of cyanobacteria lead to increased atmospheric oxygen and forced the anaerobic bacteria from most of the Earth's surface thereby foreclosing many evolutionary possibilities. The so called "forced moves" in "design space" create many of these replacement events in the types of phenomena that are possible together at any given moment in history (Dennett 1995, chapters 4, 5, and 6). The formation of protons from free quarks as the result of the cooling of the universe is one such "forced move" in design space. These forced moves are as Bronowski puts it "the barb which evolution gives to time" (Bronowski 1977, 192). It is my belief that the increasing size of the universe itself allows for the accumulation of causal types of phenomena.

7) Natural hierarchical levels or "levels of stability" are inherent in historical systems. A natural hierarchical level is defined by the occurrence of a new, novel and stable phenomenon that increases the level of causal complexity of the system enough to give rise to a new level of self-organization in the system. These levels are characterized by their stability in design space.

8) As a result of these characteristics, all historical systems *evolve*.

The universe is a closed, historical system. The fundamental process that produces change in our universe is its expansion, and, indeed, the universe has evolved through time. The history of life on earth is but a small part of that evolution, and the processes that produced life on Earth are one and the same for the evolution of the universe itself.

What I am suggesting is that biological complexity increases as the product of a simple natural algorithm. And that this simple algorithm is responsible not only for the increase in complexity that can be observed in biological evolution but in the evolution of the universe itself. But where does this put Maynard Smith's evolutionary transitions?

A Natural Hierarchy of Causal Complexity

> "Natural hierarchical levels are defined by the occurrence of new, novel and stable phenomena that significantly increase the level of causal complexity in an historical system, and that, in turn, give rise to new levels of organizational complexity."—(Alles 1998)

There are few truly novel ideas and so it is with my concept of natural hierarchical levels. Jacob Bronowski came to a similar idea with his concept of "*stratified stability*". The following quotes are from his essay *New Concepts in the Evolution of Complexity* (1977). "It is evident that we cannot discuss the variability of organisms and species without also examining their stability, as the second of the two balanced mechanisms that are needed to complete our understanding of evolution. I call this [mechanism for stability] *stratified stability*."

"Here, then, is a physical model which shows how simple units come together to make more complex configurations; how these configurations, if they are stable, serve as units to make higher configurations; how these higher configurations again, provided they are stable, serve as units to build still more complex ones; and so on."

"the building up of stable configurations does have a direction, the more complex stratum built on the next lower, which cannot be reversed in general."

"The total potential of stability that is hidden in matter [read Dennett's design space] can only be evoked in steps, each higher layer resting on the layer below it. The stable units that compose one layer are the raw material for random encounters [read time dependent interactions of pre-existing types of phenomena] which will produce higher configurations [read new, novel phenomena], some of which will chance to be stable." (Bronowski 1977, 190-195)

The clearest example of stratified stability is the nucleosynthesis of the elements. Using this example all of the algorithmic processes that lead to greater causal complexity can be described. To build the image necessary start chronologically from the formation of the first elements. Through the causal interactions of gravity and these elements, the first stars coalesced and then ignited. This step is the formation of a new, novel phenomena—stars—from the time dependent interactions of pre-existing types of phenomena—gravity and the first elements. If you continue through the chronological history of the universe, what emerges is a picture of one natural hierarchical level of stability being built on another, then another and so on. Until finally we reach the history of our own solar system and on to the history of life on Earth.

It is clear, however, even without these examples that Bronowski's "levels of stability" are one and the same as my natural hierarchical levels. And that they both describe Maynard Smith's major transitions in evolution as the transitions from one natural hierarchical level of stability to another. The understanding that these transitions are achieved by the workings of a simple natural algorithm—a simple mechanistic process that is mindless and without direction—is what we gain by using the philosophical perspective of causality.

Seminar Three

Ontology and Science: The Species Question as exemplified in *Taking the Naturalistic Turn or How Real Philosophy of Science is Done* by Werner Callebaut

Abstract: By attempting to define what is meant by the term "species" in modern biology it can be shown that there exists an obligate relationship between naturalistic philosophy and science. The philosophical concepts of temporal frames of reference, coarse graining, and reification are used in this definition to show that our ordinary perceptions are not adequate to understand the nature of dynamic processes such as life on earth. From this view of "species" it is shown that innate behavior is the central factor that mediates the relationship between physically discrete individuals and the continuum of life.

Keywords: naturalistic ontology, the species problem, temporal frames of reference, coarse graining, reification

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"The third culture consists of those scientists and other thinkers in the empirical world who, through their work and expository writing, are taking the place of the traditional intellectual in rendering who and what we are."—Brockman 1995, 17

"ontology—a branch of metaphysics concerned with the nature and relations of being" —Webster's 1989

In this third and last seminar, I wish to review how we have gone about exploring the relationship between biology and philosophy. In the first talk I introduced the philosophical system of thought called naturalism—the philosophical descendent of materialism and empiricism. In the second talk I introduced the philosophical study of causality. And in this last seminar I wish to introduce the study of ontology. In these last two traditional areas of philosophy I have or will maintain that it is necessary to view them through the naturalistic perspective. I have used the term naturalistic causality and in this final talk I will define a naturalistic ontology. But why go to this bother?

There is a central point that I wish to make. Up until now it has appeared that the relationship between biology and philosophy was a marriage of convenience. Both disciplines stood to gain from the other by a subtle form of mutualism. But what I propose is that, because both causality and ontology should rationally be studied from the perspective of naturalism, there is an obligate relationship between naturalistic philosophy and science. There is no logical choice in this proposition; science and naturalistic philosophy are one and the same, bound to each other in the common goal of increasing our understanding of "who and what we are".

To demonstrate this position, I will make a simple point. If you reject any interest in a spiritual realm to reality, then what you are left with is material reality. In other words, if you reject spiritualism, then all you have left is materialism. From this you can quickly draw the logical conclusion that since we are a part of that material reality the study of the nature and relations of our being (that is, the traditional subdivision of metaphysics called ontology) is a proper and necessary part of biology. The study of the nature and relations of our being should, then, correctly be called naturalistic ontology. This is reflected in the statement that "ontological questions .... are on a par with questions of natural science." by the philosopher W. V. O. Quine (Callebaut 1993, 2, footnote 4). And this puts Brockman's "third culture" in a very different light. For now, it is not just that scientists want to take "the place of the traditional intellectual in rendering who and what we are". It has, instead, become a logical necessity. Science must, in a naturalistic view of reality, take on the responsibility for the study of who and what we are.

I will illustrate this combination of science and philosophy as it relates to ontology by introducing one of the most intractable problems in evolutionary biology—the species problem.

"We conclude that, despite the intense interest of biologists in the 'species problem' for over two centuries, the answers are not as clear as they should be."—Maynard Smith 1995, 166

"If we are to understand evolution, we have to conceptualize the relevant entities in ways appropriate to the evolutionary process even at the expense of ordinary perceptions." —David Hull in Callebaut 1993, 283

The Species Problem

From childhood we understand that a giraffe is different from a hippopotamus; that there exists life that is different from ourselves. We understand that there are different "species" of life on this Earth. But our common sense notion of species fails to explain what we have learned from modern molecular biology of the underlying chemical unity of life. This is understandable given that the concept of species is and has been the most difficult concept to grasp in all of biology. In this respect, we as adults have traveled but a short distance from our childhood.

The issue can be stated simply by asking the question: Are species discrete things? How are they separate from other "species"? And how do we define the boundaries of a "species"? I submit that the answer can be found by extending the time frame of reference with which we look at the question.

Temporal Frames of Reference

I must point out here that we humans look at things, without exception, from the viewpoint of our own time frame of reference—human time. This corresponds roughly to something more than the three score and ten years allotted to the human life span. It is, however, not a trivial point to show that our view of reality is constrained by our temporal frame of reference. We understand our world in a certain time frame of reference, but we must not be so naive as to think that external reality keeps the same time as we do. We must allow ourselves the freedom of looking at this question from dramatically different temporal frames of reference. And if we do so, what is the view?

But first, what it is that we are looking at in our "human time" frame of reference. Populations of organisms, species of organisms, genera, families, orders, classes, phylum, and kingdoms of organisms are these what we are looking at? This can not be the case. What we see in our temporal frame of reference is simply individuals. Even though many individual organisms look the same, we experience them one at a time.

But what happens if we were to extend our temporal frame of reference to twice or three times or even more times than the life span of a human being? Suddenly, we would be unable to see individual life spans as anything but a blur. Generations would start to run together, one life leading to another without a pause, without a break, over and over again. What would now come into focus? And it is focus that we are concerned with. We would begin to see changes in the whole population of similar organism; we would begin to see them evolve.

We must now change our perspective again and go back in time instead of forward. But as we go back in time we must also accelerate and go back in "geological time". We're now traveling backward in time where each second is equal to a thousand years. What do we see as we look at "species" in this frame of reference? We see "species" disappearing and blending into forms simpler and more generalized as time flows backward. We see a great coming together into simpler and simpler forms. Suddenly, great changes occur, as from land to the sea, from large to small, from varied to homogeneous. Onward and backward in time until life is but a blur of undistinguished, minute single cell life-forms living and dying in countless billions seemingly without change through countless eons of time. Where has the individual gone? Where has the "species" gone? We can no longer tell.

I would offer a new set of terms to describe what we now see. Look at patterns in the history of life rather than kingdoms or phyla. Look for form rather than species. Individuals then become expressions of form, the form being a part of a larger pattern of life. This language is the result of viewing life on Earth as a single ontological entity, a single being that has evolved through time in a pattern of forms that "from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved." (Darwin 1859)

Coarse Graining

What we have done in this thought experiment is to change the degree of coarse graining that we apply to our view of species. The term coarse graining comes from photography, where the concentration of silver compounds on the film determines the end characteristics of a photograph. The greater the concentration of silver compounds the finer the "grain" in the final print. We can see this "grain" when we enlarge a photograph. The analogy is that you should, in principle, be able to go up and down this scale of resolution in order to see either finer or coarser detail.

When we go from the very fine detail of the life span of an individual, which corresponds roughly to human time, to the coarser detail of geological time, we find that the very notion of "species" becomes problematic. To resolve this problem we can resort to a simple dichotomy. Are individual organisms discrete entities or are they points on some continuum? Are they continuous or are they discrete?

Continuous or Discrete

Are individuals physically discrete when viewed from geological time? The short answer is no. They are not and this can be seen not just in geological time but in any time frame of reference that is longer than human time. To see this it is again necessary to look backward in time rather than forward. And when you do, you see that every individual organism is physically connected to its parents, and they to theirs, and theirs, and so on backward in time in an unbroken physical continuum of life. It is only in the limited temporal reference of the human life span that we see individual organisms as physically discrete. But this is an illusion, and one that we must overcome in order to, as David Hull advises, "conceptualize the relevant entities in ways appropriate to the evolutionary process even at the expense of ordinary perceptions." (David Hull in Callebaut 1993, 283). But why are we so prone to this perceptual mistake?

The Problem of Reification

"... reification converts a dynamic process into a static phenomenon."—Rose 1995, 380

Life on earth is a dynamic process. It is ever changing and constantly in flux. And it is a gross over-simplification to consider an individual organism as a "static phenomenon". This is the problem of reification—mentally converting a dynamic process into a static object. (For those that are interested, this problem is also a manifestation of Platonic essentialism, in that, by objectifying a dynamic process we are attempting to divine its essence, see Mayr 1982.)

I appreciate that it is extremely difficult to overcome a life-time's habit of thinking of individual organisms as "objects", but it is crucial that we do so. Each organism is a dynamic flux of energy and matter that changes through time and is driven to reproduce that same dynamic flux again and again, generation upon generation in the unbroken continuum of life.

This is not a peripheral problem in modern biology as evidenced by Maynard Smith's question in his book *The Problems of Biology*: "To what extent are living organisms dissipative structures?" (Maynard Smith 1986, 2). The term "dissipative structure" is from the language of non-linear thermodynamics—chaos theory. It refers to objects that exist by virtue of a constant source of energy flowing into the structure and, in turn, being dissipated out of the structure. The classic example of a dissipative structure is a vortex forming in either water or air. I will not digress into this subject further, but I will offer the opinion that while not all of chaos theory may be useful to biology, biologist can ignore it only at their peril.

But in answer to Maynard Smith's question, I will quote Yale University biophysicist Harold Morowitz:

"... each living thing is a dissipative structure, that is, it does not endure in and of itself but only as a result of the continual flow of energy in the system.... " "From this point of view, the reality of individuals is problematic because they do not exist per se but only as local perturbations in this universal energy flow."—Morowitz in Callicott 1989, 108

All of this diversion into the deeply theoretical begs one final question: What is the cement that binds what we call "individuals" into this continuum of life? What turns physically discrete individuals in human time into a continuous dynamic flow of life? The answer takes us full turn in our quest to understand "who and what we are". The answer is our behavior; our innate behavior is what binds each of us into that seamless flow of life on Earth. This is why it is so crucial that the study of our behavior must be an integral part of modern biology. Does this mean that all human behavior becomes a proper subject for scientific inquiry? As Bronowski puts it: "... that rational thought is welcome to examine all human origins and institutions and human conduct." (Bronowski 1977, 250) The answer is certainly yes. All scientific knowledge must integrate into a coherent whole and to forbid science to study ourselves would be to claim that our behavior is not a part of material reality. It should be clear by now that we can no longer rationally separate our being into material and spiritual parts; dualism is no longer a rational position.

And so, yes, all human behavior becomes a proper subject for scientific study, including human culture. Human culture, it can now be seen, is a biological phenomenon that, because we have evolved, has its origins in that evolutionary history.

And why is all of this important? If we ignore what science tell us about ourselves and retreat irrationally into wishful thinking and superstition, we can not hope to see clearly what threatens our very survival. Jacob Bronowski was a man of particular vision and I quote him now from the closing lines of his series *The Ascent of Man*: "...fifty years from now, if an understanding of man's origins, his evolution, his history, his progress is not the commonplace of the schoolbooks, we shall not exist." (Bronowski, 1973, 436)

References

Alles, D.L. (1998). *Essays on the Nature of Causality.* http://fire.biol.wwu.edu/trent/alles/papersindex.html (9/19/04)

Beardsley, T. (1995). Darwin Denied: Opponents of Evolution make gains in Schools. *Scientific American*, (July), 12-14.

Bonner, J. T. (1995). The Evolution of Life's Complexity. *Nature*, 374(April 6), 508-509. (a review of *The Major Transitions in Evolution*, Maynard Smith 1995)

Brockman, J. (1995). *The Third Culture: Beyond the Scientific Revolution*. New York: Simon & Schuster. For a complete online version of this book go to: http://www.edge.org/documents/ThirdCulture/d-Contents.html (9/19/04)

Bronowski, J. (1973). *The Ascent of Man*. Boston: Little, Brown.

Bronowski, J. (1977). *A Sense of the Future*. Cambridge, MA: The MIT Press.

Callebaut, W. (1993). *Taking the Naturalistic Turn or How Real Philosophy of Science is Done*. Chicago: University of Chicago Press.

Callicott, J. B. (1989). *In Defense of the Land Ethic*. Albany: State University of New York Press.

Darwin, C. (1859). *On the Origin of Species*: A Facsimile of the First Edition (1964). Cambridge, MA: Harvard University Press.

Dennett, D. C. 1995. *Darwin's Dangerous Idea: Evolution and the Meanings of Life*. New York: Simon & Schuster.

Fuller, S. (1994). Underlaborers for Science. *Science*, 264(13 May), 982-983. (a review of *Taking the Naturalistic Turn*, Callebaut 1993)

Gell-Mann, M. (1994). *The Quark and the Jaguar*. New York: Freeman.

Gould, S. J. (1977). *Ever Since Darwin*. New York: Norton.

Gould, S. J. (1992). Impeaching a Self-Appointed Judge. *Scientific American*, (July), 118.

Gould, S. J. (1995a). *Darwin's Revolution In Thought*. (a video produced by) Into the Classroom Video, 351 Pleasant Street (#126) Northampton, MA 01060.

Gould, S. J. (1995b). Spin Doctoring Darwin. *Natural History*, (July), 6-9 & 70-71.

Gould, S. J. (1995c). Boyle's Law and Darwin's Details. *Natural History*, (August), 8-11 & 68-71.

Horgan, J. (1995). Escaping in a Cloud of Ink. *Scientific American*, (August), 37-41. (An interview of Gould done for S. A's *Profile* column.)

Johnson, P. (1991). *Darwin on Trial*. Washington, D. C. : Regnery Gateway.

Laudan, L. (1990). *Science and Relativism: Some Key Controversies in the Philosophy of Science*. Chicago: University of Chicago Press.

Lewin, R. (1992). *Complexity: Life at the Edge of Chaos*. New York: Macmillan.

Maynard Smith, J. (1986). *The Problems of Biology*. Oxford: Oxford University Press.

Maynard Smith, J., & Szathmary, E. (1995). *The Major Transitions in Evolution*. Oxford: Freeman.

Mayr, E. (1982). *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Cambridge, MA: Harvard University Press.

Ridley, M. (1995). *Here, there, everywhere*. *Nature*, 375(June 8). 457-458. (a review of *Darwin's Dangerous Idea*, Dennett 1995)

Rose, S. (1995). The Rise of Neurogenetic Determinism. *Nature*, 373(Feb. 2), 380-382.

Snow, C. P. (1969). *The Two Cultures and A Second Look*. Cambridge, UK: Cambridge University Press.

Szathmary, E., & Maynard Smith, J. (1995). The Major Evolutionary Transitions. *Nature*, 374(March 16), 227-232.

Webster's (1989). *Webster's Encyclopedic Unabridged Dictionary of the English Language*. New York: Gramercy Books.

Weinberg, S. (1992). *Dreams of a Final Theory*. New York: Pantheon.

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