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Reductionism, Naturalism, and Nominalism: the "Unholy Trinity" and its Explanation in Zubiri's Philosophy

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Abstract

Belief in the "unholy trinity" of reductionism, nominalism, and naturalism is at the root of much anti-religious thought, whether consciously or not. Taken together, these doctrines, in the extreme form in which they are usually held, preclude any belief in the spiritual, and thus any type of theistic interpretation of science, such as theistic evolution. There are two basic approaches to resolving the science-religion conflict posed by the unholy trinity. The first involves rejection of branch or conclusion of science, as is done by Creationists. The second is to deny the scope implicitly assumed for science by the unholy trinity. This is done at the direct observational level by those such as the Intelligent Design school, and at a deeper, more indirect level by most advocates of theistic evolution. But the unholy trinity itself has many serious problems, both with respect to science and philosophy. It tends to channel scientific thought and procedures into certain directions, and keep them from others, quite independently of empirical evidence, thus imposing an intolerable burden on science, which can operate quite well on much weaker metaphysical assumptions. The unholy trinity also rests on erroneous assumptions about the nature of the real, about epistemology, and about metaphysics. Utilizing the philosophy of Xavier Zubiri, it is possible to clarify the nature of those assumptions, and why they are wrong.

Resumen

Creencia en la "trinidad impía" de reduccionismo, nominalismo, y naturalismo es la raíz de mucho pensamiento anti-religioso, si conscientemente o no. Tomadas juntas, estas doctrinas, en la forma extrema en la que normalmente se sostienen, evitan cualquier creencia en lo espiritual, y así cualquier tipo de interpretación teística de la ciencia, como la evolución teística. Hay dos caminos para resolver el conflicto ciencia-religión basado in la trinidad impía. El primero requiere un rechazo de una rama o conclusión de ciencia, como hacen los creacionistas. El segundo es negar el alcance asumido implícitamente para la ciencia por parte de la trinidad impío. Esto se hace al nivel de observacion directa por la escuela del Designo Inteligente, y a un nivel más profundo, más indirecto por la mayoría de los partidarios de evolución teística. Pero la propia trinidad impía tiene muchos problemas serios, con la ciencia y con la filosofia. Tiende a encauzar el pensamiento y los procedimientos científicos en ciertas direcciones, bastante independientemente de evidencia empírica, así imponiendo una carga intolerable sobre la ciencia, que puede operar con suposiciones metafísicas mucho más débiles. La trinidad impía también rebasa sobre suposiciones erróneas en torno a la naturaleza de la realidad, sobre la epistemología, y sobre la metafísica. Utilizando la filosofia de Xavier Zubiri, es posible clarificar la naturaleza de esas suposiciones, y por qué ellos están equivocados.

I. Introduction

The concepts of reductionism, naturalism, and nominalism in their radical form lie at the base of most anti-religious scientific writing, lurking there at such a deep level that even the author in many cases is unaware of the metaphysics they represent. Reductionism, in its most radical

form, is the theory (or belief) that all scientific knowledge can ultimately be reduced to basic physics. Thus, biology reduces to chemistry, and chemistry to physics of atoms of molecules, and these to particle physics…and this includes human consciousness. Naturalism is the theory (or belief) that only natural forces and entities make up the world; the clear implication of naturalism is that, since science alone is competent to examine these things, there is no non-scientific knowledge of the world, or any non-scientific knowledge at all, for that matter, and no entities that science cannot examine. Nominalism is the theory (or belief) that only concrete things exist; abstract entities such as species do not. All three of these notions have immediate appeal, especially to a scientific mind. And indeed science has often progressed by utilizing one or more of them to sweep away old ideas.

In this paper I will examine the connections among these three concepts, and how they have subtlely affected and shaped (distorted) our ideas about the scope of science and religion over time, and their complex interrelationship. Are the three concepts an "unholy trinity"? Are they inextricably bound together? Can we penetrate one level deeper and examine them in the context of knowledge at that deeper level? Are they required for the conduct of science? Can they actually impede scientific research by channeling it in certain directions?

Evolution is one area where the unholy trinity is at the very heart of the battle. Those who accept this trinity generally reject any form of religion as superfluous, since they believe that Neo-Darwinian evolution can explain all life, and physics all of biology. Typical of their comments is this:

> Although many details remain to be worked out, it is already evident that all the objective phenomena of the history of life can be explained by purely naturalistic or, in a proper sense of the sometimes abused word, materialistic factors. They are readily explicable on the basis of differential reproduction in populations [natural selection], and the mainly random interplay of the known processes of heredity [random mutations]. Therefore, man is the result of a purposeless and natural process that did not have him in mind.[1]

By Ockham's razor, all other explanations, especially theistic ones, can be discarded as explanations of reality, though they perhaps served some psychological purpose. Haught comments:

> In an unfriendly cosmos, religion kept our ancestors from having to look into the abyss of the world's impersonality. By constructing mythic visions of eternal cosmic order, religions provided illusory but effective shields against the terrors of existence. And by favoring our species with the fictitious phantasm of a purposeful universe, religions gave our human predecessors a reason to keep on living, to bear offspring and thus keep their genes from perishing…The "biology of religion", while still in its infancy, has begun to gather momentum in academia. It has been advocated in one form or another by such authorities as classicist Walter Burkert, psychologist Robert Hinde, philosopher Daniel Dennett, anthropologist Pascal Boyer, linguistics expert Steven Pinker, philosopher of religion Loyal Rue, and many others.[2]

Those who seek reconciliation between science and religion in this area through theistic evolution generally reject radical reductionism (and the other extreme doctrines in the unholy trinity) in favor of a milder version. This point may be clarified by an example similar to that used by John Haught.[3] If we have a kettle of water boiling on a stove, we can ask, "Why is the water boiling?" The question can be answered at several levels:

1. It is boiling because of the heat transfer from the fire to the water via

the metal forming the bottom of the kettle. This heat transfer takes place due to molecular movement.

2. It is boiling because I put the kettle of water on the stove and turned the stove on.
3. It is boiling because I want to drink a cup of tea.

Those who accept the unholy trinity argue that all of the latter two explanations are not really important because they too can be reduced to atomic or molecular processes in the brain and body, leading to the indicated behavior, whether physical or verbal. Those who advocate theistic evolution, such as Haught, argue that the statements cannot be reduced to quantum physics because questions involving human intentionality cannot be meaningfully expressed in that language.

Those who accept Intelligent Design reject the concept of reductionism at a more physical level, arguing that not only is it impossible to carry out the reduction of (2) and (3) to simple physical processes, but moreover that physical process are inherently incapable producing the type of order observed in biological systems. Creationists of course go one step further and reject much of the inferred time scale of the physical universe, and hence its ability to produce ordered structures by evolutionary means. All of these approaches therefore reject naturalism in its more extreme form.

We may note that a great deal of discussion today about the reconciliation of science and religion seeks to penetrate deeper into the problem, and thus to determine what the issues are at the most profound level. Inevitably, the issues turn out to be philosophical rather than scientific, so that the dispute, ultimately, is between philosophical (usually metaphysical) positions rather than scientific and religious positions.[4] But this fact has not penetrated the popular consciousness and the popular press, which is still fixated on a science vs. religion conflict. It does not seem to have penetrated the mind of most critics of religion, either, who seem quite content to believe that their philosophical positions are actually grounded in science. Hopefully the exposition here in terms of the unholy trinity will make them realize just how unscientifically based, ultimately, their positions are, and how unnecessary for the conduct of science.

II. Definition of Terms

Before embarking on a comprehensive discussion of these approaches, a more detailed discussion of key terms is in order. We shall begin with *nominalism* and *realism.*

A. Nominalism and Realism

The *nominalist* school has had many famous adherents, especially in the English philosophical tradition, including Peter Abelard, William of Ockham, John Locke, and David Hume. Nominalists reject abstract entities as real in any sense, and admit them only as shorthand to facilitate discussion of groups of things. Briefly stated, the problem is whether abstract nouns refer to real, existent things, or are merely ways of referring collectively to individual things exhibiting a particular quality. For example, does "red" exist apart from individual red objects? This has immediate implications for mathematics, physical science, and biology. Nominalists claim that mathematics and logic, for example, do not actually refer to abstract entities at all, but are merely symbol manipulation systems. In biology, nominalists deny the reality of species (as distinct from individual organisms). As far back as 1689, Locke remarked that "abstract ideas are the essences of genera and species"[5] and "the boundaries of the species, whereby men sort them, are made by men."[6]

Historically, nominalism arose during the Middle Ages in connection with the famous problem of universals—abstract nouns characterizing many individuals, or singular things. For example, 'man' characterizes (can be predicated of) many individuals, whereas 'Socrates' refers only to one particular individual. The problem arose in Ancient Greece, in connection

with Plato's philosophy. His philosophy is built around the notion that abstract terms such as "red" actually refer to archtypes—perfect exemplars that really exist—and the real things only "participate" in these qualities. Later thinkers rejected this claim, and nominalists do so in an extreme form. The problem is important in connection with most forms of knowledge. For example, in a geometric demonstration of, say, the fact that the angles in a triangle always sum to 180°, we are discussing *all* possible triangles, not the one we happen to draw on the paper to do our proof—it isn't a perfect triangle anyway. Nominalists reject the separate existence of universals, or indeed any real existence for them at all (though in the Middle Ages it was generally agreed that they were ideas in the Divine mind prior to the creation of the world).[7] Nominalists believe that only individuals exist, and that individuals can be grouped in any convenient fashion when they share a suitable characteristic. Thus abstract characterizations and the corresponding nouns can be invented as needed and discarded when they have outlived their usefulness. The meaning of the nouns, indeed, can be changed to reflect fluid conditions in the world, and do not reflect any eternal verities.

Though nominalism seems appealing—perhaps even obvious—at first glance, it is in fact an extremely difficult philosophy to maintain consistently. The problem is that in virtually every aspect of our thinking and speaking about the world, we tacitly or explicitly assume the existence of the abstract entities which nominalism seeks to banish, as when we talk about sharing a suitable characteristic. Such common statements as, "grapes are good for you" or "Beethoven's Ninth Symphony is a great work" have an abstract entity as the subject. Nominalists are frequently criticized because even their own definitions of abstract entities in terms of individuals hinge on surreptitious use of abstract entities in a sense forbidden by their own creed.[8]

Nominalism is critically important in evolutionary thought, for example. Central to Darwin's whole approach was his conception of species (and all higher taxa). Obviously, individual members of a species exist; but what about the "species" itself? Does it have some existence apart from its members? Historically—prior to Darwin's time—biologists conceived of species almost in the Platonic sense, as immutable Ideas, perhaps in God's mind. Any individual organism was thus an imperfect representation of the true form of the species, unchanging and eternal. To a considerable extent, this is still the position of the Creationist school. But for the nominalists, there is no problem with changing and evolving species; species have no separate, eternal reality. Darwin gravitated to this position, which has become an essential part of modern evolutionary thinking.[9] From this, it was but a short way to the belief that all forms of life meld into each other, and thus large-scale transformations are possible, given enough time.[10]

Opposed to nominalism is *realism*, the most pronounced form of which, as we noted, dates to Plato and his theory of the Ideas. Basically, Plato's Ideas (universals) are the embodiment, so to speak, of abstract nouns. They are, in his view, *more* real than individual things, which have only a shadowy, transient existence in comparison.[11] The Ideas are permanent and unchanging, and thus form the basis for true knowledge, which must restrict itself to studying them and not the ever changing world presented to us by sense perception. Some individual thing which is red *participates* in the Idea red, but is never perfect and cannot take on all of the reality of the Idea. The Platonic tradition has remained strong over the past 2400 years, and often finds its greatest proponents in the mathematical community. However, it had great influence on biologists as well:

> [B]iologists and naturalists of the nineteenth century…were followers of Plato. Plato maintained that all objects on Earth are merely rough fac-

> similes of some idea archetype [form] that exists only in heaven. Pre-Darwinian biologists felt, similarly, that earthly horses were merely imperfect replicas of some ideal horse, and earthly lions were rough and ready copies of the original, heavenly lion, and so on.[12]

The explicit mix of theology and biology in this view rendered it quite inflexible in certain areas, especially with respect to change in a species, and in particular, gradualistic change.

Aristotle and many later philosophers in his tradition rejected the idea of a completely separate existence for the universals, but did accept that they are real and the basis for knowledge; this position is known as "moderate realism". For the Aristotelian tradition, universals are often conceived in terms of *essence*: that which makes something be what it is. When matter is *informed* by a particular form or essence, it becomes the thing in question. Thus horses have an essence, common to all of them, as do men. Essence then becomes the basis for knowledge of things as well; when one knows the essence, one knows what something is in the most fundamental sense. Hence "species" becomes a metaphysical concept, with certain attributes such as unchangeableness and eternity. It is this metaphysical aspect of the species question which had such a great influence on the thinking of biologists, whether they adopted a Platonic or Aristotelian view, or some mix.[13]

B. Reductionism

Reductionism arose because of the success of science in explaining the natural world, especially the success of physical theories. For example, Newtonian mechanics was able to explain the movement of heavenly bodies in terms of the same forces acting on the surface of the earth. Thus, the moon "falls" toward the earth in the same way that the proverbial apple "falls" on Newton's head. Similarly, the atomic theory of matter explains the Periodic Table, and much of the physical and chemical properties of elements. Quantum mechanics can, in theory, explain the characteristics of each element in detail. Its first great triumph, in fact, was explanation of the spectral lines of hydrogen. An early, natural generalization of this idea was that the laws of physics, in the form of Newtonian mechanics, coupled with a billiard-ball view of matter, could explain all of nature, and indeed could predict the future and retrodict the past with perfect accuracy, if only sufficiently accurate information about conditions at some instant could be determined. This idea was dealt a fatal blow by the development of quantum mechanics, since it showed that the key assumption of completely deterministic position and velocity was untenable. Nonetheless, the idea that "enough" predictability remains even in light of quantum mechanics has persisted. Radical reductionism—the reduction of all science (including biology) to basic physical laws—is a bold program, but of course a program which has only been roughly sketched out, never actually accomplished.[14] Clearly, however, if all knowledge can be reduced to a few laws of physics, a.k.a., to a "theory of everything", then belief in the "spiritual" becomes highly questionable. Indeed, it is only one step more to conclude that the "spiritual" does not exist, and the word 'spiritual', in nominalistic terms, is just a noun used to refer to certain types of behavior, which ultimately can be explained by (be reduced to) physical laws. That last step is *naturalism.*

C. Naturalism

Naturalism is the doctrine that only "natural" processes may figure in valid scientific explanations of phenomena. Such explanations are termed "naturalistic". Non-natural (for example spiritual forces) cannot figure in any scientific explanation, whether or not one believes that such forces exist. On this point, virtually all scientists would agree; one cannot invoke spiritual forces to explain phenomena *when one is doing science*. This is *methodological naturalism*. However, disagree-

ment starts when a further, metaphysical/epistemological step is taken. When one asserts that naturalistic explanations are capable of explaining *all* phenomena, or at least, all phenomena that can be meaningfully be described and explained, the scope of the "all" ranges from the origin of the universe and the first cell (abiogenesis), through the mechanisms which account for the history of all flora and fauna on earth, up to human behavior. In simplest terms, everything that happens has a natural cause or causes, and these causes stem from natural forces and are therefore subject to explanation by science. The implication is clearly that anything else is not real. Such is the doctrine of *naturalism*, in its most extreme form, sometimes substituted by the more loaded word, *materialism*. It is this version of naturalism that we find in the unholy trinity.

Thus nominalism, reductionism, and naturalism come together to form a theory (or belief) that all knowledge is ultimately reducible to basic physical laws, which can describe all phenomena; anything that cannot be so described does not exist; and there are no abstract entities anywhere that might escape this comprehensive net, entities whose very existence points to something beyond what science is capable of describing and explaining. The three elements—nominalism, reductionism, and naturalism—stem from a set of core beliefs whose origin will be discussed in part IV of the paper. Figure 1 illustrates the unholy trinity. In the case of the unholy trinity, nominalism and naturalism work jointly to create its epistemology and metaphysics. In practice, epistemological issues tend to ignored by those advocating the trinity, because they are primarily concerned with metaphysics—what is real and what is not. Insofar as they have an epistemology, it tends to be of the Humean empiricist variety, which is not surprising, since Hume himself subscribed to the three elements of the unholy trinity (and drew more or less the same type of conclusions).

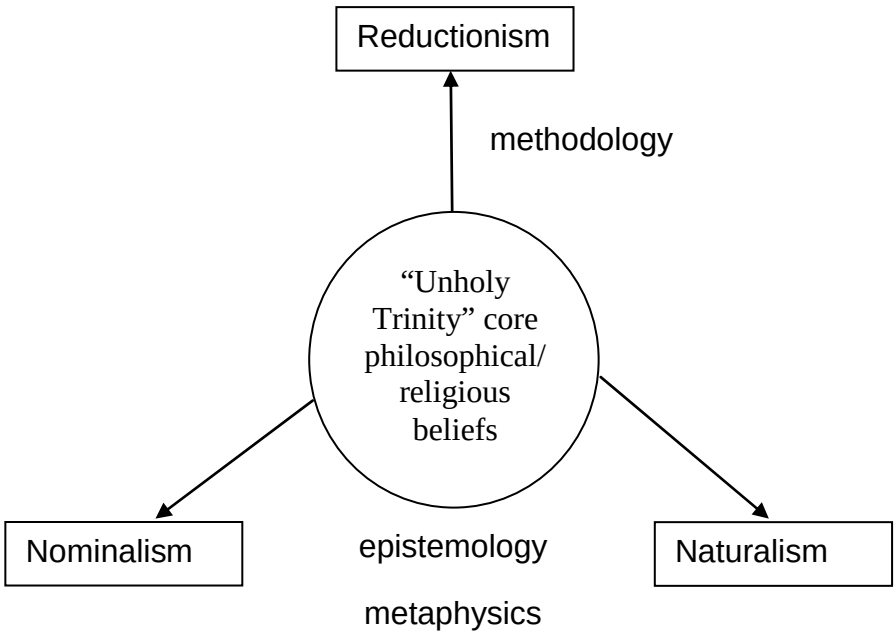

Figure 1. Emergence of key aspects of "Unholy Trinity" from core philosophical/ religious beliefs.

As we have indicated, the question of naturalism (like that of reductionism and nominalism) is more of a philosophical or religious rather than a scientific issue, because it deals with the scope of science rather than any particular scientific question. In addition, it is clearly an outlook and worldview, rather than an inference from actual results. Nearly all writers on the philosophy of science, and all schools of evolutionary thought, *start* with a position on naturalism, rather than inferring one from the evidence. Nonetheless, naturalism has an "empirical" component, namely, the question of whether satisfactory scientific explanations for all phenomena can be found. If some phenomena resist such explanation, and are forever objects of speculation, then there is evidence that naturalism is inadequate. The Intelligent Design school, indeed, seeks to go beyond this absence of explanation by demonstrating in a more positive manner that no such explanation can be found.

Naturalism in its more extreme form is an excellent gauge of the essentially religious nature of many scientific controversies, such as the evolution controversy. This is due to the fact that naturalism tends to be associated with a particular attitude, namely that "the facts are irrelevant". In the foregoing paragraph, we describe a situation which might provide evidence for the inadequacy of a thoroughgoing naturalism. This was actually misstated, because it assumes enough of an open mind on the part of partisans of said theory that they would be willing to consider the possibility that the theory might be wrong. But it appears that few would do so. The following remarks are typical:

> *Even if all the data point to an intelligent designer*, such an hypothesis is excluded from science because it is not naturalistic.[15] [italics added]

The religious nature of this remark is immediately obvious if we reword it to have a Creationist flavor:

> Even if all the data point to an old earth, such an hypothesis is excluded from creation science because it is not biblical.

In other words, it does not matter what evidence may be adduced, we won't change our mind anyway. The reader is left to ponder the question of whether science is a private bailiwick where any rules can be made, or a public search for truth based on empirical observations, wherever it may lead.

D. What is at Stake?

Now, why all the fuss about nominalism, realism, reductionism, and naturalism? Who really cares? Can't a scientist carry out his work without dealing with these vexing issues? Yes and no. In theory, yes—and there is general agreement about scientific method and is applicability in the day-to-day conduct of science. So even Creationists use the same scientific methodology and same equipment and procedures as their opponents; this is obvious if one reads their literature and the science textbooks that they produce. But in the larger context of human knowledge, especially theoretical knowledge, it seems that the answer is no—the metaphysical questions are too compelling to be left alone. Kant himself recognized this, with his famous opening of *The Critique of Pure Reason*:

> We come now to metaphysics, a purely speculative science, which occupies a completely isolated position and is entirely independent of the teachings of experience. It deals with mere conceptions- not, like mathematics, with conceptions applied to intuition- and in it, reason is the pupil of itself alone. It is the oldest of the sciences, and would still survive, even if all the rest were swallowed up in the abyss of an all-destroying barbarism.[16]

As is well known, he later went on to incorporate Newtonian physics into his philosophy via the categories; and his notion that the mind synthesizes experience so as to be in accordance with that physics clearly indicates that no other type of

science is possible.

The metaphysical beliefs can indeed drive scientific reasoning. In the case of evolution, the model of biological change integral to Neo-Darwinian evolution requires a nominalistic view of species. This is because the model assumes that slow, gradual changes can eventually yield any conceivable biological organism, under the proper environmental conditions or series of conditions. Obviously, if anything can shade into anything else, given enough time and space, there are no fixed or immutable species; and indeed, the term "species" can only be an abbreviated way of referring to some organisms grouped together for convenience sake. For this reason, prominent members of the Neo-Darwinian school openly admit their goal of establishing a nominalistic foundation for biology and taxonomy. Mayr expresses his pleasure in "eliminating the last remnants of Platonism, by refusing to admit the *eidos* (idea, type, essence) in any guise whatsoever."[17] Eisely follows suit,[18] as does John Maynard Smith.[19]

To deal with this problem, Neo-Darwinism has devised a nominalistic (at least in their view) definition of species based upon populations of individuals rather than archetypes of any sort. The basic idea is that a species is an interbreeding population:[20]

> …[A] species [is] a sexually interbreeding or potentially interbreeding group of individuals normally separated from other species by the absence of genetic exchange, that is, by reproductive isolation.[21]

Clearly, the Neo-Darwinians take (and indeed are committed to) a nominalist approach, which leads directly to a very fluid concept of species, which can thus change freely over time. The Creationists, just as obviously, start from the assumption of fixed and immutable *kinds*, created by God. This is a very realist position: a dog is an example of the dog kind, and this statement has nothing to do with how we define "dog". These kinds do not and cannot evolve in any Darwinian sense; the only change they can exhibit is degenerative, leading in some cases to speciation. But the relationship to the kind is always paramount.[22]

Thus we have a situation where deep-seated philosophical beliefs are actually driving science; and this is at the root of the problem of the unholy trinity (as well as other positions in the evolution controversy and the philosophy of science). So in order to come to grips with the Science/Religion question, one must therefore understand basic philosophical issues. Those who advocate the trinity must understand just what philosophical positions they have taken, be it explicitly or (more likely) implicitly. Since these philosophical positions cannot be justified on the basis of science, they must be argued as philosophical questions. And this changes the entire footing of their claims, making them much more like those of other schools who reject the trinity in its radical form. Haught comments on the thought of Frederick Crews:

> Crews…moves comfortably among scientists who make blatantly philosophical judgments and then pass these off to the public as though they were purely scientific conclusions rather than composites of science and metaphysics.[23]

The advantage of approaching the science/religion discussion by an investigation of the unholy trinity is that it focuses attention on the deep underlying philosophical issues that separate the various positions.

III. The Unholy Trinity Viewed From Zubiri's Philosophy

We can now examine the unholy trinity and its crucial role in the science/religion dialogue. Any belief system (philosophy, pseudo-religion, etc.) based on the unholy trinity will conclude that religious belief is hokum, because there is an irreconcilable conflict between the two. Simply put, those who accept the unholy trinity will deny that there is anything real about religious belief or experience, or at least that

there is anything in them that cannot be explained adequately on the basis of the phenomena which science analyzes and describes. Of course, one need not subscribe to the unholy trinity to come to this same conclusion; but clearly many do. There are essentially two approaches to resolving this apparent conflict between science and religion:

(1) *Deny that accepted science is correct*. This method rejects one or more scientific theories, in favor of new theories claimed to be scientific but not in conflict with some sacred text such as the Bible, or a particular group's interpretation of that text. In the case of evolution, this is the approach of Creationism. The Creationists reject key scientific theories such as the age of the earth and the ability of random processes to create new and improved species. For them, there is no need for any type of "theistic evolution" because there is nothing to reconcile: science, properly formulated, agrees with a literal reading of the Bible.

(2) *Deny the scope assumed for science by the unholy trinity*. I wish to argue that this is the approach taken by most authors, including those who purport to accept science at its face value and pursue what is known as "theistic evolution". There are many levels at which this can be done, because there are many levels at which science is assumed to operate, or at least to tell us about reality. They can be understood in reference to the unholy trinity. The key point is that these approaches always involve a rejection of the unholy trinity *at some level*. Accepting the unholy trinity precludes any type of theistic belief, as we have explained. The rejection can be at a direct observational level, or at a deeper level, not subject to direct observational confirmation.

(a) *Direct observational level*: In this case, one denies the unrestricted explanatory scope usually assumed for some branch of science, that is, one denies that science can explain all directly observable phenomena. This is not the same as rejecting a scientific theory; it is, rather, denying that the theory can in fact explain everything that its advocates claim that it can explain. Since explanation via a theory is often a complex process, involving many assumptions, clear demonstration that a theory can adequately and conclusively explain some observed fact may be difficult. If a particular phenomenon cannot be explained by a theory, it could be because the theory is wrong, or because nature is more complex than we thought, so that other factors come into play, factors that the theory does not consider. Unknown laws of nature may be among these factors, as they were when steam (heat) engines were first developed. In that case, the rather crude state of steam engines led to the belief that indefinite improvements in engine efficiency could be made. This belief eventually collided with the Second Law of Thermodynamics, which clearly imposes a limit on heat engine efficiency. A similar situation occurred with respect to the design of telescope optics: early practitioners assumed that unlimited resolution was possible if only lenses could be ground with sufficient precision. Unknown at the time were the limitations imposed by diffraction.

Fortunately, at the direct observational level, any denial of the scope of science has immediate observational consequences. For example, to deny, as the Intelligent Design camp does, that a certain structure or process can arise by natural process is to make a claim which can be examined empirically with the accepted methods of science. Similarly, to deny that energy incident on a system is sufficient to account for its observed entropy is also to make a directly verifiable claim. If verified, any such claim would become part of science itself, albeit one which reveals a limitation of great import. In this sense, the denial of the unrestricted scope of science at the direct observational level is tantamount to modifying—refining perhaps—a scientific theory, or proposing a new, improved version of it. This is not the same as case (1), because there is no wholesale rejection of a branch of science, only a refinement of it. Denial of the scope of science in this manner largely precludes

the need for theistic interpretations of it. So in the case of evolution, the Intelligent Design camp has little or no need of any type of theistic evolution, because it claims that evolution cannot account for all observed facts, and thus that there is little to be reconciled. In other words, because there are in fact limits to what science can explain, some type of interventionist explanation is required.

(b) *Deeper level*: At a deeper level, the situation is quite different, because the claims made there are not subject to direct experimental test, though they are often inferences from theories based firmly on direct observation. Such inferences generally require some additional assumptions, either scientific or metaphysics. For example, if I say that dreams are just physico-chemical processes, I have made a metaphysical claim about the reality of dreams, but not one which can be verified in any easy manner, if at all. Similarly, if I make the nominalistic claim that abstract entities do not exist, this again has important ramifications, but cannot be verified in any direct experimental fashion. Claims about parallel universes, and even some aspects of string theory, fall into the same category.[24,25] It is of course at this level that the unholy trinity operates. By supplying key assumptions, it enables one to make inferences from accepted scientific theories, and even to extend those theories. It some cases it even leads to very confused positions, such as the belief that events such as the Big Bang correspond to *creation ex nihilo*—the ultimate "free lunch".

So if some aspect of the unholy trinity is denied, such as radical reductionism, there is no direct conflict with any particular observation or set of observations; one just can't carry out a program—a program that, in any case, has only been sketched out in very general terms. And it is here that the whole drama of theistic evolution is played out. Theistic evolution accepts science at face value, and maintains that the scientist will never encounter any sort of "wall" blocking his progress, such as that claimed by the Intelligent Design camp. Rather than maintaining such a direct challenge to empirical laws, theistic evolution argues that what the scientist finds is not the whole of reality or the whole explanation of reality. In other words, there are aspects of reality that are not accessible to science, or even meaningfully describable in scientific terms. It is here that theology has its meaning (and philosophy as well). So both theology and philosophy operate on a deeper level than the level of phenomenal appearances, the presumed realm of empirical science. For example, consider a theological doctrine such as Divine creation of the universe. For the theistic evolution proponent, no theory about this contradicts science because science only investigates phenomena, and not things such as creation *ex nihilo*.

On this point, the Unholy Trinity would weigh in as follows: radical reductionism would maintain that these supposed scientifically uninvestigable aspects of reality are in reality just epiphenomena, and the words spoken about them are just a type of verbal behavior that could ultimately be predicted based on brain states. Thus, a statement such as, "I dreamt that I was chased by monsters" is just a story told by the dreamer, a particular verbal behavior, one which could be predicted if suitable measurements of the subject's brain were made. Similarly, a statement such as "I'm boiling the water to make tea" is just a particular audio emission of a complex system, also ultimately predictable. Nominalism would question whether abstract entities such as dreams can exist anyway. And naturalism would concur in rejecting the reality of things not analyzable by science, such as intentions and dreams. Open to debates is the epistemological problem of whether it is possible to define truth and knowledge in a consistent fashion under the philosophical assumptions of the unholy trinity:

> …there is a blatant contradiction between an *exclusively* selectionist explanation of mind, on the one hand, and the implicit trust you place in

> your own mind's capacity to arrive at the naked truth, on the other. Clearly, in asking me to accept the *truth* of evolutionary materialism's selectionist explanation of human intelligence, you have tacitly introduced something extraneous to your pure Darwinism.[26]

At this juncture, the obvious question arises as to just what the conduct of science does require in terms of metaphysical and epistemological assumptions. Does it require the unholy trinity, and if not, is the unholy trinity actually a deleterious influence on science, by forcing scientific explanation into channels that prevent the scientist from doing an impartial examination and drawing conclusions from observations rather than predetermined assumptions. There are two approaches with respect to the unholy trinity: either claim that it is essential to the conduct of science, or claim that it is clearly implied by science itself.

What is essential for the conduct of science has been debated for decades, but it is fairly clear that science doesn't require strong assumptions of the unholy trinity. Scientist just records and explains what he sees. This is what is minimally required. The scientist need not assume that his or her work will result in any type of reductionism or naturalism in the strong sense; some things may not be explainable by science. The second approach fares scarcely better: science is not philosophy, nor is it religion. Therefore any effort to draw philosophical conclusions—even negative ones—from science is very risky. Science does tell us about reality, but only at a certain level, as nearly all writers on theistic evolution are at pains to point out. Many are the superficial arguments advanced against religion based on presumed metaphysical conclusions drawn from science.

Level	Observation	Methodology	Epistemology	Metaphysics
Minimal form	Just what we see	What reductionism falls out of normal science	Realism	Agnostic
Middle	Observations guided by theory	Look for chances to explain phenomena in terms of others	Keep only those entities needed; theories should be as simple as possible, but not simpler (Einstein)	Can't make extrapolations beyond concrete scientific results
Extreme form—unholy trinity	What we have to see	Full Reductionism	Nominalism, Naturalism	Nominalism, Naturalism

Table 1. Levels of assumptions about philosophical and methodological issues essential to conduct of science

When science gets away from direct experimental contact, it tends to blur into metaphysics. Indeed, the distinction between the two can be difficult to discern at times, and has been the subject of very heated and passionate debate. For example, consider the case of quantum physics and the Copenhagen school interpretation. Coming at the end of a very long tradition of deterministic thinking about nature, causality, and metaphysics, the new theory required abandonment of some cherished notions:

> *Uncertainty* or *indeterminism* seems to be what is most opposed to the character of all scientific thinking. Planck, therefore, indignantly rejects this concept; to renounce determinism would be to renounce causality, and with it,

> everything that has constituted the meaning of science from Galileo up to the present day.... Indeterminism, if it exists, would be for Planck a characteristic of the present state of our science, but in no way a characteristic of things themselves.[27]

Why were the physicists, together with many others, so disturbed? The answer is simple. If the notion of strict determinism had to be abandoned *because of developments internal to science itself,* then the equation (assumed implicitly by scientists from the renaissance to the 20th century):

causality = determinism = regulation of all reality by physical laws

would be dealt a shattering blow, and with it the two related equations:

science = knowledge

field of scientific investigation = reality

These latter two, indeed, are tenable at best only on the assumption that anything one wishes to know about the perceivable world can be determined with arbitrary accuracy by science. Since this situation bears some relationship to that of the unholy trinity and evolutionary thought, it is worth examination. As Zubiri has keenly observed:

> ...not only is it untrue that the idea of cause gave rise to modern science, but in fact modern science had its origin in the exquisite care with which it restricted this idea. That renunciation was for the representatives of the old physics the great scandal of the epoch. How is it possible for physics to renounce explanation of the origin of *all* movement? This heroic renunciation, nonetheless, engendered modern physics.[28]

These turned out to be metaphysical notions, superfluous for the conduct of science, but widely regarded at the time, and for 200 years prior, as notions absolutely essential to science. So metaphysical or epistemological preconceptions can directly influence the direction of science, and this is why they can be so dangerous. For example, Poincaré realized in the late 19th century that chaotic motion occurred in many cases as the result of the (deterministic) equations of physics; but he was ignored because such motion didn't fit the metaphysical and epistemological paradigm then current for science, according to which deterministic equations had to give rise to ordered behavior, and random phenomena were only so because of our ignorance of initial conditions. At the time of Galileo, the metaphysical notion that circular motion of the planets was perfect and therefore self-explanatory dominated astronomical thought. The main problem with Kepler's and Galileo's theories, therefore, was not that they made the sun the center of the solar system, but that they required elliptical rather than circular motion, and hence destroyed the metaphysical explanation of heavenly bodies.

By making the shift from science to metaphysics, and then using the metaphysics to construct a world view, science loses its purity and is illegitimately put into the service of something ultimately foreign to it. This does not mean that no metaphysics is essential to science. Clearly, some is—something we have known since Kant, even if his ideas were wrong.

To illustrate the point further, let us return briefly to the problem of species definition, discussed earlier. One's understanding of evolution is profoundly affected by one's understanding of the term "species." Indeed, there is no understanding of evolution at all, and no theory of it is possible, without an adequate definition of basic classification and selection units. Darwin's understanding of species as fluid, ever changing entities marked a sharp break with the traditional static view. As discussed above, those who advocated the static view of species were greatly influenced by realism or *essentialism*. Within this tradition, species were viewed as real entities reflecting distinct and relatively immutable forms. Central to Darwin's whole approach was his radical, nominalistic conception of species (and all higher taxa) as mere arbitrary

conglomerates of individual organisms. Modern evolutionary theory has at its heart a model of biological the nominalistic view of species. This is because nominalism is the only position consistent with the view that slow, gradual changes can eventually yield any conceivable biological organism, under the proper environmental conditions or series of conditions.

The side one takes in the evolution debate clearly has implications regarding the amount of change one would permit a species to undertake:

> The metaphysics matters enormously, as Darwin well knew. So long as we acknowledge that 'species' is merely a biological concept, then we are happy to accept any biological observation pertaining to the species that seems to make sense. For example, we would not be surprised to find that one species could change—evolve—into another; or indeed that any one species could give rise to several different lineages, each of which could evolve along separate lines, to produce several or many different lineages. Why not? If that is what the fossil record or other evidence suggests, where's the problem? But if we believe, as the pre-Darwinians did, that each species represents a divine ideal, then the notion that a species might change into a different species becomes not only strange but blasphemous…many of Darwin's contemporaries were less offended by his apparent rejection of God's Creation, than by his perceived abrogation of Plato.[29]

This is perhaps a bit overstated; though the basic observation is sound. Modern evolutionary theory is quite explicit about the nominalistic definition of species:

> The theory of evolution holds that existing plants and animals have originated by descent with modification from one or a few simple ancestral forms. If this is true, it follows that all the characteristics by which we can classify them into species have been and are changing, and further that on many occasions in the past a single populations has given rise to two or more populations whose descendants today are sufficiently different from one another to be classified as different species. Now there is no reason to suppose that either the processes of modification in time, or the processes of division of a single species into two, have always, or even usually, occurred in a series of sharp discontinuous steps. Therefore *any attempt to group all living things, past and present, into sharply defined groups, between which no intermediates exist, is foredoomed to failure*.[30] [italics added]

But, just what is the objection to use of a more essence-based definition of species in connection with evolution? Why would that cause problems? Perhaps evolutionists can concede that their nominalistic definition has problems and agree to an essence-based definition after all.[31]

Perhaps, but the admission would be fraught with danger for the following reasons:

1. The notion of essence makes the Neo-Darwinian school very uncomfortable, primarily for extra-scientific metaphysical reasons, namely that even essences in the Aristotelian sense tend to point to some type of supra-natural reality which does not fit into the generally materialistic paradigm implicitly or explicitly adopted by the school.
2. It is difficult to understand change, especially gradual change, in connection with essences. Essence allows for limited variation, provided that the characteristics which make something be an example of the species remain intact. In traditional philosophical language, "accidents" can vary, but not substance. But of course it is the non-accidental or essential characteristics which must change in order for

evolution to occur. This clearly implies the forbidden "jumps" or "saltations".

3. If species correspond to essences, then that implies some common architecture. That in turn implies constraints on how the architecture, and thus the species, can change. But such constraints may not be reconcilable with the need for slow, incremental variation in species over long time periods, in their passage to becoming another species.

From these considerations, it is easy to see how metaphysics, in this case nominalism, is a driver for a scientific theory. Some might argue that this is not really so undesirable; but science freed from such constraints is surely a more vigorous and healthy enterprise.

IV. Origin of belief in the unholy trinity: reality and openness of real

What are the roots of belief in the unholy trinity? A facile answer would be that some people just want to reject all forms of religion and desire to make science itself into a new religion, motivated perhaps by some radical (or rabid) atheism. Dennett and Dawkins immediately come to mind. There is, undoubtedly, some evidence that this is the case; but it really does not penetrate to the heart of the matter. What is the fundamental reason that the unholy trinity has a significant following in Western thought, and has had such a following for at least a century or more?

Ultimately, the Unholy Trinity is based on a conception of reality that has very deep roots in philosophy, namely, a belief that reality is "closed", and can be exhausted, at least in principle, by rational, i.e., scientific, knowledge. This belief had perhaps its first clear expression in Laplace's Demon, an imaginary figure who had knowledge of the position and velocity of all particles in the universe, coupled with a knowledge of Newton's laws—the only laws securely known at the time. With this knowledge, the Demon could predict the entire future course of the universe and retrodict its entire past history.

To a considerable extent, belief that reality is closed supports two long-standing philosophical doctrines, which Spanish philosopher Xavier Zubiri terms *the entification of reality* and the *logification of the intelligence*. Entification of reality is the belief that reality is ultimately composed of stand-alone entities, such as the billiard-ball particles of Laplace's Demon, or Aristotle's substances. Logification of the intelligence is the belief that knowledge in the proper and primary sense is only at the rational level; any other "knowledge" would be inferior and of minor importance.

Typically, believers in the unholy trinity have a straightforward view of science: *science is objective knowledge about the world*. Advocates of this view also claim that science is the only or the principal source of such knowledge, and also that truth is an agreement of thought with things. Now, Zubiri would agree that science is objective knowledge about the world; where he disagrees concerns the level of the knowledge delivered by science. For those who accept (implicitly or otherwise) the logification of the intelligence, there is only the one level, that of rational knowledge. In Zubiri's philosophy, this is not so; science is *not* the primary source of knowledge. There are three levels of knowledge: primordial apprehension of reality (direct contact with reality), logos (defining what things are with respect to other things), and reason (methodological explanation of what things are and why they are, as in done in science, literature, and theology, for example). So science, a form of reason, must build on what *is* the primary source, primordial apprehension. Moreover, since the truth attained by reason is not what he terms "real truth", i.e., absolute truth, it is not infallible—further developments can force revisions. This allows Zubiri to overcome one of the major objections to realism as a theory of science: the history of science is replete with examples of new theories replacing old ones because of new discoveries and new evidence. Under the realist philosophy,

this is inexplicable. But for Zubiri, scientific theories are not our primary source of knowledge of the world; so their replacement as science progresses does not pose an epistemological problem, as it does for the advocates of this philosophy of science.

In some cases, advocates of the unholy trinity assume a more positivistic attitude: the meaning of a statement is intimately related to its operational method of verification, so scientific knowledge is the only knowledge available, since non-scientific statements cannot be so verified. This leads to a leveling of knowledge:

> …science begins by breaking down [the] world so as to reduce it to its just cognitive proportions. These just proportions are expressed in the term "the facts:" what is before me, only in virtue of being there and insofar as it is there, without the least intervention on my part. Now, the facts thus understood tend to be reduced to empirical data. Scientific truth will consist in nothing but agreement with these data, and science will be simply a knowledge about their ordered concatenation. The reduction of things to facts, and of facts to sensible data, leads inexorably to the idea of an intellectual life in which all branches of knowledge are equivalent and whose overall unity is given only in the encyclopedia of complete knowledge.[32]

For Zubiri, there are three serious problems with any positivistic approach: (1) The meaning of statements cannot be identified with their method of verification, because this represents a hopeless confusion of the three levels of human intelligence. Verification methods involve concepts of reason, whereas the meaning of statements arises at the level of logos, coupled of course with primordial apprehension of reality.[33] (2) We are not dispossessed of knowledge of things, but have it through primordial apprehension (though not in the scientific sense, of course). (3) There is no one-to-one mapping of facts to sense data, because this again represents a confusion of levels of human intelligence. The senses do not deliver "data" to us because they do not "deliver" anything at all: that is the paradigm of *sensible intelligence*, based on a presumed separation of sensing and knowing. We do not have to infer reality based on data delivered to us, on the model of an information technology system with remote sensors, because we are immersed in it; the sensing and knowing are part of a single, integral process: *sentient intelligence*.

Moreover, reality, in Zubiri's philosophy, cannot be entified, and thus broken down into logical atoms, be they sense data or billiard-ball particles. Reality is, rather, something open. Reality cannot be considered as some transcendental *concept*, or even as a concept which is somehow realized in all real things:

> …rather, it is a *real and physical moment*, i.e., transcendentality is just the openness of the real *qua* real….The world is open not only because we do not know what things there are or can be in it; it is open above all because no thing, however precise and detailed its constitution, is reality itself as such.[34]

So the idea of being able to capture it in a complete way, or to say all that can be said about it utilizing rational knowledge such as science, is doomed from the start. There will always be knowledge about the world which cannot be subsumed under science (or any other form of rational knowledge), or captured in any human formula. Zubiri notes that art, literature, and music are other examples of rational knowledge that tell us about the world—tell us different things about it than science does. Hence, the fundamental or constitutive openness of reality means that the search for it is a never-ending quest; he believes that the development of quantum mechanics in the twentieth century has been an example of how our concept of reality has broadened. In particular, it has been broadened to include the concept of person as a fundamentally *different* kind of reality:

> That was the measure of reality: progress beyond the field was brought about by thinking that reality as measuring is "thing". An intellection much more difficult than that of quantum physics was needed in order to understand that the real can be real and still not be a thing. Such, for example, is the case of person. Then not only was the field of real things broadened, but that which we might term 'the modes of reality' were also broadened. Being a thing is only one of those modes; being a person is another.[35]

This, obviously, is quite inconsistent with the unholy trinity. The notion of "personhood" as something other than a thing simply does not compute in nominalistic and naturalistic terms.

Successful theories remain as beyond-reality-postulations and the reality they postulate usually enlarges our canon of reality; unsuccessful theories become essentially literary postulations; indeed, "science fiction" as a literary genre is closely related to failed scientific theories. Thus the Theory of Relativity gave us relative space and time, and the speed of light as a universal constant, as well as the equivalence of mass and energy, made famous by $E = mc^2$ and of course nuclear weapons.

Zubiri believes that one of the principal errors of past philosophers was their excessively static view of knowledge—a conquer it "once and for all" approach. Typical of this mentality are the repeated attempts to devise a definitive list of "categories", such as those of Aristotle and Kant, and Kant's integration of Newtonian physics and Euclidean geometry into the fabric of his philosophy. This view also characterizes the epistemology of the unholy trinity—science will continue to approach (presumably asymptotically) the ultimate truth about matter, i.e., the world. Rather, knowledge as a human enterprise is both dynamic and limited. It is limited because the canon of reality, like reality itself, can never be completely fathomed. It is limited because as human beings we are limited and must constantly search for knowledge. The phrase "exhaustive knowledge" is an oxymoron:

> The limitation of knowledge is certainly real, but this limitation is something derived from the intrinsic and formal nature of rational intellection, from knowing as such, since it is inquiring intellection. Only because rational intellection is formally inquiring, only because of this must one always seek more and, finding what was sought, have it become the principle of the next search. Knowledge is limited by being knowledge. *An exhaustive knowledge of the real would not be knowledge; it would be intellection of the real without necessity of knowledge.* Knowledge is only intellection in search. Not having recognized the intrinsic and formal character of rational intellection as inquiry is what led to…subsuming all truth under the truth of affirmation.[36] [Italics added]

In Zubiri's word's, reason is "measuring intellection of the real in depth".[37] There are two moments of reason to be distinguished (1) intellection in depth, e.g., electromagnetic theory is intellection in depth of color;[38] (2) its character as *measuring,* in the most general sense, akin to the notion of measure in advanced mathematics (functional analysis). For example, prior to the twentieth century, material things were assimilated to the notion of "body"; that was the *measure* of all material things. But with the development of quantum mechanics, a new conception of material things was forced upon science, one which is different from the traditional notion of "body". The canon of real things was thus enlarged, so that the measure of something is no longer necessarily that of "body". Measuring, in this sense, and the corresponding canon of reality, are both dynamic and are a key element in Zubiri's quest to avoid the problems and failures of past philosophies based on static and unchanging conceptions of reality.

This conception of reality is, so to speak, a radical "paradigm shift". Among its consequences is the fact that there are multiple *types of reality*, though they share the *de suyo*, the formality of reality. Zubiri notes that

> [t]he reality of a material thing is not identical with the reality of a person, the reality of society, the reality of the moral, etc.; nor is the reality of my own inner life identical to that of other realities. But on the other hand, however different these modes of reality may be, they are always reity, i.e., formality *de suyo*.[39]

Zubiri's observation is all the more interesting viewed in the context of the Western philosophical tradition, which has tended to equate "reality" with material reality, and thus has had difficulty with the ontological status of moral reality, of society, of mathematical entities, of fictional characters, and even of colors as perceived—all things discarded by the unholy trinity.

Now of course, not everything which we perceive in impression has reality beyond impression; but the fact that something is real only in impression does not mean that it is not real. It is, because it is *de suyo*. And what is real in impression forms the basis for all subsequent knowing, including science. Still, we are quite interested in what is real beyond impression, which may be something else, or the same thing understood in a deeper manner. For example, electromagnetic theory tells us that colors are the result of photons of a particular energy affecting us. But, according to Zubiri there are not two realities (the photons and the colors), but *the colors are the photons as perceived*. Reason is the effort to know what things are "in reality" which are known in primordial apprehension.

The unholy trinity, then, rests on a foundation of incorrect ideas about reality and our knowledge of it, as illustrated in Figure 2.

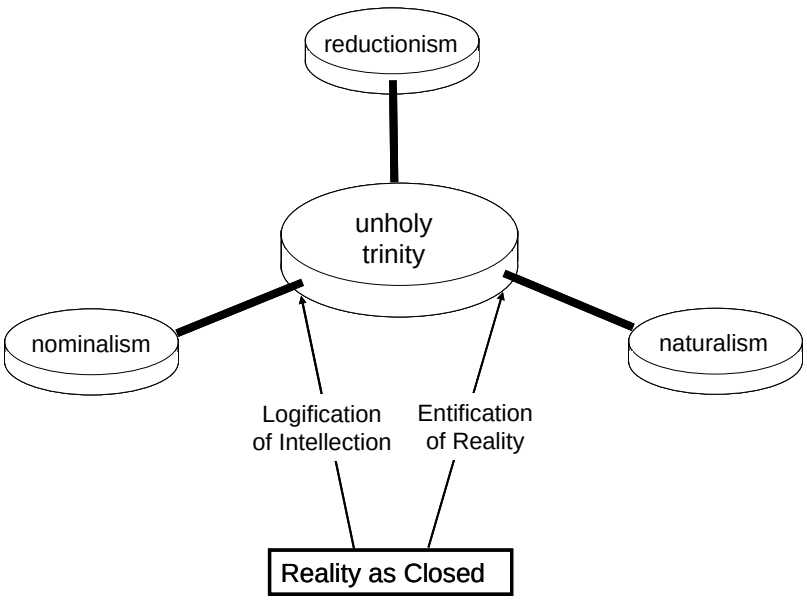

Figure 2. Unholy trinity and its philosophical roots

Belief in the unholy trinity is squarely founded on both logification of intellection and entification of reality. It is founded on logification of intellection because any type of nominalism bases knowledge on conceptual relations, whereas it is grounded

on the primordial apprehension of reality. Similarly, if there is no logification of intellection—i.e., knowledge is not always in a rational (discursive) form, then radical reductionism becomes impossible, because there are types of knowledge that can't be put into rational form and "reduced". And this reality cannot be entified, cannot be split into stand-alone units, whose interactions account for all of reality, be they quarks or anything else—the essence of reductionism. Finally, naturalism combines these two by claiming that reality is exhausted by "natural" entities, those investigatable by science, at the level of rational knowledge, and furthermore that this rational knowledge can in some sense be complete. And finally, naturalism, as a belief in the idea that reality can be exhausted with scientific (rational) knowledge, and therefore that there are no other "things" in the world, is impossible if reality cannot be entified—divided into the correct pieces for categorization. Rather, reality is open, and our canon of the real constantly subject to enlargement. Nominalism is also unviable, because it too is based on a shifting mapping of concepts to things, something that is not possible if there is a more fundamental form of knowledge than the discursive.

While the unholy trinity is not the only possible philosophical position that depends on the notion of reality as closed, and on the logification of intellection and the entification of reality, it is a particularly egregious one. If reality is not closed, then no knowledge scheme can exhaust it, and none can claim to explain all aspects of it. Thus any equation of science with knowledge is doomed to fail. There will always be aspects of reality that escape any human formulation of knowledge, especially rational knowledge. Different types of rational knowledge will encompass different types of reality. Thus, theology, music, poetry, and art, will all reveal aspects of reality to us, though perhaps less than science.[40]

Notes

[1] George Gaylord Simpson, *The Meaning of Evolution*, revised. edition, New Haven: Yale University Press, 1967, p. 345.

[2] John Haught, *Deeper than Darwin*, Boulder, CO: Westview Press, 2003, pp. 106-107.

[3] Lecture by John Haught given at Metanexus Conference, Philadelphia, PA, June, 2006.

[4] *Ibid.*

[5] Locke, John, *An Essay Concerning Human Understanding,* Book 3, Chapter 3, §11.

[6] *Ibid.*, Book 3, Chapter 6, §37.

[7] Some of this discussion is taken from "The Medieval Problem of Universals", *Stanford Encyclopedia of Philosophy*, http://plato.stanford.edu/entries/universals-medieval/.

[8] See article on "nominalism" in *The Oxford Companion to Philosophy,* Oxford: Oxford University Press, 1995, p. 624.

[9] Darwin, Charles, *Origin of Species*, chapter 2, "Doubtful Species", New York: Mentor, 1958, p. 68.

[10] Tudge, Colin, *Variety of Life*, Oxford: Oxford University Press, 2000, p. 29.

[11] Plato, *Republic.*

[12] Tudge, *op. cit.,* p. 28.

[13] Tudge, *op. cit.*, p. 28-29.

[14] Add ref to Midgely.

[15] Todd, Scott, Correspondence, *Nature* 410 (6752):423, 30 September 1999.

[16] Kant, *Critique of Pure Reason*, Preface to the Second Edition, Translated by J. M. D. Meiklejohn.

[17] Mayr, Ernst, Introduction to the facsimile edition of *Origin of Species*, Cambridge: Harvard University Press, 1966, p. xi.

[18] Eisely, Loren, *The Firmament of Time*, Athenium: 1960.

[19] Smith, John Maynard, *The Theory of Evolution*, New York: Penguin, 1958, p. 152.

[20] Many variants on this notion exist, but the central feature of interbreeding and interfertility is common to all. For a review see Rusch, Wilbert, "The Species Problem", *Creation Matters* **4**(1):1-4 (1999).

[21] Strickberger, Monroe W., *Evolution*, 3rd edition, Sudbury, MA: Jones and Bartlett, 2000, p. 239.

[22] Cumming, Kenneth, *On the Changing Definition of the Term "Species"*, Institute for Creation Research, Impact No. 211, January 1991.

[23] Haught, *op. cit.,* p. 128.

[24] Peter Woit, Not Even Wrong: The Failure of String Theory And the Search for Unity in Physical Law, New York: Basic Books, 2006.

[25] Lee Smolin, *The Trouble with Physics*, *The Rise of String Theory, the Fall of a Science, and What Comes Ne*xt, Houghton-Mifflin, 2006.

[26] Haught, *op. cit.*, p. 98.

[27] Xavier Zubiri, *Naturaleza, Historia, Dios*, sixth edition, Madrid: Editora Nacional, 1974, p. 287; translation from English edition, *Nature, History, God*, translated by Thomas Fowler, University Press of America, 1982.

[28] *Ibid.*, p. 289.

[29] Tudge, *op. cit.*, p. 28-29.

[30] Smith, John Maynard, *The Theory of Evolution*, New York: Penguin, 1958, p. 152.

[31] We are assuming an Aristotelian type of essence here, as a more moderate position, rather than a Platonic "type" or "idea", as the latter, conceived as an idea in God's mind, was a common notion at Darwin's time. With its theological baggage and clear implications of eternality and unchangeableness, it was (and is) something entirely unacceptable to the Darwinians and their successors.

[32] Zubiri, *Naturaleza, Historia, Dios,* p. 17.

[33] Of course, the meaning of some statements may involve reason, but ultimately meaning has its roots at the level of logos.

[34] Xavier Zubiri, *Inteligencia y razón*, Madrid: Alianza Editorial/Sociedad de Estudios y Publicaciones, 1980, p. 20; English translation, *Sentient Intelligence*, tr. by Thomas B. Fowler, Washington: Xavier Zubiri Foundation of North America, 1999, p. 248.

[35] Zubiri, *Inteligencia y razón*, p. 56; *Sentient Intelligence*, p. 261.

[36] Zubiri, *Inteligencia y razón,* p. 261-262; *Sentient Intelligence*, p. 336.

[37] Zubiri, *Inteligencia y razón,* p. 45; *Sentient Intelligence*, p. 257.

[38] Zubiri, *Inteligencia y razón,* p. 43; *Sentient Intelligence*, p. 256-257.

[39] Xavier Zubiri, *Inteligencia y realidad*, Madrid: Alianza Editorial/Sociedad de Estudios y Publicaciones, 1980, p. 173; English translation, *Sentient Intelligence*, tr. by Thomas B. Fowler, Washington: Xavier Zubiri Foundation of North America, 1999, p. 63.

[40] This has a nice parallel in mathematics, and specifically, the implications of Gödel's theorem. Up until the 1930s, it was generally believed that the process of discovering mathematical truths could be complete, at least in a "theoretical" sense. This belief was one motivation for the development of mathematical systems such as Whitehead and Russell's *Principia Mathematica*, and it certainly animated the thought of David Hilbert. It also allowed for nominalistic interpretations of mathematics, i.e., the regarding of mathematics as a symbol manipulation process only. There is no reason, under these interpretations, to doubt that all truths about mathematical objects can be known, at least in principle. In this sense, they would be exhausted through the act of postulating them, just as one would expect for ideal objects. For Zubiri, the incompleteness theorem of Gödel means that the mathematical object, once created, has a reality, and a reality with properties *de suyo*; and this reality is *not* exhausted by the postulation, indeed, just the opposite.[40] In other words, the reality of these objects goes far beyond the construction used, somewhat analogously to the fact that the reality of a building goes far beyond the architect's blueprints. As this reality includes what can be deduced about the object, the interpretation of Gödel's theorem is that it shows rigorously that they are not exhausted through logical deduction, or in other words, they have a reality which exceeds what we put into them by postulation, and that no single set of axioms can exhaust mathematical reality.