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METHODOLOGICAL THEISM

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Resumo

Do modo como o defino, teísmo metodológico é a posição segundo a qual, para os propósitos de fazer ciência (ou investigação empírica, mais genericamente), nós deveríamos tratar o mundo *como se* fosse projetado por Deus. Uma vez que o teísmo metodológico não afirma que Deus é uma hipótese científica, ele é compatível com o *naturalismo metodológico*, que diz que deveríamos invocar apenas entidades naturais como hipóteses científicas. Isso constitui uma grande diferença entre o teísmo metodológico e o assim chamado Movimento do Design Inteligente, que rejeita o naturalismo metodológico. Eu não apenas defendo que cientistas teístas deveriam adotar o teísmo metodológico, mas também que este é mais fiel à prática e sucesso atuais da ciência do que suas alternativas mais importantes. Chego a essa conclusão ao olhar mais de perto os critérios de escolha teórica na ciência. Por fim, discuto as importantes ramificações potenciais que essa visão pode ter sobre a prática científica e nossa visão do mundo físico.

Palavras-chaves: naturalismo metodológico, Movimento de Design Inteligente, axiarquismo, religião e ciência.

Abstract

As I define it, methodological theism is the position that, for the purposes of doing science (or empirical inquiry more generally), we should treat the world *as if* it were designed by God. Since methodological theism does not claim that God is a scientific hypothesis, it is compatible with *methodological naturalism*, which says that one should only invoke natural entities in a scientific hypothesis. This constitutes a major difference between methodological theism and the so-called Intelligent Design Movement, which rejects methodological naturalism. I not only argue that theistic scientists should adopt methodological theism, but that it accounts better for the actual practice and success of science than its major alternatives. I do this by looking closely at the criteria of theory choice in science. I then discuss the important potential ramifications this view might have on scientific practice and our view of the physical world.

Keywords: methodological naturalism, Intelligent Design Movement, axiarchism, religion and science.

I SOME BACKGROUND

Before developing the position I call methodological theism, it will be helpful to consider a well-known position that it easily can be confused with, that of the so-called Intelligent Design (ID) movement, which has a significant following in the United States.ID advocates not only claim that there is scientific evidence for an intelligent designer of life on earth, but that the hypothesis of such a designer should be considered a scientific hypothesis[1].Opponents of ID often argue that as a matter of methodology, scientific explanations should only refer to natural entities and processes, a position called *methodological naturalism*. Since a transcendent designer is by definition not a natural entity, methodological naturalism entails that reference to such a designer should not be part of science; however, reference to a designer that is part of our universe, such as an extraterrestrial intelligence, is allowed. One cost that goes along with this claim is that if the hypothesis of a transcendent designer is excluded as a matter of methodology, then one cannot claim that science purports to tell us the truth about the origin of the universe and life on earth, but only that science gives us the best naturalistic account. This, however, moves finding the truth about questions of origins partly outside the domain of science, to philosophy or theology.

As an analogy, if before starting an investigation, a racist detective excludes all white people from being the murderer, we would not expect his methodology to reliably determine the actual murderer. Rather, at best his methodology would be designed to determine the most probable non-white murderer. Applying this analogy to the ID debate, opponents of ID need to be honest in their presentations of evolution insofar as they are speaking as scientists who subscribe to methodological naturalism, Instead of presenting evolution as the true (or most probable) account of the origin of life on earth, they need to present it as only the best naturalistic account. Of course, speaking as philosophers or theologians, they could claim that evolution is the best overall explanation of life on earth.

[1] See "Questions about Intelligent Design," at http://www.discovery.org/id/faqs/#questionsAboutIntelligentDesign.

On the other hand, the major problem I see with ID's claim that we should include the hypothesis of a transcendent or generic designer as part of science is that such a hypothesis is not what I have called *scientifically tractable*. A hypothesis is scientifically tractable if the explanation it gives of some set of phenomena can be filled in using other branches of science, at least in part. All hypotheses in the sciences are tractable in this way. For example, consider the big bang theory. The postulated "fireball" that resulted in our current universe provides a detailed explanation of such things as the microwave background radiation and the abundance of elements because we can use current particle physics to elaborate this fireball's internal dynamics. If its internal workings were forever beyond the realm of current science to investigate, it is doubtful such a hypothesis would be of much scientific interest. The same is true for the theory of evolution and other scientific theories.

Insofar as the hypothesis of ID invokes a transcendent designer, it lacks this scientific tractability. One cannot use current science to elaborate the internal dynamics of a transcendent designer (though one might for a specific sort of non-transcendent designer, such as an extraterrestrial intelligence). Yet, lacking this characteristic is no small matter, since it is what allows scientific hypotheses to provide detailed explanations and predictions, and it gives scientists something to work with. It is not sufficient for advocates of ID to reply that intelligent design is the best explanation of various features of the natural world: many theists argue that God is the best explanation of the big bang and the laws of nature and many platonists argue that the existence of an immaterial realm of mathematical truths is the best explanation of the success of mathematics in science, but clearly this is insufficient to make the God or platonic hypotheses part of science. Even if advocates of ID are not convinced by the above line of reasoning, this significant and relevant difference between ID and regular scientific hypotheses should be acknowledged.

Instead of treating the ID hypothesis as part of science, what I propose is that we treat the hypothesis of design, particularly design by God, as not itself a part of science, but a hypothesis that could potentially influence the practice of science. I call such a hypothesis a *metascientific* hypothesis. Such a hypothesis can influence science by affecting how we think the world is likely to be structured. Taking seriously the possibility of design opens science up to investigate, instead of simply dismissing, various hypotheses about the nature of the physical world that postulate "designlike" patterns at a fundamental level. Hypotheses falling in this category include those advocating biocentric laws and higher-level patterns of teleology in evolution, such as explored by Teilhard de Chardin (1955), Rupert Sheldrake (1988), Simon Conway Morris (2003), and others. I thus applaud the kind of work being engaged in by some of supporters of ID at the Seattle based Biologic Institute in which they look for design-like patterns in nature that seemingly cannot be explained by neo-Darwinian evolution. Although such patterns themselves are purely naturalistic, one would probably not look for and discover such patterns (given that they exist) if one rejected any sort of design hypothesis. In contrast, those who subscribe to a purely naturalistic view of the world favor hypotheses that minimize the appearance of design, or more broadly teleology.

Treating the world *as if* it were designed has already been productive in physics. Since the scientific revolution, physics has implicitly assumed that underlying physical reality has a beautiful and elegant mathematical design. As Morris Kline, the famous historian of mathematics, observed: "From the time of the Pythagoreans, practically all asserted that nature was designed mathematically" (Kline, 1972: 153). Historically, starting with Galileo and Kepler, this has been what has grounded the search for an underlying elegant mathematical order in nature, though today such an order is largely taken for granted apart from any theistic basis. Indeed, as Banish Hoffman, one of Albert Einstein's main biographers, notes, "When judging a scientific theory, his own or another's, he asked himself whether he would have made the universe in this way had he been God" (HOFFMAN, 1973: 7-8). This shows that in doing science, Einstein treated the world *as if* it were created by God, even though he did not believe in the God of traditional theism.

Treating the world *as if* it were created by God is what I call *methodological theism*. I propose that such a stance could be fruitful in other areas outside of physics, and that this is where the true significance for the practice of science of the question of whether the universe and life were in some way “intelligently designed”. I will explain this view in more depth in the rest of the paper and consider some potential implications for scientific practice.

II METHODOLOGICAL THEISM EXPLICATED

Since God is perfectly good, theism should lead us to expect that the universe is structured so as to positively, if not optimally, realize moral and aesthetic value. This means that a theist should expect the basic structure of the universe has a teleological order. As will be explained more below, these observations imply that when choosing between two hypothesis that account for the data, theists should choose the one that appears to result in the most moral and aesthetic value. Thus, under methodological theism, goodness – in both the moral and aesthetic sense – functions as a theoretical virtue: that is, as a means of deciding between two hypotheses both of which are logically consistent and account for the data. Theists also believe that God can intervene in the natural order, and so would be open to the existence of breaks in the natural order: e.g., they should be open to the possibility that the first cell simply came into existence around one or two billion years ago, without having come into existence via a process of chemical evolution.

To see how goodness should function as a theoretical virtue for theists, suppose there are two theories, h_1 and h_2, of equal scope and which entail all the known data, but we know that h_1 leads to a reality with a better overall balance of good over evil. In this case, a theist should think that it is more likely that h_1 is true than h_2, even if h_2 is significantly simpler than h_1. At the very least, the theist should not judge h_2 more probable than h_1. For example, suppose that h_2 is the hypothesis that the universe will undergo a quantum tunneling event and all life will be wiped out in the next ten years, and h_1 is the hypothesis that the universe would continue on for a long time. Now suppose both theories are of equal scope and they entail all the known data, and that one believes such an end to life has such negative value that overall a reality in which h_1 is true is better than h_2. In this case, a theist should think that h_1 is more probable than h_2 even if h_2 is simpler than h_1.Usually, however, goodness will not play such a direct role in choosing theories, but rather play an indirect role of supporting the use of simplicity (and sometimes elegance) in theory choice; this is because, as argued below, typically a universe with a simple (or elegant) underlying law structure allows for the realization within the universe of certain moral and aesthetic values.

It is helpful to see methodological theism in terms of an even larger methodological position, that of methodological axiarchism. Axiarchism is the thesis that reality is structured in such a way as to positively, if not optimally, realize value. Theism entails axiarchism, and given that the existence of God adds to the overall value of reality and God's existence is logically possible, axiarchism entails theism. Methodological axiarchism is similar to methodological theism in that it considers moral and aesthetic values as theoretical virtues. I will mainly focus on this in the rest of the paper.

It should be noted that both methodologic theism and methodological axiarchism are compatible with methodological naturalism. They are incompatible, however, with a position that could be called *methodological atheism*, which holds that when doing science, one should treat the universe as lacking any teleological structure, particularly with regard to human existence. Although few explicitly advocate methodological atheism, it is often conflated with methodological naturalism. This results in many scientists effectively advocating methodological atheism even though they purport only to be advocating methodological naturalism. So, it is important to distinguish between the two. Further, since typically only hypotheses that refer to natural entities are scientific tractable, my arguments above imply that theists also should be methodological naturalists.

Next, I will show that methodological axiarchism is not an arbitrary imposition on science, but arises naturally out of scientific practice.

III CRITERIA FOR THEORY CHOICE

My argument begins by considering what has become known as the *underdetermination of theory by data problem*. This is the problem that for any set of extant observational data, there are indefinitely many logically consistent hypotheses that can account for the data but which have different predictive consequences in untested domains. Consequently, in order for scientists to choose one theory over another – even merely for its potential predictive success in unobserved domains -- they must go beyond logical consistency and fit with data. Rather, they must rely on what are called *theoretical virtues.* The most commonly cited theoretical virtue is that of simplicity, a virtue that says that everything else being equal, we should prefer simple theories over complex ones. Using this virtue commits one to some claim in the neighborhood of the idea that the relevant aspects of the world (such as the fundamental laws of nature) are more likely to be simple than complex.

The need for invoking simplicity is nicely illustrated by the case of “curve fitting," in which scientists attempt to find the right equation that both accounts for a body of data and can serve as a trustworthy basis for future predictions or extrapolations. For example, suppose that one collects data on the relation between the magnitude of force exerted on a mass and the magnitude of the mass's acceleration. The data will consist of measurements of accelerations that result from various forces. Graphically, this could be represented by a plot of data points (with error bars), with the amount of force on the y-axis and the amount of acceleration on the x-axis. It is a mathematical fact that for any number of data points, there always exist infinitely many functions that will perfectly go through the data points, but radically disagree about the values of the force associated with unobserved values of acceleration. Consequently, to choose the appropriate function to use for predictions, scientists must consider something more than fit with data. Typically, scientists consider the simplicity, naturalness, elegance, or some other purported feature of an equation – such as how well it fits with background information (such as previous theories or similar cases). Indeed, the equation they ultimately choose might even miss one or more of the points by a greater amount than experimental error. [See Fig. 2]

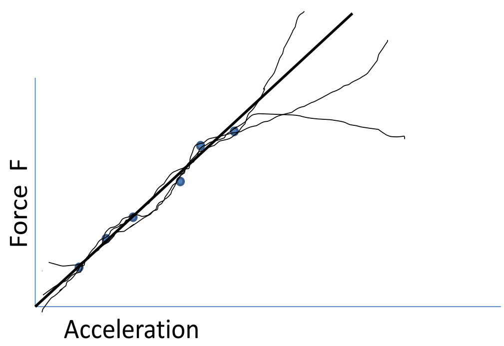

Fig. 2. In extrapolating from the data points using the solid line instead of the other possible curves, scientists are implicitly assuming the world is in some sense more likely to be simple than complex.

In the terminology I will now introduce, the use of a theoretical virtue implicitly commits one to claiming that some corresponding property is what I call an *ideal of natural order* (INO). Roughly, I define some overarching property to be an INO for a person if and only if:

(i) Methodologically the person is explicitly or implicitly committed to treating the world as being, or likely to be, structured in such a way that there is a positive realization of that property;

and,

(ii) That commitment guides their inductive practices and choice of theories.

For example, the use of simplicity in scientific theory choice implicitly commits one to something in the neighborhood of the claim that the universe is more likely to be simple than complex (at least in its basic law structure). Thus, insofar as scientists use simplicity this way, they are committed to simplicity as an INO. Finally, I define a *primitive* INO (a PINO) as an INO that is not based on a commitment to some other INO. Suppose, for instance, that one holds simplicity as an INO because one believes that the world is structured to optimize elegance and that elegance requires simplicity. In that case, one would not hold simplicity as a PINO.

As shown by the curve-fitting example, INOs form the basis of our inductive practices – such as being able to extrapolate from observed data and to choose the best explanation of some set of phenomena. This means that one's PINOs cannot be justified in a non-circular way by their past success, since any argument from their past success to their future reliability would be an argument from observed data (namely, their past success) to unobserved data (namely, their future success), and thus would itself require assuming one's PINOs. Nonetheless, it seems possible for their past success to increase one's confidence in them, and thus in some way confirm them; and likewise for their past failure to undermine them.

In most cases of scientific inquiry, naturalists and axiarchists share the same INOs, with some qualifications to be discussed below. Where they differ is in their PINOs. Consider simplicity. Both axiarchists and naturalists would accept simplicity as an INO for almost all cases of empirical inquiry. Naturalists would likely take some appropriately practical version of this INO as primitive – such as claiming that it is a brute fact that the universe is structured in a simple way, and it is a brute fact that simplicity should be an epistemic norm to decide between scientific theories. In contrast, axiarchists claim that reality is ordered for the positive realization of moral (and aesthetic) value – that is, the axiarchic thesis itself is their PINO; or put succinctly, axiarchists see goodness as a PINO.

If the axiarchic thesis is to make sense of the use of simplicity and other theoretical virtues in scientific methodology, axiarchists must at least show that axiarchism renders the use of such virtues unsurprising in the vast majority circumstances. To begin, an axiarchist could point out that simplicity contributes to elegance, at least for the classical notion of elegance as simplicity with variety, famously stated by in the eighteenth century by William Hogarth(1753).Since axiarchism should lead us to expect an elegant universe, and elegance encompasses simplicity, axiarchism makes sense of the use of simplicity as an INO.

Axiarchists could also argue that there are certain moral goods that can be more fully realized in a world structured for the development of scientific technology and discoverability. For instance, technology (which depends on discoverability) allows for the embodied conscious agents (ECAs) that arise in the universe to influence each other for good or for ill on a much larger scale, thereby greatly increasing the range and extent of potential virtuous responses and positive connections between these agents. In addition, one might think scientific discovery is important in and of itself. They could then go on to argue, as I will below, that the universe's manifesting the right kind of simplicity often greatly aids in its discoverability. Thus, given that we can glimpse some good coming from a universe that gives rise to ECAs that can discover it, axiarchism renders it unsurprising that the universe will be discoverable, and hence unsurprising that simplicity will generally be a good guide in scientific theorizing.

Although the axiarchic thesis constitutes an enormous assumption about the structure of reality beyond what we can observe or deduce by the accepted rules of logic, any PINO of the naturalist will also. Thus, even if axiarchists cannot offer a further justification for their thesis (such as via an argument for theism), that would not make axiarchism worse off than naturalists, since as discussed above, to engage in scientific inquiry they also must posit their PINO without further justification.

One could also put the point as follows. If value is defined more generally as any property that comes in degrees and plays a normative role, then to engage in scientific inquiry one must be committed to some property, p, being a PINO. Axiarchists hold that this property involves moral value; naturalists deny this, opting for some non-moral value – typically simplicity, or somewhat reluctantly, elegance, which is a "half-way house" between simplicity as a PINO and moral and aesthetic value as a PINO.[2]

Given that neither taking simplicity nor moral and aesthetic value as one's PINO can be justified in a non-circular why, does the practice of science itself give us a reason to prefer one over the other? I will now argue that the way simplicity is actually used in scientific theory choice implicitly assumes that the universe is teleologically structured for discoverability, an assumption that is compatible with taking moral and aesthetic value as a PINO but not the way naturalists need to treat simplicity as a PINO (namely, as not involving teleology).Specifically, the kind of simplicity that has been successful in science, and is now implicitly considered normative, is simplicity in the *humanly practical limit*, not absolute simplicity or elegance. This kind of simplicity is one that helps us in the process of discovering even deeper laws of nature, and so is implicitly teleological.

As an example, consider Newton's law of gravity, $F = Gm_1m_2/r^2$, where F is the force between two masses (m_1 and m_2) separated by a distance r. This is a relatively simple equation. Newton's theory has been enormously successful, yet by 1920 it was superseded by Einstein's general theory of relativity, which conceptualizes gravity in terms of a curvature in four-dimensional space time. Like Newton's equation, Einstein's equation is simple – namely, $G = 8\pi T$, where G is the Einsteinian tensor that gives the curvature of space time and T is the stress-energy tensor that represents the density and

[2]Many leading physicists have acknowledged this "half-way house" of elegance as an important criterion of theory choice. This is well-known with regard to Albert Einstein. Here are two other examples. Paul Dirac, a major figure in 20th century physics and one of the founders of quantum mechanics, famously stated that "it is more important to have beauty in one's equations than to have them fit experiment" (Dirac, 1963: 47). Similarly, according to Steven Weinberg, a Nobel Laureate in Physics, "Not only is our aesthetic judgment a means to the end of finding scientific explanations and judging their validity – it is part of what we mean by an explanation" (Weinberg, 1994: 149). He further states that "mathematical structures that confessedly are developed by mathematicians because they seek a sort of beauty are often found later to be extraordinarily valuable by the physicist" (Weinberg, 1994: 153).

motion of matter in space. *Newton's equation and Einstein's equation are only simple, however, when written in terms of their respective mathematical frameworks:* for Newton, a three-dimensional flat Euclidian space and for Einstein a semi-Riemannian geometry, in which the time and space dimensions are intermixed. When Newton's equation is written in terms of Einsteinian mathematical framework, it is very complex, and vice versa. So, the simplicity or complexity of the motion of mass-energy expressed by these equations depends on the mathematical framework in which they are written. This is analogous to the number π. It can be expressed in a simple way in terms of geometrical concepts, namely as the ratio of the circumference of a circle to its diameter; yet expressed in numerical form, it is infinitely complex, being an irrational number with an infinite number of digits that never start repeating.

When expressed in terms of the Newtonian mathematical framework, Einstein's law of gravity becomes Newton's law with an enormous – perhaps even infinite -- number correction terms that take into account the configuration and motion of the matter: that is, as $F = Gm_1m_2/r^2$ + many, many correction terms. Hence, the actual motion of matter due to gravity is enormously complex when expressed in the Newtonian mathematical framework. The reason Newton was able to up with his law of gravity was because for most practical purposes these correction terms could be ignored; just like for most practical purposes, one can use 3.159 as an adequate approximation for π. After hundreds of years of applying Newton's law, scientists realized that it was not accurate in certain situations – such as when applied to the orbit of Mercury.

The fact that these correction terms are small for most practical purposes is both the result of the form of Einstein's equation and the fact that we have developed where the gravitational fields are small and the relative velocities of the matter around us is small compared to the speed of light. If the earth orbited around a black hole, these correction terms would be substantial, and hence Newton's equation would have not provided a successful description of the gravitational interactions that we encountered in practice. In that case, the criterion of simplicity would not have allowed the discovery of his equation. So, the success of simplicity in discovering Newton's law was not because the ultimate law of gravity is simple, but because expressed in the Newtonian framework, it takes on a simple form for almost all practical purposes. Further, it would have been almost impossible to make the leap to the Einsteinian mathematical framework without the tremendous success of Newton's law in the eighteenth and nineteenth centuries.

Similar things could be said about the relation of quantum mechanics to classical mechanics: if the probabilistic predictions of quantum mechanics are written out in the classical mathematical framework with real numbers denoting quantities, one obtains simple equations (corresponding to the equations of classical mechanics), with infinitely many correction terms that are very small except when quantum effects become important. (If this were not the case, there would not have been any need to develop quantum mechanics.) This simplicity in the humanly practical limit – what could be called *practical* simplicity – has allowed us to discover the classical equations while at the same time providing the experimental basis for moving to the quantum framework.

To make sense of the success and continued use of this practical simplicity, one cannot merely assume that the underlying law structure of the world is likely to be simple or elegant. Neither of these would give us any grounds for thinking that the equations of physics would be simple in the humanly accessible limits within ultimately unsatisfactory mathematical frameworks (such as the Newtonian frame-work), but not simple outside those practically useable limits. Being structured for discoverability, however, does make sense of it. Given our limited cognitive capacities, we would expect a discoverable world to be one structured so that practical simplicity is a useful guide. Thus we would expect a universe that is optimally discoverable to be such that (1), at each conceptual framework (such as the flat space-time of Newtonian mechanics), simplicity would offer a generally good guide; but (2), it would fail at the boundaries, thereby forcing the ECAs in that universe to go to the next theoretical rung (e.g., such as to the curved space-time of Einstein) in their scientific quest.

The above illustrates that what could be called *practical* simplicity, not the absolute simplicity of a theory, that has been successful in scientific practice. In fact, since most physicists think that current physics is a low energy approximation to some higher-level set of theories, most likely formulated in a mathematical framework as different from the current one as the framework of general relativity is from Newtonian mechanics, it is this form of simplicity that they implicitly use. They do not think the absolutely simplest equation in the current framework – the one without any small correction terms – is the most likely to be true.

The naturalist could respond that it is also a lucky brute fact that the universe has exhibited this practical simplicity. This response, however, misses an important point: scientists continue to be confident in this form of simplicity. If the success of practical simplicity (or any other type of simplicity) is merely considered an accidental regularity – something that just happens by chance – there are no grounds for expecting it to continue. Yet, scientists do expect practical simplicity to continue to work – and this is true even in the practice of predictively relying on virtually any equation of physics, since as illustrated by the curve fitting example, there are always an indefinite number of competitors that account for the data but yield radically different predictions. Practical simplicity is what separates out the equations actually used from these competitors. (It is not absolute simplicity since most physicists think that current physics is a low energy approximation to some higher-level set of theories, most likely formulated in a mathematical frame-work as different from the current one as the framework of general relativity is from Newtonian mechanics.) Thus, one must not only assume that the world just happens to have been structured for the success of practical simplicity, but that it is non-accidentally structured in this way, whatever further account one gives of this idea of being non-accidental. Because practical simplicity makes essential reference to the limitations of ECAs, relying on it appears to involve an implicit teleological commitment to the universe being structured for discoverability, which is at best difficult to reconcile with naturalism.[3]

Next, I will consider the potential implications of methodological axiarchism/theism for future science.

IV POTENTIAL IMPLICATIONS FOR FUTURE SCIENCE

In applying methodological axiarchism/theism to any area of inquiry, one's value intuitions will play a critical role. Specifically, methodological axiarchists assume that the universe is structured in such a way as to fully satisfy the range of our deepest

[3]Philosopher Mark Steiner (1998) has developed this idea in some depth for the case of physics. By looking at many examples, he argues that the practice of scientists assumes that the world is more user-friendly than would make sense under naturalism. He does not use my example of simplicity, however.

value intuitions, not just that of simplicity or beauty, but also our moral and spiritual intuitions. This means that among theories that explain the data and are logically consistent, they will prefer those that best meet these value intuitions.

What might some of these value intuitions be that could guide one's scientific theorizing? Besides beauty and discoverability, one might think that a morally satisfying universe would be one that had a certain moral and aesthetic richness. This might incline one against certain forms of reductionism. Reductionist views, I believe, are often espoused largely on the basis of their seeming simplicity, which, I believe, partly explains why many scientists and philosophers insist on the reduction of consciousness to physical processes despite the severe problems that one encounters. If one adopts moral and aesthetic value as one's PINO, and one thinks that a non-reductionist view would allow for a realization of deeper moral and aesthetic values, then this major motivation for reductionism will be lost; this could in turn have major effects on scientific theorizing in the field of consciousness studies, at least for those who are open to the axiarchist's PINO.

Further, many find growth, creativity, and interconnection of value. For instance, many people feel alienated from each other and the created order, and feel the absence of such connection as something bad. Part of the source of this sense of alienation is the mechanistic worldview that is left over from the scientific revolution, a view which many scientists unthinkingly adopt. This view typically takes the form of a particular kind of reductionism, what could be called *mechanical reductionism*, according to which the behavior of wholes can be explained entirely by their parts and their spatiotemporal relations. In this view, the universe and human beings consist of nothing more than elementary particles and fields interacting according to the laws of physics. Insofar as things are interconnected with each other, the interconnections are via external causal interactions and spatial-temporal relations. There is no deep interconnection that penetrates into the interior of the things that are interconnected.

Although mechanical reductionism is implicitly assumed by many scientists, it is not consistent with modern physics, particularly quantum mechanics (QM).[4]As Timothy

[4]Indeed, this sort of reductionism is even inconsistent with the other fundamental pillar of modern physics, Einstein's general theory relativity, at least according to one of its leading experts, Cambridge University mathematical physicist Roger Penrose (1989: 220-1).

Maudlin, a leading philosopher of physics, states:

> …the physical state of a complex whole cannot always be reduced to those of its parts, or to those of its parts together with their spatiotemporal relations, even when the parts inhabit distinct regions of space. Modern science, and modern physics in particular, can hardly be accused of holding [mechanical] reductionism as a central premise, given that the result of the most intensive scientific investigations in history is a theory that contains an ineliminable holism (Maudlin, 1998: 55).

For axiarchists who hold that rich interconnections are of value, this inconsistency would be no surprise. To illustrate what I am talking about in a little more depth, we will consider a view along these lines proposed by biologist Rupert Sheldrake. A former research fellow in biology of the Royal Society, Sheldrake is regarded by many as one of the most innovative biologists living today, while at the same time by many other scientists as a 'scientific heretic' who has attempted to fuse 'magic' with science based on inadequate evidence.

Sheldrake hypothesizes that living organisms are much more deeply interconnected than recognized within standard biology and biochemistry. Specifically, he postulates that there are deep pattern forming fields that provide non-local connections and coordination between organisms. One kind of coordination Sheldrake considers is the ability of cells to differentiate into enormously complex patterns – such as that of the human body – during embryonic development, a process called *morphogenesis* (Sheldrake, 1988).The standard orthodoxy in biology attempts to understand morphogenesis within a mechanical reductionist framework – namely, in terms of highly structured chemical gradients that tell cells how to differentiate, with the gradients ultimately generated by an organism's DNA. Yet, as Nikoloz Tsikolia points out (Tsikolia, 2006: 335), although chemical gradients often play a necessary role in cell differentiation, the developmental pattern often remain the same despite substantial differences in the gradient, such as those caused by random fluctuations in a particular gradient or those produced by alternative developmental pathways. From the experimental data, Tsikolia concludes that unknown non-local principles must be at play in morphogenesis, though he does not explicitly subscribe to Sheldrake's hypothesis (Tsikolia, 2006: 335).

To explain this and other cases of highly organized coordination, Sheldrake proposes a theory of morphogenic ('pattern forming') fields that are not reducible to chemistry and can be non-local. He speculates that these fields undergo what he calls "morphic resonance" with those morphogenic fields of past and present organisms to which an organism is closely related, resulting in a form of mimetic information transfer. He claims his hypothesis could provide a fruitful framework for explaining not only morphogenesis, but a wide range of other phenomena involving large-scale coordination and connection. For example, he cites the ability of homing pigeons, sea turtles, and the like to find their way home after being displaced over more than a thousand miles from their point of origin. As can be seen by looking at several issues of the *Journal of Experimental Biology* devoted to this phenomenon, all hypotheses not involving non-local, global coordination that scientists have proposed in the last thirty years face enormous theoretical obstacles or are inconsistent with experiments[5]. Although there could always be overlooked hypotheses, this failure suggests that we should take seriously the possibility of some non-local connection.

As another example of how his hypothesis works, Sheldrake considers experiments that purportedly show that if rats learn to navigate a certain type of maze in the USA, rats at distant locations, such as Australia, will subsequently learn to navigate the maze much more quickly (Sheldrake, 1988: 174-177). He speculates that the first rats that learned the maze modified their collective information fields. Then, via morphic resonance, subsequent rats picked up this new information. Sheldrake also cites how once a few birds in Europe learned to open milk bottles, this ability spread far more quickly through the bird population than seems possible by recognized, local means of information transfer (Sheldrake, 1988: 177-181). Sheldrake proposes that this morphic resonance is a pervasive phenomenon in nature, occurring all the way from protein folding to human society. Since these morphic fields evolve, what could be thought of as 'creativity' is built into them.

Of course, Sheldrake's hypotheses might prove to be false. But I think that one who adopts the axiarchist's PINO will be much more sympathetic to them. If one is a naturalist, his hypotheses will be entirely unappealing since they postulate a rich but subtle underlying order that smacks of some sort of teleology. This appears to the

[5]See, for instance, Papi and Luschi (1996) and Walcott (1996).

reason for the swift rejection of his ideas without any examination of their empirical support: they are labeled as magic. For the naturalist, the most satisfying ultimate theory will be one that getting rid of as much appearance of teleology in the world as possible. For the theist, it will be one that shows in which the order of the world can be seen to realize value. In fact, Sheldrake himself is a theist, which probably has played a major role in him being willing to explore such unconventional hypotheses.

I end with a quotation by William James, the famous American philosopher and psychologist:

> If we survey the field of history and ask what features all great periods of revival, of expansion of the human mind, display in common, we shall find, I think, simply this: that each and all of them have said to the human being, "The inmost nature of reality is congenial to powers which you possess (McDermont (ed.), 1977: 331).

In the case of methodological axiarchism/theism, the claim is that reality is congenial to our moral and spiritual capacities – e.g., our longing for deeper connection. If James is right, adopting this view could lead to a great revival and expansion of the human mind.

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