

On Recent Scientific Advances and Incompatibilist Freedom

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Introduction

With the development of scientific investigation, both the structure of the universe and its laws were being discovered. With the dramatic advances of Newton, there was a surge of hope that soon all unpredictability would be banished from the universe through mathematics and natural sciences. This era was characterized by the scientific affirmation of determinism, best exemplified by Laplace's statement that:

If we can imagine a consciousness great enough to know the exact locations and velocities of all the objects in the universe at the present instant, as well as all forces, then there could be no secrets from this consciousness. It could calculate anything about the past or future from the laws of cause and effect (Peitgen 12).

This was indeed a *Zeitgeist* that permeated not only the sciences but also philosophy and theology. Human behavior, therefore, did not escape being characterized as a process subject to universal determinism, and thus the task of philosophy was to find a notion of freedom *compatible* with determinism. It was not until recently that this *Zeitgeist* has begun to be exorcised by two scientific discoveries – Quantum physics and Chaos theory – and yet I believe we are merely at the transition from the deterministic era. Although I believe Quantum and Chaos theory have indeed made significant advances towards an indeterministic worldview, determinists justifiably raise several doubts as to whether such recent scientific advances actually contribute anything significant to the free will debate. In part I of the present essay, I wish to outline the main ways in which Quantum and Chaos theory have contributed to establishing incompatibilist freedom. I conclude that although such scientific advances have indeed taken a necessary first step away from the causally deterministic worldview, philosophers have yet to establish successfully incompatibilist freedom. In part II, I turn to a different notion of determinism which is as much a part of this *Zeitgeist* as Laplace's demon, viz. theological determinism. I suggest that in *this* field, Chaos theory can be surprisingly helpful in

dismantling the deterministic worldview by forming an alternative understanding of the relationship between God's knowledge and incompatibilist freedom. I conclude that Chaos theory is certainly the path by which we may hope to advance in the problem of theological determinism, and that such success gives us renewed hope that recent scientific discoveries can advance philosophical discussion in the free will debate.

I

The roots of Quantum physics lie in the first half of the 20th century with the theories of Werner Heisenberg and Erwin Schrödinger. They first hypothesized, and later experiments confirmed, that the mere observation of subatomic particles affects their behavior to such an extent that it is impossible to determine both their position and their velocity simultaneously. This impossibility, moreover, is not a practical impossibility that may be overcome with better tools – it holds even in pure theory. The deterministic worldview invites us to believe that, even though we may be unable to determine, and thus predict the behavior of subatomic particles, we can nevertheless assume that it follows *some* deterministic pattern or hidden variable even if these remain unknown to us. However, John von Neumann and John Bell later demonstrated that there is no such hidden variable, and that in fact there cannot be such a deterministic pattern. In other words, Quantum physics shows not merely that *we* cannot determine and predict the behavior of subatomic particles, but also that their behavior is *itself* indeterministic and unpredictable. It has been proven, therefore, that the type of Laplacean determinism presented above is simply not true, at least on the subatomic level. As Heisenberg put it:

In the strict formulation of the causality law – when we know the present precisely, we can calculate the future – it is not the final clause, but rather the premise, that is false. We cannot know the present in all its determining details (Peitgen 12).

However, how significant is this discovery for the deterministic worldview as a whole and for the free will debate more specifically? Although it is impossible to determine the position and velocity of an electron simultaneously, it is not at all difficult to determine both the position and velocity of a car simultaneously. Certainly, there will be subatomic uncertainties in this calculation, but these do not affect either ordinary experience or scientific investigation of non-subatomic objects. What does subatomic indeterminism matter for us, who do not deal with the world on the subatomic level? Quantum physics by itself, therefore, may undermine the *theoretical* justification of the deterministic worldview, but it has little effect on our practical employment of it.

The picture of the effects of Quantum physics on the free will debate is equally bleak. Arthur Eddington, a physicist commenting on freedom and determinism, states that even if von Neumann and Bell's proofs are called into question, Quantum physics shifts the burden of proof onto the determinist's shoulders, for "it is the determinist who puts forward a positive proposal and [thus] the

onus of proof is on him” (347). However, Eddington is less confident that this shift contributes much to indeterminists about human freedom:

It would be rash to suppose that the physical controlling cause [of volition] is contained in the configuration of a few dozen atoms. I should conjecture that the smallest unit of structure in which the physical effects of volition have their origin contains many billions of atoms. If such a unit behaved like an inorganic system of similar mass, the indeterminacy would be insufficient to allow appreciable freedom (348).

Even less optimistic is Wesley Salmon’s account of the effect of Quantum physics in the free will debate. Since the only level in which Quantum physics provides for indeterminism is the subatomic level, the only effect Quantum physics would have in the present debate is if subatomic events could make some significant difference regarding the freedom of a choice or action. Salmon, assuming the Quantum indeterminacy of the disintegration of an atom, presents the following scenario:

Suppose...that you are trying to make up your mind about experimenting with marijuana.... At the crucial point in your brain is an unstable atom. Its relation to the decision process is something like a trigger mechanism. If that atom disintegrates at the proper moment, it will start a process that will lead causally to the decision to smoke pot. If it does not disintegrate, you will decide against it. Does the decision... seem free? Hardly (365-6).

Salmon’s intuition seems quite strong. The determination of a choice by means of a genuinely undetermined disintegration of an atom seems to give just as much freedom as would the determination by means of some random factor external to the agent. What is needed, Salmon indicates, is a certain degree of *control* that lacks in Quantum physics. Therefore, Quantum physics may undermine the theoretical notion of universal determinism, but Quantum indeterminacy alone provides no freedom of choice and no reason to believe it has any significant effect on choice making.

Switching over to Chaos theory, after giving a brief explanation of the theory itself I will proceed to investigate whether this new scientific theory can further debunk the deterministic worldview and establish indeterminist freedom. Chaos theory has its origins in several scientific studies of the middle of the 20th century. Most famously, in Edward Lorenz’s study of weather forecasting from where we get the term “butterfly effect.” In a nutshell, Lorenz discovered that minute alterations in the initial conditions of a weather forecasting program could have monstrous consequences in the actual forecasts produced by the program. This alone may not seem so mind-blowing, but when it was shown that this is how the weather *actually* behaves, then Chaos seems a little more interesting. After all, what Lorenz indicates is that something as insignificant as the

fluttering of a butterfly's wings in Brazil can actually determine whether or not a hurricane forms over Florida (See Peitgen, 41-2).¹ The interesting thing about Chaos, therefore, is that even simple systems that have been taken to be deterministic "can generate random behavior, and that randomness is fundamental; gathering more information does not make it disappear" (Peitgen 10). Chaos is this fundamental randomness, and it has been found not only in the weather, but also in the movement of tectonic plates, in the motion of turbulent fluids, in the growth of populations, and even in the Stock Market. It would seem, therefore, that just as Quantum physics debunked determinism in the subatomic level, so would Chaos theory rule out determinism in many other systems and perhaps in the universe as a whole.

However, this conclusion is much too rash. In order to see why, we only need to refer to the technical definition of Chaos: "Technically, scientists term as 'chaotic' those nonrandom complicated motions that exhibit a very rapid growth of errors that, *despite perfect determinism*, inhibits any *pragmatic* ability to render accurate long-term prediction" (Peitgen 6, emphasis added). The "fundamental randomness" to which I referred to in the previous paragraph is in fact a merely *seeming* randomness, it doesn't rule out causal determinism.

An apparent paradox is that chaos is deterministic, generated by fixed rules which do not themselves involve any elements of change.... In principle, the future is completely determined by the past; but in practice small uncertainties, much like minute errors of measurements which enter into calculations, are amplified, with the effect that even though the behavior is predictable in the short term, it is unpredictable over the long term (Peitgen 11).

Chaos theory, therefore, is similar to Quantum physics insofar as it proclaims some fundamental unpredictability in nature. Unlike Quantum physics, however, the unpredictability of Chaos has not been shown to involve any ultimately indeterministic process. In other words, it remains possible that there exists, insofar as Chaos is concerned, hidden variables that function in a merely deterministic pattern, and although Chaos theory indicates that *we* cannot determine and predict the behavior of chaotic systems, it remains possible that their behavior is deterministic nevertheless.

It is not surprising, therefore, that most philosophers have not taken Chaos theory to provide any significant contribution to the free will debate against the deterministic worldview. This attitude is exemplified by Eleonore Stump, who reiterates my analysis of Chaos as follows:

What chaos theory undermines is just our ability to predict or explain the causal chains of events found in nature. So we might suppose that even if deterministic causal series aren't always predictable, they nonetheless exist.... So on this view, the events at the time of the Big Bang are the start of causal chains that eventually lead in a deterministic way...to all subsequent events, including brain events, even if those subsequent events aren't knowable or predictable at the time of the Big Bang (82).

If Chaos theory contributes anything to the free will debate, therefore, it is not in support of indeterminism but rather of compatibilism, for we can now account for the unpredictability of human behavior in terms of Chaos without having to undermine the traditional commitment to the deterministic worldview.

Despite the pyrrhic victory of Quantum physics over determinism and the counterproductive effect that Chaos theory has on its own, it is in their *connection* that these theories most successfully oppose the deterministic worldview. What Quantum physics demonstrates is that the Laplacean argument (viz. “if you know the present precisely, you can predict the future”) is wrong because its presuppositions are erroneous – it is impossible to know the present *precisely* because there exists genuine indeterminism at the subatomic level. What Chaos theory now demonstrates is that not only is the Laplacean premise wrong, so is the conclusion: even knowing everything we can know about the present state, it remains impossible to predict the future. “The validity of the [Laplacean] causality principle is narrowed by the [Quantum] uncertainty principle from one end as well as by the intrinsic instability properties of the underlying natural laws [described by Chaos theory] from the other end” (Peitgen 14). It seems, therefore, that the deterministic worldview can finally be put aside with the aid of these recent scientific discoveries. There exist genuine undetermined events at the subatomic level, and these undetermined events are chaotically amplified to generate truly random consequences in large scales. Thus, although determinism *seems* to hold in short periods for certain large systems, the real nature of the universe is inherently indeterministic. But how does this defeat of the deterministic worldview affect the free will debate?

Robert Kane is the only libertarian to my knowledge that has capitalized on this success of Quantum physics and Chaos theory. His argument is that, since it is possible that minute Quantum indeterminacies in the brain are chaotically amplified during decision making, it is possible that there exists genuine indeterminism in the decision making process. What Kane’s theory suggests is a response to Eddington’s concern raised earlier, for through Chaos theory Kane is able to indicate how Quantum indeterminacy plays a role in decision making. However, it is far less clear that Kane’s theory can withstand Salmon’s objection presented earlier. Salmon’s objection may remain valid because the indeterminism of Quantum physics is still the only source of indeterminism in Kane’s theory, and it is hard to imagine how the truly random behavior of subatomic particles is under the control of the agent in such a way that provides him with responsibility over his choices. Certainly, Kane’s theory is far more complex than my outline in this paragraph, but nevertheless his results are avidly contested by compatibilists. Since a thorough discussion of Kane’s theory along with compatibilist objections transcends by far the time and space provided by this essay, I intend to close this first part of my essay with the inconclusive remark that even though recent advances in science have undermined the Laplacean notion of universal determinism and moved us beyond the

deterministic worldview of which I spoke at the introduction of this essay, it remains uncertain whether these conclusions really provide for any *positive* argument for indeterminist free will. At most, the indeterminists can attempt to shift the burden of proof onto the compatibilists, but even this strategy does not settle the impasse in which the philosophy of action currently finds itself.

II

Despite the inability of Quantum physics and Chaos theory to decisively establish incompatibilist freedom in the face of causal determinism, I believe that there exists another form of determinism regarding which these scientific advances are far more productive, viz. *theological* determinism. It was briefly mentioned in the introduction that this other form of determinism is as much a part of the deterministic *Zeitgeist* as Laplace's demon, and in this second part of my essay I intend to show how Chaos theory aids in dispelling deterministic intuitions regarding God's omniscience and human freedom. This solution of the problem of theological determinism is that God in fact *does not know* future free actions. In this second section, I intend to define this argument, discern the main objections to it, and attempt to dispel at least some of these objections utilizing Chaos theory.

Before discussing this solution to the problem of theological determinism, however, I find it important to trace its roots to the Aristotelian solution to the closely related problem of *logical* determinism. What I here define as the Aristotelian solution to the problem of *logical* determinism is the claim that, because contingent propositions about the future lack a truth value, no sound logical argument can be given for determinism or fatalism based solely on the truth value of future contingents. For example, it is *now* neither true nor false that Brazil wins the 2006 World Cup. The proposition that describes this event *may* become true in 2006, and it *may* not. Were I to have expressed this proposition last year, and were Brazil to win the World Cup next year, I would certainly have expressed a truth. Yet this expression *becomes* true (or false) *only* in 2006 when Brazil in fact does (or doesn't) win the World Cup. The Aristotelian solution requires, therefore, the explicit denial of the principle of bivalence, the principle that every proposition has (eternally, it seems) a truth value. This is the critical point where I acknowledge that some will be philosophically dissatisfied with the Aristotelian solution. Logicians seem to want a simple system in which the principle of bivalence holds, because it has been difficult to formulate a widely accepted three-value system of logics. However, given the possibility of the radical indeterminism that libertarian freedom requires us to attribute to the world, it seems at least possible that since free events are undetermined prior to their occurrence, by the same token the truth value of the propositions which describe these events are also undetermined prior to the occurrence of these events. Whether the denial of the principle of bivalence results in an intractable problem of logics is an issue that I must

leave aside for now. My concern is merely to indicate that, at little *prima facie* cost, it is possible to formulate an adequate solution to the problems of logical and theological determinism with the aid of Chaos theory, and that this theory rests on the intuition that future contingent propositions lack truth value (or at least appropriate *grounding* for such truth value) until their occurrence.

Returning now to the central argument of this section, I believe that the notion of essential omniscience draws an intrinsic connection between the problem of logical and theological determinism. This connection was articulated by Ted Warfield in a beautifully clear and concise essay, where he claims that *if* the problem of logical determinism is solved, so is the problem of theological determinism. Warfield adopts the following, rather unproblematic definition of divine omniscience: “God knows all true propositions” (80). Given this definition of omniscience, and the reasonable assumptions that if God exists, he exists necessarily and is necessarily omniscient, Warfield argues straightforwardly that propositions such as

(3) It was true in 50 AD that Plantinga will climb Mount Rushmore in 2000 AD, and

(5) God knew in 50 AD that Plantinga will climb Mount Rushmore in 2000 AD

are necessarily equivalent (82).² Thus, Warfield argues that if it can be shown that the truth of (3) does not preclude the freedom of Plantinga’s action in 2000 (in other words, if the problem of *logical* determinism can somehow be solved), then neither will the truth of (5) preclude Plantinga’s action in 2000 from being free, i.e. the problem of theological determinism is also solved. I agree completely with Warfield so far. I disagree, however, with his assumption that the problem of logical fatalism has been solved in such a way that allows for the compatibility of foreknowledge and libertarian freedom (80), as evident above. Accepting his argument, though not his assumptions, therefore, I believe it is possible to indicate how the Aristotelian solution to the problem of *logical* determinism would also apply to the problem of *theological* determinism. That is, since the truth of (3) would preclude Plantinga’s action in 2000 from being free, so would the truth of (5). And if the best way to escape logical determinism is to deny that propositions like (3) can be true, then similarly the best way to escape theological determinism is to deny that propositions like (5) can be true.

Concerns regarding the denial of the principle of bivalence aside, it is clear that the Aristotelian solution to the problem of theological determinism is *philosophically* satisfactory. An argument for theological determinism can validly be refuted if the premise that God has foreknowledge of future contingents is shown to be unsound. The main concern regarding the Aristotelian solution to the problem of theological determinism, therefore, is not whether it is philosophically acceptable but rather whether it is *theologically* acceptable. In what way can divine omniscience, providence and sovereignty be sufficiently maintained if God does not know future contingents? These are the questions that I now intend to address.

There are two main theological objections to the Aristotelian solution. The first is that Aristotelianism seems unsupported by scriptures. Although I trust that most scriptural passages

regarding the issue can be reinterpreted metaphorically or in such a way that is not incompatible with Aristotelianism, this is a task I must leave for biblically oriented theologians and will not address in the present essay. The second objection is more philosophical in nature. It is the concern that Aristotelians are unable to account for divine omniscience and providence satisfactorily, and this gives rise to a new aspect of the problem of evil that is problematic specifically for Aristotelians: viz. that a God who does not know future contingents creates a world recklessly, without knowing exactly how things will turn out. It would be possible, therefore, that God could create a world that becomes so infested with evil, so absolutely repugnant, that it would not be justified to consider God *good* in face of such reckless creation. This objection to Aristotelianism is strong indeed, for it claims that it undermines not only the traditional notions of omniscience and providence, but also God's ultimate goodness as well.

In response to the objection at hand, Aristotelians can argue that the notion that God does not know future contingents need not imply that God is not omniscient, for omniscience can be satisfactorily defined as "knowledge of all truths" (as Warfield defined) or alternatively as "knowledge of everything that can be known." According to the first definition of omniscience, Aristotelians can still claim that God is omniscient (i.e. knows all truths), despite the fact that God does not yet know the truth value of propositions regarding future contingents, for such propositions are neither truths nor falsehoods prior to the occurrence of events they describe. Similarly, Aristotelians can still claim that God is omniscient according to the second definition of omniscience (i.e. knows everything that can be known) despite the fact that God has no knowledge of future free actions. As Aristotelians claim that propositions about future contingents do not yet have truth value, it is possible to argue further that future free actions are inherently not things that can be known. Just as not being able to perform an action that cannot be performed due to its inherent nature (like drawing a round square) is traditionally not taken to detract from God's omnipotence, the Aristotelian can argue that not being able to know something that cannot be known due to its inherent nature (like undetermined facts about the future) does not detract from God's omniscience.

Given that omniscience can be understood this way, the weight of the objection against Aristotelianism is shifted to the issue of divine sovereignty and the problem of evil. Therefore, the heart of the current objection is that if God does not know future contingents, he cannot know how creation will unfold and thus *knowingly* intend or permit that creation unfold as it does through free human agency. However, it is only *if* he cannot know how creation will unfold that God's providence is undermined and his behavior deemed reckless. In response to this objection, I will provide an Aristotelian way of conceiving of God's knowledge that counters this objection, i.e. it denies that God cannot know how creation will unfold *even though* he does not know future free actions. The way I intend to demonstrate this conception of God's knowledge is through an analogy

with an aspect of Chaos theory called “the Chaos game.” I will first explain this analogy and then attempt to show how it counters the objection at hand.

Although Chaos theory is normally associated with knowledge of near events and inability to know distant consequences, there exists also an aspect of Chaos theory that has something like the reverse effect, viz. despite lack of knowledge of near events, we can yet have certain knowledge of distant consequences. The Chaos game is the classical example of this aspect of Chaos theory. In order to “play” the Chaos game, we must randomly generate the numbers 1, 2, and 3. A die would suffice for practical purposes, although a Quantum-based random number generator could also be used.

The random numbers which appear as we play the game, for example, 2, 3, 2, 2, 1, 2, 3, 2, 3, 1, ..., will drive a process. The process is characterized by three simple rules. To describe the rules we have to prepare the game board. [The figure attached at the end of the essay] shows the setup: three markers, labeled 1, 2, and 3, which form a triangle.

Now we are ready to play. Let us introduce the rules as we play. Initially we pick an arbitrary point on the board and mark it by a tiny dot. This is our current *game point*. For future reference we denote it by Z_0 . Now we throw the die. Assume the result is 2. Now we generate the new game point Z_1 , which is located at the midpoint between the current game point Z_0 and the marker with label 2. This is the first step of the game. Now you can probably guess what the other two rules are. Assume we have played the game for K steps. We have thus generated Z_1, \dots, Z_k . Roll the die. When the result is N generate a new game point Z_{k+1} , which is placed exactly at the midpoint between Z_k and the marker labeled N A pattern seems to emerge which is just as boring and arbitrary as the structure of a random walk. But that observation is a far cry from the reality. In (a) we have run the game up to $K = 100$, in (b) up to $k = 500$, in (c) up to $k = 1000$, and in (d) up to $K = 10,000$ steps.³

The impression which [these images] leave behind is such that we are included, at first, not to believe our eyes. We have just seen the generation of the Sierpinski gasket by a random process, which is amazing because the Sierpinski gasket has become a paragon of structure and order for us. In other words, we have seen how randomness can create a perfectly deterministic shape. To put it still another way, if we follow the time process step by step, we cannot predict where the next game point will land because it is determined by throwing a die. But nevertheless, the pattern which all the game points together leave behind is absolutely predictable. This demonstrated an interesting interplay between randomness and deterministic fractals (Peitgen 278-9).

As one may already predict, the analogy is that just as we have certain knowledge that Sierpinski's gasket will unfold despite the fact that it is impossible to predict where any point will fall, so can God know with certainty how creation will unfold despite the fact that he cannot

foreknow or predict any free human actions. In order to clarify the analogy, I shall point to each aspect of the Chaos game and indicate how it corresponds analogically to God's knowledge and its relation to free agency.

In the Chaos game, there are three original points arranged in the shape of an equilateral triangle and one arbitrary point within the triangle. In the analogy, these correspond to the initial conditions which God sets up in the world (perhaps something like space and all physical objects within it). In the Chaos game, the moment of this "setting up" of the game is Z_0 , in the analogy this moment is the moment of creation (perhaps the Big Bang, or the moment immediately prior to it). The first step of the game, the drawing of Z_1 , is the first undetermined and unpredictable point of the game. In the analogy, this corresponds to the first free action, which is both undetermined and unpredictable (perhaps the fall of Adam). Each further point may represent another undetermined and unpredictable free action. The Sierpinski gasket which appears after enough points are drawn corresponds in the analogy to the state of the world at the end of times, the perfection of creation. Since God and his creation are good, we may assume that the figure of the Sierpinski gasket corresponds in the analogy to a sufficiently good aspect of the completion of creation (perhaps the state of creation in which all evil is morally justified, or the "best possible world"). Thus, our ability to know that Sierpinski's gasket will unfold through the truly indeterministic process of the game corresponds in the analogy to God's ability to know that ultimately creation will unfold as he knowingly intends or permits. Most importantly, our ability to know that Sierpinski's gasket will unfold despite the fact that we do cannot predict any specific point corresponds in the analogy to God's ability to predict the unfolding of creation despite the fact that he cannot predict any specific free actions or the outcome of the lives of any free human agents.

Certainly there are many possible objections to this analogy. The first objection is that in the Chaos game, the formation of Sierpinski's gasket is causally determined given the initial conditions and the rules of the game. It would seem, therefore, that all of creation is causally determined by God's creative power in a similar way, and hence the legitimacy of human freedom is still at stake. In response to this objection, it is granted that the analogy indicates that the unfolding of creation is determined by God in the initial conditions and in the process he sets up through which creation unfolds. Notice, however, that the process of the Chaos game *includes* the fact that the placement of each point is *undetermined*. In a certain way, the process determines that the placement of the points be undetermined. Similarly in the analogy, therefore, the process God sets up is such that human free actions are themselves *undetermined*. God determines that free actions be undetermined, and in doing so God waves his ability to know future free actions. The fact that God determines the unfolding of creation by determining the initial conditions of creation and the process through which it unfolds does not infringe on the indeterministic freedom of humans because it is *through* the

indeterministic process of human free agency that God determines the goodness of creation in its perfection.

Another possible objection is that, although the placement of points is completely undetermined in the Chaos game, all points must nevertheless fall within certain predetermined boundaries. In the analogy, therefore, human free actions must also, despite their indeterminacy, fall within certain boundaries. This restriction may undermine the significance of the indeterminacy of free actions. In response, however, we admit that our actions, even those taken to be free, are restricted by several boundaries such as the laws of physics, our physical abilities, the circumstances in which we find ourselves, etc. The imposition of *some* restrictions need not undermine the significance of free agency, however, so long as the options remaining are morally relevant and significantly different. The objector may insist that the alternatives cannot be morally relevant because whichever alternative is taken, it must be in the end be the “good” alternative, for it ultimately contributes to God’s intended goodness and perfection of creation. However, there already is much in the literature indicating that the ultimate goodness of creation need not imply that *every* aspect of creation is itself good, so long as the inclusion of evil aspects are morally justified in the perfection of creation. The ultimate goodness of creation implied in the analogy, therefore, may truly include evil aspects so long as it provides, as indicated above, for ultimate moral justification.

An objection that does discern a shortcoming of the analogy is that in the Chaos game the indeterministic process is genuine *randomness*, while in the analogy it is human free agency, and not randomness. However, this is an issue where the analogy *must* fall short, since if in illustrating this Chaos game we were to appeal to free agency as the mechanism that drives the process, we would merely include in the explanation that which must be explained. The only way to illustrate this notion of God’s knowledge in such a way that does not beg the question is to draw an analogy between the indeterministic freedom of agents to something *other* than that. The closest thing in nature to indeterministic free agency is Quantum randomness, for it is the only thing known to be undetermined. The reason why this shortcoming of the analogy becomes problematic is because we must make the analogy between free *agents* and something other than agents (i.e. the points in the Chaos game). However, anything other than free agents (e.g. subatomic particles), since they are not *agents* that can be in control of their own behavior, may be *indeterministic* like free agents and yet never more than merely random, and in this *latter* aspect they will be unlike free agents.

These observations point to the fact that, even if this notion of God’s knowledge and its relation to human freedom is accepted, it presupposes something like agent causation. Indeed, it assumes *libertarian freedom* insofar as it claims that there must be some way in which an agent’s free choice (undetermined by definition) can *still* be under his control. Indeterminism alone is not sufficient for *control* is also required. Providing a satisfactory account of control is the most difficult task for libertarians. It is also a task that transcends the scope of this paper. My intention in this

essay is merely to demonstrate, by means of this analogy with Chaos theory, how God may have certain knowledge of the unfolding of creation while simultaneously lacking certain knowledge of future free actions. Thus, it is most important to emphasize that, just as in the Chaos game it is not despite the indeterminacy of the process that Sierpinski's gasket is formed but rather through the undetermined placement of the points that the figure is generated, likewise in the present analogy it is not *despite* the indeterminacy of free actions that God's providence is maintained, but rather *through* human free agency itself that creation unfolds to its perfection as God knowingly intends and permits.

It is not difficult to imagine how Aristotelianism accounts for divine providence despite not only indeterminism but also genuine unpredictability of human free actions. If genuine love requires that an agent freely choose to love the beloved, then God could not have *caused* human beings to love him or one another. The only way in which God could create creatures capable of loving him and one another is if he created them genuinely free to choose to love or not. This genuine freedom, however, necessarily includes the possibility that one might choose *not* to love God and humanity. This would be moral evil. If it is the case that the world was created so that a good and loving God could bring about goodness and love through his creation, then it is necessary that God's creatures be *free* to love him and each other in return. If in creating creatures with this degree of radical freedom God must renounce his ability to foreknow their free choices, this seems to be a small price to pay when compared to genuine love. In other words, if the incompatibilism between human freedom and God's knowledge of future contingents is true as I argue,⁴ then we are forced to choose between God's goodness and love and God's knowledge of future contingents. When faced with this choice, it does not seem unreasonable to give up God's foreknowledge as Aristotelians do in order to emphasize God's goodness and love.

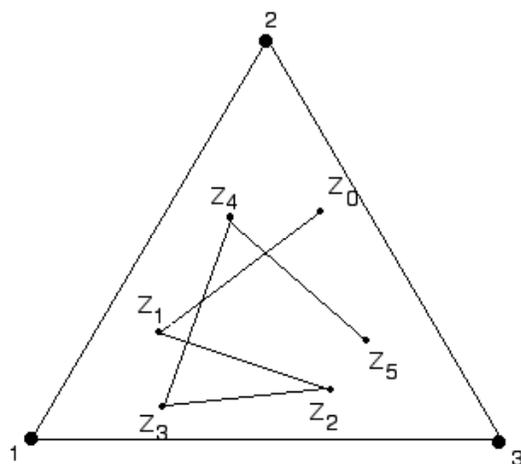
In the second part of this essay, I have attempted to show that Chaos theory productively aids in addressing theological determinism. In conceiving of God's omniscience as not involving foreknowledge of free choices, it is only through the analogy with the Chaos game that God's providence and goodness are rescued from the charge of recklessness. Certainly, the present analogy is only sufficient to explain how God's omniscience need not conflict with free actions. Although the present essay provides nothing but a rough outline of this notion of God's knowledge and its relation to free actions, I believe this is the most original and promising path in attempting to solve the problem of theological determinism. Moreover, the great value of Chaos theory in discussing theological determinism increases the hope that recent scientific advances may still aid in discussing the remaining deterministic challenges to incompatibilist freedom that were left unresolved in the first part of this essay. After all, scientific advances such as Chaos theory are only in their infancy, and original thinking in such areas can still yield surprisingly good and thought provoking results.⁵

Notes

¹ See also Edward Lorenz, “Predictability: does the flap of a butterfly’s wings in Brazil set off a tornado in Texas?”, talk given at the December 1972 meeting of the American Association for the Advancement of Science in Washington, D.C.

² Warfield actually argues that (3) and (5) are “logically equivalent” (82), yet discerns in a footnote that “strictly speaking, all that is needed here is that (3) logically implies (5)” (85). I wish to point out that it is only this logical *implication* that is required, and I insist on no claim of logical *equivalence*. I owe this point to Kirk Ludwig.

³ The first figure illustrates the first 5 steps of the Chaos game:



The next figures illustrate the game at (a) 100, (b) 500, (c) 1,000, and (d) 10,000 points.



⁴ Other philosophers who have also argued this position include William Hasker, Nelson Pike, Richard Swinburne, and Peter Geach.

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