A Designer Universe:
Chance, Design, and Cosmic Order

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Introduction

In an effort to illustrate how natural development in the physical universe works, Canadian philosopher Charles De Koninck gives the following example. A duck hunter, wishing to bring down a duck in the most efficient way, uses a shot gun that produces a random scattering of many pellets. It only takes one pellet of shot, hitting a vital spot, to bring down a duck and any one of the many pellets fired will do. Indeed, the hunter prefers fewer rather than many pellets hit the duck—ideally only one. Yet flying ducks move pretty fast and he wants to be sure of a hit. So, by design, he cultivates a random distribution of bird-shot. This, explains De Koninck, is how nature operates to achieve her ends.

Now, precisely how does duck hunting with a shot gun illustrate natural change? How exactly does it help us to understand how natural kinds come to exist? The point that De Koninck is making is, perhaps, best understood in the context of a fierce debate over what counts as a scientific explanation of natural entities such as planets, animals, plants, and even chemical compounds. Some hold that such beings come about through a series of chance combinations of some basic elements while others hold that such combinations do not just happen, but must be planned or designed in some way.

The debate between these two camps has been going on a very long time. The ancient Greek philosopher Empedocles insisted that natural entities, such as animals and other organisms, arose as a result of the basic chemical elements randomly combining with each other. The viable combinations survived, while the non-viable combinations died out. Thus, it seems *as if* chemical combinations were planned in such a way that certain living organisms result, but in fact the existence of these organisms is purely chance. Plato, on the other hand, considered Empedocles' idea insufficient as a scientific explanation of living things or, for that matter, any natural entity. How, Plato asks, can living beings result from a chance combination of material elements which are not themselves alive? And, more generally, how can order result from chaos? Random combinations by themselves can only result in randomly combined beings—beings simply thrown together without rhyme or reason, beings that exhibit no order or plan. Such beings are not intelligible as the beings they are—that is, random combination can never be the scientific explanation of why a certain being is what it is. Plato's point is that what comes to exist randomly comes to exist in such a way that there is no sufficient reason for its existing and being *this* rather than *that*. The explanation for the existence of this particular duck is parent ducks, not zebras; one does not get a hippopotamus from iron ore or even from living vines. If there is no reason why a natural being exists and is the way it is, then there is no reason one can come to know and, therefore, no scientific explanation. The only way to account for the existence and species of a plant, an animal, or other natural entity is to set out the design according to which its material components are ordered so as to make *this* entity and not some other.

At the very beginning of the history of science, then, a fundamental dispute arose concerning the

very nature of scientific knowledge. As our scientific knowledge has increased over the centuries, one might have expected that this dispute would have been resolved, but this has hardly been the case. The debate about chance and design has intensified and is, indeed, very much with us today. Much of the discussion has revolved around biological evolution: Charles Darwin's view that the diversity of living things is due to gradual evolution of some species from others by the mechanism of natural selection from random variations. Nor is the debate confined to biology, for cosmologists concerned with the origins and development of the whole universe have also tended to take opposite positions on this question of chance and design. One thing is clear, however: that the two sides agree that chance and design are mutually exclusive. What comes to exist by random combination cannot exist by design and what is designed cannot owe its existence to random variation.

What reasons do we have for Empedoclean view that everything arises by chance? What reasons do we have for rejecting this view and insisting that the physical universe must be designed—perhaps by some divine designer? Indeed, what precisely is meant by "chance" or "random variation"? What exactly is design? Are chance and design really incompatible as so many have thought? These fundamental questions provide the subject of tonight's presentation which will investigate a few of the more prominent arguments for chance and design in nature and, further, will suggest an alternative to this dichotomy.

The Watch on the Heath

From the time of Plato until about two hundred years ago, the notion that the universe is the product of some divine designer was a commonplace. Most educated people held that God created the universe according to his own design and that human science is the attempt to understand that design. Such ideas were certainly supported by religious teaching, but they were also thought to arise from the study of nature itself. Isaac Newton, for example, argued that the laws of motion by themselves could not account for the initial design of the planetary system. He points out that:

> Though these bodies may, indeed, persevere in their orbits by the mere laws of gravity, yet they could by no means have at first derived the regular position of the orbits themselves from those laws.

From this he concludes:

> [Therefore,] this most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful being. (*Principia mathematica naturalis philosophiae*, general scholium)

Such "design arguments," however, also had their critics. Two hundred years ago, Scottish philosopher David Hume rejected such reasoning as Newton's claiming that it is based on a mistaken analogy with human artifacts. Hume admitted that physical systems, such as the planetary system or biological organisms are like the products of human design in some ways. The eye of an animal, for example, is similar to a mechanical watch in that both are composed of many individual parts, each of which is specifically formed to function along with the other parts to produce the operation of the whole. While organisms are similar to artifacts in this way, they also differ in important ways. In particular, organisms reproduce themselves whereas watches and other artifacts do not. Therefore, since organisms always come from other organisms, analogy would suggest that all organisms and their parts came from some primeval organism rather than some divine designer. In the same way, since motion begets motion, the physical motions of the planetary system would by analogy come from other physical motions. If the elemental combinations from which these organisms and motions emerge are random, then there is no need to bring in some overall design to explain how things got to be the way they are.

Hume's objections, however, did not stop William Paley who, twenty-four years later in 1803,

published what has become the most famous modern version of the design argument. Paley argued like this: Suppose you were out for a walk across the English countryside and, as you were crossing the heath, you came across a working mechanical pocket watch. Now, even if you had never seen a watch before, you would naturally assume that an intelligent designer was responsible for its existence. Why? Because every one of its many parts, each of which is formed to work in a specific way, work together to bring about a clearly discernible outcome—namely, the movement of the hands in a regular manner marking time. In fact, one who thought that the watch on the heath came to exist by pure chance, would be considered a bit crazy. When one investigates the products of nature, suggests Paley, one sees the same sort of intelligent design. The eye of a mammal, for example, has many parts each of which are constructed in such a way that they are just right for contributing to the function of the eye as a whole—namely, to produce sight. Indeed, something similar might be said for the planetary system: the various mechanical laws of motion and of gravity are just the right physical laws needed to produce the motions of the planets as we observe them.

Some, knowing that Paley was a churchman, have been convinced that Paley's argument is based on religious teaching and have earnestly searched for his hidden theological assumptions. Paley himself, however, considered his argument quite general and independent of religious doctrine. Indeed, he considered it based on what he took to be a reasonable philosophical principle: objects in which the parts are well-arranged so as to achieve some specified end are designed for that end and where there is design for an end, then there must be a designer intending that end with the power to bring about that design.

Now, if Hume's criticism of design arguments seems consistent with Empedocles' idea that natural beings result from the elements linking up at random, then Paley's argument is the very antithesis of this "random-combination" view. It is clear that Paley himself thought that it was, for he says:

> I desire no greater certainty in reasoning, than that by which chance is excluded from the present disposition of the natural world. Universal experience is against it. What does chance ever do for us? In the human body, for instance, chance—that is, the operation of causes without design—may produce a wen, a wart, a mole, a pimple, but never an eye. (*Natural Theology*, I).

Hume had anticipated this sort of reasoning and rejected the necessity of the conclusion to an intelligent designer. Even if we were to come across a perfectly-designed production, that does not mean that a perfect designer *must* be the producer. Hume insists that:

> Were this world ever so perfect a production, it must still remain uncertain, whether all the excellences of the work can justly be ascribed to the workman. If we survey a ship, [for example,] what an exalted idea we form of the ingenuity of the carpenter, who framed so complicated, useful, and beautiful a machine. And what surprise must we feel, when we find him a stupid mechanic, who imitated others, and copied an art, which, through a long succession of ages, after multiplied trials, mistakes, corrections, deliberations, and controversies, had been gradually improving. (*Dialogues concerning Natural Religion*, 718)

Yet Paley thought that he had found empirical evidence that the physical universe is intelligently designed, for he considered that the order observed in nature is *so* regular and *so* well-adapted that it could not be the result of pure chance.

Into the Gap

Despite its critics, Paley's watch-to-watchmaker argument made quite an impression some two hundred years ago. Many felt that, thanks to Paley, they could have their traditional religious teaching about

creation and progressive modern science too. This all changed with Charles Darwin's theory of biological evolution by natural selection. In 1859, Darwin used the analogy with selective breeding to argue that living organisms only *appeared* to be designed. The intelligent breeder can be replaced with an unconscious mechanism of natural selection acting on random variations to produce the variety of observed organic species from other simpler species. As Hume suggested, then, there is no necessity to posit an intelligent designer as the explanation of organic complexities. As time went on, the success of biological adaptation studies seemed to support Darwin's view that complex organic structures could gradually emerge from simpler forms by natural selection operating over long periods of many millennia. Thus, for example, one could explain the distinctive morphology of bird feathers required for flight by arguing that the elongated scales on reptile limbs enabled the animal to more effectively catch insects for feeding. Natural selection favoring those efficient insect-feeders, such scales became longer and longer through many generations until the creature was eventually able to fly a few feet above the ground making insect catching even more efficient. Further, what seemed true of organisms could be extended to the physical universe as a whole: if organic structures, such as the eye of the mammal, did not necessarily demand an intelligent designer as an explanation, then neither does the planetary system or any other example of cosmic order.

So, a conceptual shift took place in the later half of the nineteenth century. As Darwin's theory became better known, more and more people found Paley's argument less and less convincing. Yet, the intelligent watchmaker argument did not die out completely. It continued to have its advocates and in the past decade has been revived in a sophisticated form by promoters of Intelligent Design Theory. Encouraged by developments in physical cosmology that seemed to indicate a finite universe expanding from a primordial "big bang," advocates of Intelligent Design have urged a reexamination of Darwin's evolutionary approach in light of updated versions of Paley's watchmaker argument. Specifically, they have focused on various gaps in the evolutionary process in an effort to show that Darwinian explanations in terms of natural selection are insufficient to explain the development of species observed to exist.

One sort of "gap" argument is given by Michael Denton who argues that the available evidence from the fossil record does not support gradualistic Darwinian-type morphological development. One might be able to argue from natural selection that one form developed from another form within the same or closely related species. Thus, it may be plausible to hold that the long pointed wings of a certain species of hawk gradually developed from an ancestor species with shorter and stubbier wings on the grounds that longer wings made possible soaring at greater heights more effective in searching for prey. Such explanation, however, becomes far less plausible in explaining the development of one phylum, a large group of species with analogous morphologies, from another. This is because their body plans are just not similar enough. The gap between the morphologies of, say, a jellyfish and a fish is simply too big to be plausibly filled by a gradual process of natural selection. Indeed, argues Denton, this is why one does not find the expected intermediaries in the fossil record. Thus, one must have recourse to an intelligent designer as the cause of the observed phyla in the plant and animal kingdoms. Darwinians, of course, respond that, simply because one has not found the expected intermediary forms in the fossil record does not mean that they cannot be found. Such "plausibility arguments," such as Denton's, are hardly conclusive.

Another sort of "gap" argument is provided by Michael Behe who argues that the gap between the biologically functional and non-functional cannot be bridged gradually. It is all or nothing: an organism either possesses the function or does not; there is no intermediate state. This is because the various factors in the biochemical pathways needed for a function are so interdependent that, if even one is missing, the function will be lost. In a now famous—or, in the view of some, infamous—book *Darwin's Black Box*, Behe argues that some biological structures and processes are so complex that they cannot have come about by random variations no matter how much time has elapsed. In particular, there are those biological complexities which he calls "irreducible" where the parts of a biological system are ordered to a particular outcome in such a way that *every one* of the parts is necessary for the outcome to occur. In such irreducibly

complex systems, the absence or maladjustment of just one part is enough to prevent the whole system from functioning properly. The origin of the whole system, therefore, cannot be explained by the accumulation of chance variations, because natural selection would not retain them. They would not be retained because each random variation in itself is useless or even deleterious to the organism.

Blood clotting in mammals provides an example of the sort of thing Behe has in mind. The clotting of blood is not a simple matter, but is a complex process requiring several stages of change that must happen in just the right way. Thus, there must be a determinate amount of chemical substances activated at the right time and at the right speed. If any factor is missing or if the timing is not exactly right, then the animal might die; blood would either clot too much and clog the circulatory system or not clot enough to prevent bleeding to death. Many other biological systems are similar: a random mutation which simply produced one of the factors and not the others would either be of no use to the organism or, if produced in an unregulated way, would be detrimental to the organism. If a gradual accumulation of random mutations cannot explain the existence of such systems, Behe concludes, the only reasonable alternative is direct intervention by an intelligent designer. More specifically, Behe suggests that God programs the first cell he directly creates for the development of the biochemical pathways of all future organisms, some of these being "turned on" at a later point in time.

Behe has essentially provided a scientifically up to date version of Paley's argument. If one observes a biological system that is an irreducibly complex structure or process the existence of which cannot be adequately explained by a gradual accumulation of random variations, then the most reasonable conclusion is that this system was intelligently designed. Behe does admit that some biological structures can be explained in Darwinian terms. He specifically mentions the gross anatomy of the eye which was, of course, Paley's famous example. Such morphologies can come about gradually by natural selection. It is at the biochemical level, argues Behe, that one finds clear examples of irreducible complexity which cannot be explained by an evolutionary process of chance events.

The contemporary defenders of Darwin, however, are not so sure. After all, if there are examples of irreducible complexity at the level of gross anatomy which admit of a gradualist explanation in terms of random mutations, then why should we not expect to find the same sort of explanation working on the biochemical level? What is so special about biochemical complexity that in principle precludes random variation and natural selection? The bone structure of the mammalian ear seems to be an irreducibly complex system and, at first sight, there seems to be no way in which it could have come to exist by a gradual series of chance variations of the reptilian lower jaw. How could the intermediate species have survived without a properly functioning jaw, but hearing? As biologist Kenneth Miller has pointed out, however, the discovery in the fossil record of a double-articulated jaw joint solves the problem, for it shows how such an animal could both feed and hear during a transition from reptile to mammal form. Natural selection could then be understood as favoring each of the intermediate stages arising as random variations. Even if it seems difficult to find intermediary biochemical systems bridging the gap between simpler systems and more complex, it does not necessarily follow that it is impossible.

This is where the contemporary debate on design stands: some defending the Empedoclean-Darwinian position that the universe is populated by beings that have come to be as they are by chance combinations of the elements; others defending some version of Paley's argument for the necessity of an intelligent designer who planned and carried out the elemental combinations in such a way that the universe contains precisely the beings it does. Now, despite the clear differences between these two approaches to explaining the natural universe, they share a very important assumption: chance and design are incompatible. What comes to exist by random combination cannot have come to be so combined by design. The universe is explicable either by chance events or by the unfolding of a—perhaps divine—plan. Clearly, if chance and design are mutually exclusive at every level of being, then one must decide which is the most reasonable way to explain the universe. The many modern heirs of Empedocles have decided on chance in

place of design whereas those who, attempting to keep alive Paley's argument, advocate design to exclusion of chance.

Bird-Shot and Mushroom Spores

Let us return to De Koninck's duck-hunting example. Recall that, in order to achieve a certain outcome—the bringing down of a duck—the hunter plans to use bird-shot instead of a bullets. His end is actually achieved when, by chance, a certain pellet of shot happens to hit a vital spot in the flying duck, bringing it down. Now, in what way is this example relevant to the controversy over chance and design in nature? How does this example help us understand the production of natural outcomes?

Notice first of all that we have two very different kinds of operations working together to produce the outcome: the downed duck. There is *chance*: the random distribution of pellets results in the chance event of a particular pellet hitting a vital place in the duck. There is also *design*: the hunter plans to use the random scattering of bird-shot to produce the chance event that brings down his bird. In fact, we might add an additional element: the *designer*: the hunter himself with his ability to cultivate a random distribution of bird-shot in such a way that a chance hit achieves his goal. Finally, it might be noted that the random scattering of bird-shot is not absolutely random, but only random within limits—that is, it is only random relative to the plan and intention of the hunter. The randomly distributed pellets do not go just anywhere—the hunter, after all, *aims* the gun to produce a *certain* random scattering of pellets. The pellets are truly random missiles, but their random motions occur within the limits intended by the hunter.

De Koninck's point, then, is that change and development in the natural universe involves chance, but it is also a matter of design. Moreover, where there is design, there must be something that has the power to bring about the outcome according to the design. The hunter uses shot instead of bullets because it increases the probability of hitting his target. In fact, his hope is that most of the pellets will miss the duck. Yet a scientific explanation of how the duck was felled would indicate that one of the pellets struck the duck in a vital place. This is the way nature operates: chance events causally produce certain outcomes as part of an overall design aimed at that outcome. Mushrooms produce an enormous superfluity of spores as part of a natural process aimed at reproduction. Not all of the spores will result in new mushrooms and it is by chance that *these* do and *those* do not. Yet the whole reproductive process is ordered in such a way to produce these chance events, for mushrooms do not reproduce in just any way, but in this particular way. Consider, suggests De Koninck, what would happen to humanity if there were but one sperm for each ovum. Clearly, there is a reason for the superfluity of sperm, even though it is by chance that this particular sperm is the one responsible for fertilization.

Now, if De Koninck is right, then the followers of Paley as well as the followers of Darwin are wrong: chance and design are not incompatible. Indeed, De Koninck's point is that the dichotomy of chance and design, so common in contemporary debates about cosmic and biological evolution, is a *false* dichotomy. Chance and design are not mutually exclusive at every level. One of the earliest thinkers to see this clearly was the medieval Catholic theologian Thomas Aquinas. He pointed out that, in certain ways, chance and design *do* exclude each other, for what is designed does not come about by chance with respect to the intended end. Reality, however, is not all homogeneous; it is differentiated and one of the ways in which it is differentiated is that it exists at different levels. Therefore, while chance precludes design at the same level, it does not necessarily do so at a higher level. Thomas gives two examples from human experience to illustrate this. The first is the chance meeting of two servants who, without their knowledge, were independently sent by their master to the same location. From the servants' point of view the meeting is chance, but it was intended by the master (*Comp. Theo*. 137). His second example is the chance finding of a treasure by someone digging a grave in a certain place at the instigation of another who hid the treasure there (*Summa Theo*. Ia.116).

In order to understand what Thomas Aquinas is getting at here, we must take a quick look at

precisely what is meant by "chance." Chance, he says, is a certain relationship between causes and outcomes. An agent cause is a chance cause when it is incidentally the cause of a meaningful outcome which could be the outcome at which the cause aims but normally is not. [Thomas' actual words are "Chance is a *per accidens* cause of things in the realm of purpose which happen in the fewer number of cases" (*In Aristotelis physicorum*, II, lect. 12). So, an effect comes to be by chance when what caused it acts blindly to produce the effect which it would not normally produce. When some agent acts for an end, the outcome is what the agent aims at, unless the action of the agent is impeded. When we are presented, then, with a meaningful outcome to be explained, one must either hold that it was aimed at or it was not aimed at the same time and in the same respect. This, of course, is contradictory and the reason why many hold that chance and design are incompatible.

There is no reason, though, why what happens by chance—that is, what *is not* aimed at a certain outcome—cannot be a functional part of a larger whole which *is* aimed at that outcome. At the level of the part, the event is chance, but at the level of the whole system the event is a functional element of that to which the system is directed. If one only tracks the series of proximate agent causes of the flight of the bird-shot pellet, the trajectory is chance with respect to hitting the bird. If, however, one understands how this chance trajectory is part of a larger system aimed at bringing down the bird, then it is clear that what operates by chance at one level can be a functional element of what is designed for an end at a higher level.

It is important to notice here that Thomas Aquinas does not assume that all instances of teleology—that is, instances of *aiming at an end*—are intelligent or even conscious. Certainly the human hunter who decides to use shot is an intelligent designer. The hawk that begins its dive toward its prey at a certain point in its stalking flight is a conscious designer. Yet one can certainly say that the earth's tectonic plates shift *in order to* relieve stress or acorns fall *for the sake of* oak reproduction without implying that the earth or oaks do these things consciously. Where there is a process with a natural terminus, there is *aiming at an end* and such a process need not be conscious. Therefore, a natural system might be designed to produce an outcome without being a conscious system. In cases of both conscious and unconscious teleology, a system might be ordered to an end in such a way that it uses random events to achieve that end.

Paley attempted to argue that such ordering to an end, such design, ruled out chance explanation and, therefore, established the necessity of an intelligent divine designer of the universe. Thomas Aquinas, too, held that the natural order indicated the existence of a divine designer, *but not as an alternative to chance*. In fact, Thomas sees the presence of chance in the natural world as something intended by God so that nature might be more varied, hierarchical, and complete. If God had created a world in which nothing ever failed and every agent necessarily achieved its end, then the world would be less good. This is because the goodness of the universe does not only consist in one thing being richer (better) in its way of existing than another—as there is more to being an animal than there is to being a plant—but in one thing producing (causing) another—as there is more capability in being able to reproduce a being like oneself than to just be such a being. Chance has goodness of this latter sort.

Thomas Aquinas would also disagree with Behe and other Intelligent Design Theorists regarding their view that God must directly intervene within the physical universe to bring about the forms we observe. Despite the complexity of biochemical processes, there is no *a priori* reason why chance cannot be involved in their production. Using an example of the biology of his day, Thomas points out that, claiming that animals are designed does not rule out their production by random combinations of the elements:

> Nothing prevents the generation of something to be in itself [*per se*] designed when referred to one cause and, nevertheless, accidental [*per accidens*] and chance [*casualis*] when referred to another cause. This is clear in the production of animals generated from putrefaction. If this process is referred to particular causes, acting here at the lower level, it is found to be accidental [*per accidens*] and chance [*casualis*]. For heat which causes putridness does not tend by its natural appetite to the generation of this or that animal which follows from putrefaction. But if it is referred to the heavenly

> power which is the universal power ruling generation and corruption in these lower things, the generation is not accidental [*per accidens*], but in itself [*per se*] intended. This is because it belongs to this intention that all the forms which are in the potentiality of the matter be drawn [*educantur*] into act. (*In Aristotelis Metaphysicorum*, XII, §1403)

Despite the fact that we now know that the spontaneous generation of certain organisms the medievals thought they were observing is not actually a way these organisms reproduce, nonetheless, the point that Thomas is making is clear: in nature, what is chance at a lower level can be part of a larger design at a higher level.

In the same text, Thomas cites an example given by Aristotle which makes the point even more clearly. Suppose that one goes to get a massage just because it feels good—perhaps to relieve stress—but that on account of this one's blood pressure is lowered contributing to overall health. At one level the contribution to health is chance, but at another level it is by design:

> For it is outside the intention of the masseuse that health be obtained, whereas health itself, if it is referred to nature which rules the body is not accidental [*per accidens*], but intended in itself [*per se*]. Indeed, if it is referred to the intellect of the masseuse, it will be accidental [*per accidens*] and chance [*casualis*] . . . and, therefore, Aristotle here rightly assimilates those things which come into existence by skill to those which come into existence by nature. (*In Aristotelis Metaphysicorum*, XII, §1403)

Both the skill of the masseuse and the natural dispositions of the body are involved in the production of a healthy blood pressure. That one of these causes is incidental to the healthy outcome does not make it any less of an explanation of the outcome. Yet the skillful actions of the masseuse could not have had their incidental effect unless the body in fact operated in such a way that, by its design—that is, by its natural order—the relief of stress tended to result in the lowering of blood pressure. Thus, the chance cause produces its outcome within the context of a natural order—a system that is supposed to (is designed to) function in this way.

One of the reasons why Thomas Aquinas thought it was necessary to acknowledge the chance element in nature is that it is the way that novelty is introduced into nature. As he would put it: the chance mixing of the elements is a way of actualizing the natural potentials of the elements which would otherwise not be actualized, if thing acted uniformly without encountering any impediments. Philosopher Marie George once told me that her favorite example from modern biology illustrating Thomas' point here is the way white blood cells produce antibodies. They do so by randomly mixing pieces of genetic material to produce millions of different antibodies. One among the many random combinations inevitably is the right one. This kind of system working by random processes plainly has better chances of producing antibodies to deal with new mutant strains of germs than a system which produced determinate types of antibodies according to fixed rules.

Other modern followers of Thomas Aquinas, such as De Koninck, see the value of modern biological research in this context. An important element in adaptation studies in modern botany and zoology is the identification of the random variations by which an organism adjusts to its environment within its genetic limitations. If nature did not resort to random mutations, new adaptations would not arise. Thus, chance is a source of beneficial novelty in nature. Thomas Aquinas, then, articulated both the reality and importance of random combination in natural operations. Attention to his insight also provides a significant contribution to the modern debate between the Darwinian evolution theorists and the Intelligent Design Theorists, for it shows that the dichotomy between chance and purpose is a false dichotomy. Natural outcomes are the result of both chance events and design and finding evidence of one in the

production of some natural being does not rule out the presence of the other.

Once, Always, and for the Most Part

If chance has its utility and random combinations can be advantageous, then are not Empedocles and his modern followers correct to reject design? After all, saying that chance variation is an advantage in nature is to say that certain combinations spring up for no definite purpose as a result of random mixing and, when they happen to serve some purpose, they are retained and function for that purpose. This function is not something intended, even though it ends up appearing *as if* it were intended. So, is design really just apparent, after all? Is it really unnecessary to bring design into our scientific explanations?

Thomas Aquinas did not think so, despite his insistence on the usefulness of chance in nature. Why? Because it is contrary to our experience of nature. Nature is determined: in its processes and productions it is oriented to doing something, to making something and these processes and productions are regular, even when they are not absolutely inevitable. What nature does is, for the most part, not vain and wasteful. What we observe in the heavens is the regular motions of the planets and stars. What we observe in living things is like giving birth to like. Chance events occur, but they are rare. In fact, were chance events not unusual, they could not be advantageous. What makes the useful random combination useful is that it becomes the regular pattern, it becomes no longer random, but part of a system determined to some end.

Empedocles admitted that chance events are undetermined events, but he insisted that all harmony and usefulness found in nature is chance. His explanation of an animal species, for example, is that it happen by chance that the parts of the animal were assembled so that the animal was preserved in its existence and that this happened many times. This, however, cannot be, because things that happen by chance come about in the fewer number of cases. If it happens all the time, then it is not chance. We observe that order and advantage occur in nature always or for the most part. Therefore, what cannot happen by chance, must be determined to an end—that is, it must be designed.

Thomas Aquinas points out that chance causes do not bring about their effects by determinate means—this is why we call them "chance" or "random." When something happens by chance, there is *some sort* of order between cause and effect, but it is not a *determinate* order. Nature, however, is a determinate order, as we observe in the operation of the planetary system or in living organisms. It might be that a particular chunk of matter, traveling on a random vector, comes under the gravitational influence of another chunk of matter by chance. Once they thereby become ordered into a determined system, however, their motions are no longer chance. Even if the original pre-biotic soup was formed by chance, its composition would not be chance because it would have a formula, a recipe, which when followed yields determinate results. In general, chance causes cannot be relied on to provide the same determined effect. Therefore, life may emerge from a particular pre-biotic combination of the elements by chance, but when the genes code for the proteins that make up the organisms over and over again, this is no longer chance, but design. As Thomas says:

> It does happen that sometimes what comes to exist for the sake of something, comes to exist by luck, when it is not done for the sake of that something. But if this always or frequently happens, it is not said to be by luck. (*In Aristotelis physicorum*, II, §516)

This is analogous to what happens in human action, according to Thomas. One might achieve some end by a chance action which is not normally associated with that end. When one repeats the action for the sake of the end, however, one can no longer call it chance without overlooking the obvious. Thomas points out:

> What is outside one's intention is arrived at in the fewer number of cases; for what is always or frequently conjoined to an effect falls under the same intention. For it is foolish to say that someone intends something and does not want what is frequently or always conjoined with it. (*In Aristotelis physicorum*, II, §428)

To borrow an example from Marie George: One might make Port wine by accident while transporting wine by sea and the sailing ship, getting caught in the doldrums, continuously rocks gently back and forth while the temperature in the hold where the wine casks are stored gets higher and higher. If this happened once and not again, one might think that it was luck. However, if one noticed that every time these conditions obtained, the wine was turned to Port, then one would realize it was not just luck. Indeed, one might figure out what the recipe (the design) for Port is from analyzing the *per se* causes at work while the ship was in the doldrums. Clearly, to consider every transformation of wine into Port purely chance, would at the very least be a sign that one was not paying attention to what was going on. So, luck or chance has played its role, but it is not the whole story in the discovery of Port wine.

The point of these examples is not simply to show that chance and design can exist together, but that the advantageousness and productiveness of chance events is bound up with design. By themselves, chance events are simply chance events. It is only with respect to some end that they can be understood as advantageous or disadvantageous, as productive or unproductive. This is because, by themselves, they are undetermined and are only determined as part of a system designed for some end. Bringing about something in an orderly way is something chance does not do. Because our experience of nature is an experience of order, chance cannot be all there is to its explanation. Indeed, if this were not the case, then science would be impossible, for the universe would be unintelligible.

Thomas Aquinas adds another element to this analysis of chance and design: intelligence. He says:

> It is, however, impossible that something unable to known the goal operate for the sake of that goal and arrive at it in an orderly way, unless it is moved by someone having knowledge of the goal. This is just as an arrow is directed to its mark by an archer. (*In Aristotelis physicorum*, II, §250)

It seems impossible that a meaningful result could be brought about in an orderly way without its being known as a goal. If the archer does not know what the target is, he will not be able to aim the arrow nor know how to manage the bow. You can have a series of blind chance events operating for the sake of an outcome. This operation, however, cannot be a matter of the chance events alone. It must also be a matter of how chance happenings function within a system itself operating for the sake of the outcome. This system may be blind too, but in a different sense. The blindness of chance events is not just that they are not intelligent, but also that they are indeterminate, as already mentioned. The system within which the chance events become part of what brings about the outcome is determined, and so not blind in this sense, but it may not be intelligent. This system, however, could not operate in its determined way unless it were part of another system which *is* intelligent—that is, not blind in any way. Thus, one has a natural hierarchy with an intelligent designer in the highest place.

Conclusion

It may seem that Thomas Aquinas and the Intelligent Design Theorists end up in the same place. Perhaps, in a certain sense. In another very important sense, however, they are quite different positions. There are two general ways in which the design argument has been made. The first is to attempt to find reasons why certain natural phenomena cannot come about by chance as an immediate cause and then to conclude to an intelligent designer as the immediate cause as the only alternative explanation. This is the sort of design argument Paley and Behe are attempting to make. The second sort of design argument points

out that chance and design are not mutually exclusive and that chance always operates within a system designed for an end which itself must be, ultimately, the product of an intelligent designer. This is the argument of Thomas Aquinas.

The difference between these two design arguments has to do with where the intelligent designer—in the case of the design of nature, the divine designer—fits into the order of nature. For Intelligent Design Theorists, such as Behe, God is an immediate cause of certain natural entities and operations—namely, the ones that are irreducibly complex. This sort of "God of the Gaps" view makes God something like a natural cause, only spiritual rather than material. God is an alternative to natural, material, chance causes. It is as if God, having created the universe, must "reach into it to make certain parts of it work." Thomas Aquinas rejects such a view as compromising God's status as creator of the universe. Far from being an alternative to natural causes or acting within nature, God is the author of *all* nature, including all of its natural operations. God is not an *immediate* cause, but an *ultimate* cause. Thus, God, the Intelligent Designer, stands outside of nature as its ultimate source. Nature has an integrity of its own and operates according to its own principles with which God endowed it. God is present to all of nature in its operations making them exist, but God is not within nature nor does God need to intervene in nature. On Thomas' view, Intelligent Design Theory makes natural science impossible, for it claims that some or all of nature is inexplicable by its own principles—the principles with which God endowed it. On the contrary, Thomas held that natural science *is* possible precisely because it is possible to scientifically comprehend design in nature without having to scientifically comprehend the design of God, a task impossible for human beings to carry out.

In studying the historical debate about chance and design in nature, then, we must consider all the possible positions, not only those premised on the dichotomy between random variation and design. Those currently engaged in this debate would do well to attend to the position of Thomas Aquinas who provides an alternative to this stark dichotomy and, perhaps, a more integrated approach to understanding the striking order of the natural universe.