

# THE SECULARIZATION OF CHANCE: TOWARD UNDERSTANDING THE IMPACT OF THE PROBABILITY REVOLUTION ON CHRISTIAN BELIEF IN DIVINE PROVIDENCE

*by Josh Reeves*

*Abstract.* This article gives a brief history of chance in the Christian tradition, from casting lots in the Hebrew Bible to the discovery of laws of chance in the modern period. I first discuss the deep-seated skepticism towards chance in Christian thought, as shown in the work of Augustine, Aquinas, and Calvin. The article then describes the revolution in our understanding of chance—when contemporary concepts such as probability and risk emerged—that occurred a century after Calvin. The modern ability to quantify chance has transformed ideas about the universe and human nature, separating Christians today from their predecessors, but has received little attention by Christian historians and theologians.

*Keywords:* Thomas Aquinas; Augustine; John Calvin; chance; providence; randomness

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They [superstitious gamblers] believe that it is necessary to appease this blind divinity that one calls Fortune, in order to force her to be favorable to them in following the rules which they have imagined. I think therefore it would be useful, not only to gamesters but to all men in general, to know that chance has rules that can be known (de Montmort 1708; Bellhouse 2008, 569).

Yet we who have been born into the empire of chance hardly notice its dominion over us; over the way we parse our world, make up our minds, argue our points, and judge our fellows. Our statistical way of life is too much a way of life to catch the eye (Gigerenzer et al. 1989, 289).

The flipping of a coin in the modern world is a mundane act. We do not think twice about using a coin flip to start a sporting event, or to break the tie between two groups who disagree. In situations where it

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would be difficult to make an equitable agreement between competing parties, we consent to abide by the outcome of *chance*, used here in the ordinary English sense as something accidental or not planned. But this does not mean chance events are entirely unpredictable. One of the characteristic features of living in Western society is that we measure chance in countless ways, whether for investment returns, the likelihood of disease, crime, earthquakes, the success rate of birth control, seat belts, and so on (Hacking 2006, iv). Measuring chance helps us to act in the world and to reason about it, identifying plausible explanations both for common and unlikely events in our lives. The ubiquity of probability calculations helps to explain why chance itself is mundane. We now live, as Gerda Reith (2005) has argued, in the “Age of Chance.”

In Christian history, however, the outcome of seemingly unpredictable events was often seen as a vehicle of divine revelation and therefore sacred. In Acts 1:21-26 (NIV), the apostles elect a replacement for Judas by casting lots after praying: “Lord . . . show us what of these two [candidates] you have chosen.” From a modern perspective, relying upon chance is not an effective strategy for ensuring the best leadership; it is a way of avoiding the decision altogether. But the apostles believed that God would guide the lots in such a way to produce the right decision, just as God had done many times in the Hebrew Scriptures. The sacredness of chance is also seen in the prohibitions Christians placed against gambling and other games. The English Puritan James Balmford argues, for example, that even coin flipping before a sporting event is symptomatic of vanity. He says, “But by using Lotts in sport we tempt the Almighty, vainly desiring the manifestation of his speciall Providence in his immediate disposing; Therefore we may not use Lotts in sport” (Balmford 1623; Bellhouse 1988, 71). Chance does not exist in our world according to Balmford; the coin flip, like all events in the universe, has been specially determined by God, and so we must act with proper deference by not forcing God to act without good reason.

How did this change come about, where chance has been stripped of its religious meaning (Reith 2005, 182)? Why has chance moved from a way of accessing the divine will to becoming an everyday feature of the world? I believe the answer is not that we live in a secular age, where chance is all that is left after God has been removed. Rather, a transformation in modern thinking about the natural world and chance separates modern Christians from their premodern ancestors, a shift that began long before the theories of evolution or quantum mechanics. The purpose of this article is to describe this transformation, starting first by explaining the positions of three major theologians—Augustine, Thomas Aquinas, and John Calvin—on chance and divine providence. The article then will describe the emergence of the modern view of chance, a shift which occurred a century after Calvin. Scholars often point to the rise of the mechanical view of nature when discussing the impact of the scientific revolution on

religious thought. This article will discuss a related conceptual revolution, a less-noticed shift but perhaps one with more consequences for religious self-understanding.

Before I begin the main exposition, a brief clarification on the word “chance.” In the philosophical literature, a distinction exists between epistemological and ontological chance. Sometimes the term chance is used when we lack information. If I ask, for example: What are the chances someone in human resources reviewed my application? There is a definitive answer to this question—yes or no—but I can only make a guess. Chance in this example refers to one’s confidence in a belief about something that is unknown and so is called *epistemological chance* (Hacking 2006, 4). A stronger view is the position of *ontological chance*, which is directed at facts about the world we lack the ability to predict. Radioactive decay is a standard example because, in our current science, it is impossible to know when a particular atom will decay even with complete knowledge of the physical situation. Chance in this example refers to a feature of the world since it is not dependent on what people believe. The epistemological/ontological distinction is useful when trying to make sense of previous cultures, even though the distinction will not be clear in the minds of premodern thinkers (Gigerenzer et al. 1989, 8).

#### AUGUSTINE AND THE ROMAN GODDESS FORTUNA

As Christianity grew in strength and numbers in the centuries after the death of Christ, it set out its own vision for the world, choosing what parts of classical culture to affirm and what parts to replace. Augustine was highly influential in this process because of his intellect and extensive classical education. In a passage (IIX.41) from the *City of God*, Augustine describes the diversity of opinions in the Greco-Roman world, including on the question of chance: “Indeed, in the conspicuous and well-known porch, in gymnasia, in gardens, in places public and private, [philosophers] openly strove in bands each for his own opinion, some asserting there was one world, others innumerable worlds; some that this world had a beginning, others that it had not; some that it would perish, others that it would exist always; some that it was governed by the divine mind, others by chance and accident . . .” Whether or not our world was governed by a divine mind or chance was a major topic of Greek philosophy. The philosopher Epicurus, for example, explained the universe by the random “swerve” of atoms, denying the idea that there was a providential plan to history. This presented a challenge to which almost every major Christian thinker would respond over the next millennium and a half, including Augustine.

But in the *City of God* Augustine also gives attention to a more prevalent way of conceiving chance in the Roman world because of its association with the cultic worship of the gods. Chance was conceived to be a goddess

named Fortuna who was popular with the Greek (who called her *Tyche*) and Roman populace. The Roman Pliny described her this way: “Throughout the whole world, in all places and at all times, Fortune alone is invoked; alone commended, alone accused and subjected to reproaches; deemed volatile and indeed, by most men, blind as well, wayward, capricious, fickle in her favours and favouring the unworthy. To her is debited all that is spent, and to her is credited all that is received” (1991, 13). The imagery of Fortuna’s wheel was on state monuments and coins and there were numerous cults to her across Rome, including a temple built by the emperor Trajan (Arya 2002, 136). Whether rich or poor, emperor or peasant, Fortuna was a deity who was venerated because of her power to inspire hope for changed lives in the populace.

Whereas other gods were concerned with one aspect of human experience, such as the harvest or the sea, Fortuna intervenes in all areas of one’s life, for good or ill (Patch 1922). Her popularity is thus attributable to her omnipotence and her usefulness as an explanation for the success, failure, and unexpected in life. It was her abandoning of Greece for Rome, according to Greek and Roman historians, which explained the emergence of the Roman Empire or the emergence and downfall of emperors, such as Julius Caesar and Octavian. The imagery associated with her includes wings and a globe for her fickleness, a cornucopia from which to distribute gifts, and a rudder, representing her role in guiding sailors and the lives of humanity (Arya 2002, 68). By offering spiritual devotion, Fortuna might change her mind in your favor, though her actions were, almost by definition, arbitrary (Patch 1922). “Living in a world ruled by an inscrutable Fortune, the Romans saw every day as a gamble” (Schwartz 2006, 26).

Both to prevent the lapse of Roman Christians to paganism and assert the distinctiveness of Christian doctrine, Augustine in the *City of God* focuses on the inconsistencies and absurdities that result from devotion to Fortuna. Fortuna must be more powerful than other gods, he suggests, because she has the power to render the gods themselves famous or obscure. He says, Fortuna “certainly ought to occupy a pre-eminent place among the select gods, since she has such a pre-eminent power over them” (2009, VII.3). Perhaps her lack of pre-eminence results from her lack of good fortune! Since Fortuna’s gifts are distributed at random, she cannot direct the blessings of fortune to herself. But such a god should not be an object of praise and worship because human requests make no difference. Augustine argues, “And why is she worshipped, when she is so blind that she runs up against anyone whatever at random, and clings even to those who despise her?” (2009, IV.18). If Fortuna acted with respect to reason or for the love and virtue of her subjects, she would be a different deity altogether. For Augustine, a fundamental distinction exists between God the Creator who works all things according to a divine plan and the pagan goddess Fortuna. The God of Christianity governs with purpose, whereas Fortuna—and

chance more generally—is characterized by its absence. It would be a travesty of justice, in his view, if a deity that gave gifts to those who do not merit them ran the universe.

From the perspective of Augustine's pagan readers, the unresolved question is why was Rome successful when worship of Fortuna was at its zenith and why has Rome been less successful after it converted to Christianity? Does this not imply that life is unfair because divine favor is unequally distributed? For Augustine, things seem random because God's plan is hidden from us. The struggles of Christians, or Christian nations, is governed by God's providence and so God gives earthly riches to evil individuals for a purpose, even if we cannot understand the reasons (Weithman 1997, 245). Augustine says, "God . . . himself gives earthly kingdoms to both good men and bad. He does not do this rashly, or as it were at random, for he is God, not Fortune. Rather he acts in accordance with an order of things and times which is hidden from us, but entirely known to him" (2009, IV.33). The God of Christianity is omniscient and omnipotent, intimately involved in the unfolding of creation, and does not make arbitrary decisions. Attributing a measure of arbitrariness to this world, long recognized in Roman culture and ascribed to the fickleness of Fortuna, was for Augustine a sign of unbelief in God's self-revelation.

#### THOMAS AQUINAS AND THE CASTING OF LOTS

As a follower of the Greek philosopher Aristotle, one might suspect that Thomas Aquinas would differ from Augustine on chance. From the perspective of Aristotelian natural philosophy, some events happen necessarily while others cannot be predicted and so are contingent, but neither result from a power which guides and orders nature from outside the causal system. Though persuaded by this philosophy of nature, Aquinas was also a follower of Augustine. As so he says in the *Summa Theologiae*: "But as to the order of Divine providence, 'nothing in the world happens by chance,' as Augustine declares" (Aquinas 1948, IA, Q.103, Art.1). Aquinas's account of providence is a mediating one, accepting the Aristotelian account of nature while also asserting that God governs all particular events in the world.

The plausibility of Aristotle's mediating position rests on the distinction he and others make between primary and secondary causation. God, as the Creator of the Universe, is the primary cause while all causation in the natural realm is secondary. God uniquely transcends the natural order of causes and so does not compete with it, instead choosing to operate through and cooperate with secondary causes. Aquinas argues that God's might and wisdom are revealed through the ability to bring about the divine will without undermining creature causality.

Rather than focusing further on Aquinas' distinction between primary and secondary causation, this section will examine how Aquinas' *via media* mindset expresses itself on a related subject: lot casting in the Hebrew Bible. As I will show, Aquinas does not want to deny the efficacy of the practice; otherwise he would be rejecting Biblical and Church tradition. Yet Aquinas also thinks it should not have a regular place in the Christian life, and thus should not be the normal means for accessing God's providential will.

The sanctioned use of divination in the Old Testament supports Augustine's viewpoint on chance: the casting of lots in the Hebrew Bible was consistently interpreted as revealing the will of God because God chooses the outcomes of all events in the world. When distributing the land of Canaan, for example, Joshua says to the Israelites, "I will cast lots for you in the presence of the LORD our God" (Joshua 18:6 NIV), which suggests that Yahweh is distributing the land (Dommershausen 1975, 455). The sacred meaning of lot casting is confirmed by other passages, when it was used to select Saul as the first king of Israel (I Samuel 10:21), determine which goat should be a sin offering on the Day of Atonement (Leviticus 16:9), and gain divine guidance as to when to begin an attack (Judges 20:28, I Samuel 14:19). Lot-casting was also a way of revealing hidden sin; Joshua is commanded by God to cast lots to determine which person had stolen property set aside for Yahweh after a military conquest. And the sailors in the book of Jonah, who seem to be non-Israelites, cast lots to determine who is responsible for their impending calamity (1:7). Finally, the religious importance of casting lots is suggested by the Urim and Thummim, which were stones or sticks that were thrown to ascertain the divine will. In Exodus (28:30), God commands they be kept on the high priest Aaron's breastplate so it will be "on Aaron's heart" when he goes before the Lord in the Tabernacle. The privilege of keeping the Urim and Thummim was reserved for the tribe of Levi by Moses in his final blessing before death, allowing priests to make divine inquiries about important matters (Ezra 2:63).

The Israelites' view of chance is summarized in the book of Proverbs, a verse constantly referred to over the history of Christian theology: "The lot is cast into the lap, but its every decision is from the LORD" (16:33 NIV). Lot casting in the Hebrew Bible is a way to rectify human ignorance through divine assistance, rather than a belief in ontological chance. On this point, the Israelites would have been indistinguishable from surrounding cultures. As Reith argues, "Nowhere in ancient or primitive cosmology do we find systematic consideration of chance as a phenomenon in its own right. Instead, its occurrence was consistently conflated with notions of destiny and the will of the gods" (2005, 17). Even the form of divine consultation can be found in other cultures. For example, in several different places in Homer's epic *The Iliad*, the participants place their lots into a helmet, offer

a prayer to the gods, and shake the helmet until one falls out (Taggar-Cohen 2002).

The use of lot casting in the Old Testament raises worries for Aquinas and other theologians to address. Why does the Hebrews' use of the practice look similar to the widespread use of magic in the pagan world? Is the lot casting truly effective, or the superstitious projection of human wishes upon contingent events, as Aristotle might say? Finally, if it is valid, why is it not used regularly in Christian decision making, such as electing Christian pastors and bishops?

Aquinas addresses these worries by, in good scholastic fashion, dividing casting lots into three categories. First, people use lots to divide goods when two parties cannot agree. Aquinas quotes Proverbs 18:18 (NIV), where it says: "Casting the lot settles disputes and keeps strong opponents apart." The use of lots to divide goods is best interpreted as an exception to the general rule, for most pre-modern Christian thought using mechanisms of chance amounted to "tempting God," by forcing God to settle matters that could be sorted out by normal means (Whitman 2012). The explicit permission of scripture allows one to use randomizers to settle arguments without committing a sin, though casting lots in other contexts is not permitted.

A second reason for casting lots is to gain knowledge of the future, what Aquinas calls divinatory lots. This type is always wrong, in his view, because it is motivated by a sinful curiosity to obtain divine knowledge. As he says, "If anyone resumes to foreknow or foretell such like future things by any means whatever, except by divine revelation, he manifestly usurps what belongs to God" (1948, IIA, Q.95, Art. 1). Divination may be successful, but the sinful desire opens the door to interference by malevolent spirits. The Israelites' use of divination can thus be distinguished from the cultures surrounding them; the prophets of the Old Testament were not magicians, using supernatural powers towards immoral ends. When the Babylonians inspected animal livers to divine the future, they were in reality seeking help from demonic powers.

The last type of casting lots, according to Aquinas, was legitimately used by the Israelites to consult God when one doubts how to act: it is "no more than a search for divine guidance in contingent and human affairs" (2012, 195). For Aquinas, God governs even events that are contingent according to Aristotelian natural philosophy. Aquinas gives the example of two servants who think they that they have met by chance, when in actuality their master intended for them to cross paths (1948, Ia, Q.116, Art. 1). Chance is just a term that draws attention to those happenings in our world we lack the ability to predict. As he says in his Commentary on Ephesians, ". . . it should be realized that many human events which seem to occur by fate and chance, in reality are arranged according to divine providence" (Aquinas 2012, 195).

Though Aquinas believes in “consulatory” lots in theory, in practice he says one should only use it in extreme circumstances. Now that the Holy Spirit guides the church, it would be insulting to try to obtain divine guidance through divination. He says: “As long as a man can discover and accomplish by himself what he ought to do, he tempts God if he resorts to lots, or any other such method, to ascertain what he should do” (2012, 195). It is not even lawful to elect church officials by lot, as it was in the Book of Acts, for it occurred before the coming of the Holy Spirit at Pentecost. The only time lot casting would be appropriate for Christians is in matters of urgent necessity, as long as it is undertaken with appropriate prayers and reverence. He illustrates this with an example from Augustine, where church officials must flee from persecution but they cannot agree about where to relocate. This shift in the way of accessing God’s will finds a parallel in Rabbinic Judaism, where the Talmud denies the use of the Urim and Thummim after the first temple was destroyed (Lindblom 1962). After this point, the Torah becomes the primary expression of God’s will, no longer to be found in the throwing of sticks or stones.

In sum, though Aquinas accepts the basic features of an Aristotelian natural philosophy, he accepts Augustine’s position on God’s providence: all events are controlled by God. He reconciled these contrasting perspectives by arguing that God was providentially guiding even the contingent events in the world.

#### JOHN CALVIN AND SPECIAL PROVIDENCE

As was the case for many Reformers, John Calvin affirmed the sovereignty of God as a key theological emphasis. Consequently, he spoke against fortune and chance as “heathen terms.” He says:

By an erroneous opinion prevailing in all ages, an opinion almost universally prevailing in our own day—that is, that all things happen fortuitously, the true doctrine of Providence has not only been obscured, but almost buried. If one falls among robbers, or ravenous beasts; if a sudden gust of wind at sea causes shipwreck; if one is struck down by the fall of a house or a tree; if another, when wandering through desert paths, meets with deliverance; or, after being tossed by the waves, arrives in port, and makes some wondrous hair breadth escape from death—all these occurrences, prosperous as well as adverse, carnal sense will attribute to fortune. (Calvin 1960, 1.16.2)

Calvin’s denouncement, along with persistent themes of fate and Fortuna in Shakespearean literature, suggests a widespread belief in chance in the general populace (Cummings 2013).

A distinctive feature of Calvin’s theology is to collapse, for all intents and purposes, any distinction between general and special providence (Par-tee 2008, 114). As described in the section on Aquinas, God’s general providence was stressed by medieval theologians, who believed that God



normally expresses God's providential care indirectly through natural processes (i.e., secondary causation). By contrast, Calvin's language suggests that God is more intimately involved in creation, intervening supernaturally in each event. For example, he says God governs the world "not by producing a kind of general motion in the machine of the globe" but by "sustaining, cherishing, superintending, all the things which he has made, to the very minutest, even to a sparrow" (Calvin 1960, 1.16.1). Because God personally governs creation to the smallest detail, a Christian is able to see God's handiwork everywhere. Misfortune is punishment for sinfulness and the inability for mothers to breastfeed their infants "is the pleasure of God to nourish one child more liberally, and another more sparingly." Even the ability to use tools like shovels is an example of the special providence of God, for inanimate objects "exert their force only in so far as directed by the immediate hand of God" (1960, 1.16.2).

The emphasis on God's sovereignty in Calvin's thought has led some interpreters to say that Calvin rejected secondary causation altogether. Thomas Torrance argues, for example, "For Calvin, all secondary causation is highly suspicious, and has no real place in theology" (1957, 29). Yet most historians see this as overstatement; Calvin did accept general providence, he just would not allow it to have a separate place from God's particular care of the world. As Calvin himself says: "Yet I do not wholly repudiate what is said concerning universal providence, provided they in turn grant me that the universe is ruled by God, not only because he watches over the order of nature set by himself, but because he exercises especial care over each of his works" (1960, 1.16.4). Calvin's God is not an inactive spectator but an energetic deity who micromanages creation down to the smallest details (Walsham 1999, 2).

God's personal concern for every aspect of creation is why Calvin distinguished his position from stoicism. For the stoics, nothing could occur in the cosmos that was not ordained by divine decree because the universe was animated with *Logos*, understood as reason or an immanent god. The goal of philosophy was not to change the world, for the world was deterministic, but to change one's attitude by embracing one's fate. For Calvin and later Calvinists, there was a difference between pagan fatalism and God's sovereign care for the world. Stoicism pictured God as too remote from creation, merely setting the world into motion rather than taking an active part in its continual governance.

Though God's will is expressed in the outcome of every event, God's reasons are not always transparent, leading Calvin to speak of the "secret counsel of God." From a human perspective, he acknowledges, there appears to be an unpredictable element, which helps to explain why many believe in chance. He gives the following example: though it may appear random if a person strays from his traveling party in the woods and is murdered by robbers, this explanation results from our ignorance. Calvin

says, “All future events being uncertain to us, seem in suspense as if ready to take either direction. Still, however, the impression remains seated in our hearts, that nothing will happen which the Lord has not provided” (Calvin 1960, 1.16.9). The sovereignty of God is at times a rational conclusion derived from the evidence and at other times an act of faith. Every event in Calvin’s theology can be ascribed to the will of God, even if the reasons behind the divine choices remain mysterious.

Despite Calvin’s appeals to secrecy and mystery, a hallmark of later Calvinists is the attempt to discern the divine will in every event, however small. One might not know the exact reasons for the unexpected events or misfortune in one’s life, but Calvin’s theology encouraged his followers to see God’s purpose in every outcome, and so many felt free to make provisional guesses. As Alexandra Walsham has shown, in Puritan journals, diaries, and letters there was a “propensity for detecting the finger of God in the most mundane events” (1999, 20). For example, one person interpreted a bee-sting and puss seeping from his navel as divine providence at work, while another acknowledged it in the discovery of a spider in the family porridge bowl. The explanations offered were flexible to cover a variety of circumstances. When an evil person suffered misfortune, it was evidence of God’s judgment; when evil triumphed, God has abandoned them to their sinful impulses (Walsham 1999, 17). To avoid all speculation about the reasons for God’s providence would be to miss the opportunity to discern the moral lesson behind God’s gifts and punishments.

Calvin’s emphasis on God’s providence had a tremendous influence on many streams of Western Christianity, becoming a central feature of the religious culture of early modern England, for example (Walsham 1999). It influenced the Bible translations; as Brian Cummings (2013, 222) has shown, “the Geneva Bible excised ‘luck’ from the entire text of scripture, allowing it in only one footnote in order to banish its usage from our mouths.” It also influenced the strong moral stance against gambling that was adopted by the Church (Reith 2005). Since God determines the outcome in games of chance, it profanes the majesty of God to invoke the divine will in such a trivial matter (Bellhouse 1988, 68). Consulting the will of God through lot casting is effective but is not God’s chosen means for revealing the divine will.

What can we conclude from this exploration of the Christian theological views of Augustine, Aquinas, and Calvin toward chance? Chance is a topic of scorn in Christian theology because it is seen to undermine belief in God’s providence: the idea that God actively cares for the world, rather than being a detached observer or unconcerned with creation. Though many Christians have been tempted to see God’s providence in ways that resemble fate—ruling the world by a strict predetermined necessity—the Christian tradition has emphasized God’s active governance over particular

events. God's sovereignty means that no events happen unless ordained or permitted by God.

#### THE EMERGENCE OF CHANCE

Having completed a survey of the origins and basic features of classic Christian views on chance, this section returns to the question of the introduction: how did chance get stripped of religious meaning? How did we get from the worldview of John Calvin, where every happening was the immediate expression of God's will, to the modern view where chance seems to be an ordinary feature of our universe? The short answer: a revolution in the understanding of chance occurred roughly a century after Calvin. Contemporary concepts such as chance, probability, and risk emerged at the end of the seventeenth century (da Col 2012, 7). It was a paradigm shift that started by applying probabilistic reasoning first to gambling and then to all sorts of problems ranging from the proper payout amount for annuities to whether God exists. The rest of the article will describe this shift and its implications for Christian theology.

The discovery of probability is attributed to Blaise Pascal's attempt to solve a gambling problem: how to divide the stakes in a game if interrupted. While others had addressed the problem by dividing the pot proportionally based on the player's past performance, Pascal instead calculated a player's likelihood of winning the game from that point onwards (Reith 2005). He made calculations about an uncertain future by introducing the concept of expectation. Rather than appealing to luck or divine intervention, Pascal discovered that even variable events were expressions of stable underlying probabilities (Gigerenzer et al. 1989, 12). The ability to discover regularities in randomness was an astonishing development. Instead of seeing each throw of the dice as an exceptional case, Pascal and others reasoned about outcomes by discerning patterns in the aggregate. As indicated by this article's epigraph by the French mathematician Pierre Rémond de Montmort, Pascal and others discovered that "chance has rules that can be known."

From its origins in solving a gambling problem, probability theory soon was applied to numerous other contexts, from the legal field to the business of insurance, becoming instrumental in the rise of capitalism (Gigerenzer et al. 1989, xiii). With the tools of probability, the new merchant class raised wealth through speculation in the international stock market. The same tools could also insulate one against failure, whether through insurance or investing in annuities. Insurance companies existed before the emergence of probability, but they focused on the risk inherent in each individual case, unaware of the regularities that emerge when risk is aggregated into groups over the long term (Gigerenzer et al. 1989, 26). In sum, the rise of the modern economy could not have occurred without the new techniques of probability to maximize profits and manage risk (Reith 2005, 23).

The rise of nation states helped spur the development of probability theory because the ability to discover statistical laws depends upon collecting quantitative facts in a systematic manner. For example, starting in 1603 London began to keep weekly logs of the number of baptisms and deaths as a way to track the plague. When a London merchant in 1662 drew statistical inferences from the mortality records, he discovered regular patterns in birth and death (Reith 2005, 23). Order in nature was unsurprising, but death and birth had been seen as not something about which statistics was possible; it was an irreducibly personal and unpredictable transaction between a person and the divine. After this point, nations were able to raise income reliably by selling annuities because mortality rates could now be predicted (Hacking 2006). Once the utility of statistics was demonstrated to the emerging nation states of the period, new facts were increasingly collected on issues of health, suicides, crime, trade, and so on. The rise of statistical thinking led to what Ian Hacking calls the “avalanche of numbers” in the early nineteenth century (1990, 11).

#### EMERGENCE OF ONTOLOGICAL CHANCE

Not until the nineteenth and twentieth centuries, when the concepts of probability and chance spread into the fields of biology and physics, would the transformation of the modern world into the “age of chance” be complete. Evidence of chance in physical theory challenged the classical physics that emerged in the scientific revolution, which proved so useful for predicting the orbits of planets and the trajectory of cannon balls. Most scientists had assumed the laws of nature applied precisely and universally, and so once all the laws and forces of nature were discovered then physicists could predict the motions, at least in principle, of the material particles of which the universe consisted. The world is deterministic in classical physics because it acts in definite, predictable ways with no alternative outcomes.

The classical picture gave way over the nineteenth and twentieth centuries, with statistical mechanics as the “bridgehead” (Gigerenzer et al. 1989, 222). James Clerk Maxwell and Ludwig Boltzman applied to molecules the same statistical techniques sociologists applied to human societies, allowing them to characterize the behavior of the system without a complete description of the physical state. The death blow to the classical picture, however, was quantum mechanics, which suggested probability was a basic feature of the universe to most physicists. Particles of atomic or subatomic size do not act like the idealized billiard ball of classical mechanics. In the orthodox interpretation of quantum mechanics, particle location is indeterminate; the act of measurement forces the particle into a determinate location, the probability of which can be predicted by physicists. Instead of the deterministic, mechanistic world of classical physics, modern physics appears to give a probabilistic one (Polkinghorne 2002, 25).

In biology also, chance played an important new role in scientific theories, most famously in Darwin's theory of evolution. For Darwin, chance variation in biology promoted the survival of some organisms over others, which allowed for increasingly complex organisms to emerge. Evolution, Darwin said, uses accidental variability in the same way that a builder may use uncut stones for an edifice (quoted in Gigerenzer et al. 1989, 137). Though Darwin did not use statistical techniques himself, he was influential in the rise of modern statistical thought because his work spurred Francis Galton, Karl Pearson, Charles Sanders Peirce, and others to work out the implications of evolutionary theory (Gigerenzer et al. 1989, 66). For example, many biologists now believe genetic drift, which is essentially a sampling error as the genes from one generation are passed to the next, to be a major driver in evolutionary change.

Chance also plays a role in biology because of biology's need for historical explanations. Biological systems are not only constrained by the underlying physics, but also by the unique events in their history that alter future evolutionary development. Terrence Deacon gives the example of the snowflake: each snowflake can be alike in principle because of the underlying physics, but a trip through the atmosphere, with variances in temperature, humidity, and so forth, produces snowflakes of radically different forms (2006, 856). In the same way, events in the history of biological evolution, like the hitting of the Earth by an asteroid, can significantly alter the trajectory of biological evolution. How different history would be if it restarted at the beginning is a controversial topic, but nonetheless chance is a fundamental concept in biology.

In summary, though some scientists and philosophers still hold to a deterministic vision of the natural world—hoping an undiscovered cause would allow one to understand and predict events that seem random from the current state of knowledge—ontological chance allows one to make sense of a wide variety of experimental data. Modern science is awash in probability, and so not much imagination is needed to see it as a characteristic of the world itself.

#### THE SECULARIZATION OF CHANCE

The last section will discuss the impact of the probability revolution on Christian belief in providence. Modernity undoubtedly changed perceptions of God and divine providence; Sung-Sup Kim says in his recent book on Providence, "We are living in a world . . . where it has become increasingly difficult to suppose divine providence" (2014, 1). Kim attributes it to Darwin's undermining of the design argument and Marx and Freud's critique of religion. Other common answers include the closed causal order revealed by science and awareness of evil in a post-Holocaust world. These explanations are helpful, but another part of the story of modernity

deserves more attention. I will argue in this section that part of the modern loss of confidence in divine providence results from the mismatch between Calvin's God—which governs each decision to the smallest detail—and the world as described by the probability revolution: one where even the most seemingly random happenings can be predicted. As chance has become a mundane part of the modern world, it becomes harder to see divine concern for particulars behind the laws that characterize chance.

As with science, the probability revolution had two stages. At the first, probability was just a useful way to reason about the world, as seen in new arguments for the existence of God. In the seventeenth century a new type of rationality emerged that abandoned the medieval ideals of obtaining certain knowledge (Gigerenzer et al. 1989, 7; Reeves 2013, 142). The very idea of *probable knowledge* only appeared in the seventeenth century. In medieval thinking, "probability" was an opinion warranted by authority, a type of knowledge that could not reach the level of certainty given by science. As ideas of probability spread, the word came to refer to a belief likely to be true. As Gigerenzer et al. say, "An increasing number of seventeenth-century writers attempted to carve out an intermediate position that abandoned all hope of certainty except in mathematics . . . yet still insisted that men could attain probable knowledge. Or rather, they insisted that probable knowledge was indeed knowledge" (1989, 5). Philosophers and other thinkers thus reconsidered practical rationality in light of probability theory; to make rational decisions about an unknown future, one needs to measure probability and risk.

The impact of this new type of reasoning on Christianity is exemplified in Pascal's wager, where he argues that it is more rational to wager on God's existence because the possible payout is infinite and the consequences, if wrong, are miniscule. Whereas the medieval theologian believed in God because of rational demonstration, Pascal asked his contemporaries to place an uncertain wager on God's existence, just as a gambler would risk money at a gaming table.

The second stage occurs when probability changes the way Christians think about the world. Despite an inherent distrust in the role of chance, it cannot be escaped in the modern world; chance, probability, and risk impact almost every facet of our lives, from medical testing, insurance, to following our favorite baseball teams. The emergence of probability also influences the way people understand themselves. The emergence of probability and statistics created the idea of a "normal" or "average" individual in the nineteenth century. Students are tested in school because the normal curve can represent almost everything, from intelligence to agricultural yields (Gigerenzer et al. 1989, xiv).

Despite the prevalence of probabilistic reasoning in the modern world, one need not accept indeterminism for probability to have theological consequences. For many in the West, probability theory instead reinforces the

view of nature that emerged in the scientific revolution, where everything is governed by natural law. The probabilistic revolution went hand in hand with the mechanical philosophy that emerged in the seventeenth century and was, in the judgment of the historian Ian Hacking, a precondition for it (1990, 3). The mechanical worldview helped philosophers to see that the world runs through laws that could be characterized mathematically and to look for underlying regularities in nature. Whereas Aristotelian science encouraged philosophers to perceive each object in nature as having its own essential nature, the mechanical philosophy encouraged many to see the natural world as composed of homogenous matter. This conceptual change is needed for probability; to collect statistics of human societies requires the “belief in the existence of homogeneous categories of people to which the regularities apply” (Daston 2008, 7).

The discovery of laws of chance had theological consequences, therefore, by reinforcing the image of the world as full of stable regularities. Scholars have long pointed to the mechanical worldview as leading to a renewed emphasis on God’s general providence, which rules the world through universal laws rather than miraculous intervention. Probability theorists could likewise discern patterns and make predictions in astonishing ways, revealing regularities in the world that were assumed to be natural. Chance in the premodern mind was something individual, happening to particular persons at particular times. But in the modern world, chance applies to populations, which means the behavior of many individuals grouped together can be predictable.

Stable regularities in the social realm raise moral questions. As Daston explains, “How could the suicide of say, Goethe’s young Werther really be his own decision, if the suicide rates remained constant for decades on end?” (2008, 8). It likewise raises theological questions. Is God really making decisions on a case-by-case basis, as Calvin’s theology suggests? If God’s actions mirror the outcomes of chance in a vast majority of cases, why believe that each event in the world results from the special intervention of God? One might still hold on to the doctrine of the sovereignty of God, but Calvin’s picture of God as an energetic deity controlling every micro-event in the world seems implausible. The divine will is thus not as accessible in the natural world for many Christians today as it was for their Christian and Israelite ancestors who cast lots. Christians today do not throw dice as a way to receive an answer to prayer because they, at least implicitly, believe the coin flip is governed by the law of large numbers.

## CONCLUSION

As the sociologist Anthony Giddens has argued, “To live in the universe of high modernity is to live in an environment of chance and risk” (1991, 109). This does not mean unexpected events did not happen to our

predecessors or that they did not generalize about the future based upon their own experiences. Rather, moderns perceive the future in ways that Augustine, Aquinas, and Calvin could not conceive because our ability to quantify chance has transformed our ideas about the universe and human nature. This article has explored how ideas about chance have changed over time, from the casting of lots in the Old Testament to the emergence of modern views of chance in the nineteenth and twentieth centuries. By recounting the views of three influential theologians, I showed why most Christian theologians see chance as antithetical to Christian views of divine providence.

This is not to say all theologies of providence are untenable in the modern period. The mistake of premodern theologians was to argue that purpose and chance are mutually exclusive; each event in the world could be neatly divided into two categories, with the outcome either chosen by a purposeful intelligence or pure happenstance. The discovery of statistical laws challenges this picture by showing how chance and predictability are often intertwined. If this is the case, theologians can offer more nuanced accounts of God's relationship to the world. As the statistician David Bartholomew has argued, there may be theological reasons for God to have used randomness as a strategy for creating the world (1984, 2008). The extent to which such arguments will succeed against the consensus of the Christian tradition remains an open question.

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