Articles

NATURAL LAW AND DIVINE ACTION: THE SEARCH FOR AN EXPANDED THEORY OF CAUSATION

by Philip Clayton

Abstract. Talk of divine action faces its greatest obstacle when it confronts natural law and efficient causation. If all valid explanations involve deterministic laws, and only microphysical causes actively trigger change, claims for divine action can serve no explanatory role. But science does not in fact require the limitation to downwardly deterministic laws and efficient causes. Evidence supports the existence of emergent systems of phenomena, which, though dependent on physical law, also display emergent causal powers not reducible to their subvenient systems. Careful study of top-down causation in biology and of mental causation in psychology offers analogies that are helpful for making sense of the notion of divine action. Theists' ascription of a causal role to God cannot be proven from science or identified with scientific forms of causality. Nevertheless, if the emergence hypothesis is correct, theistic explanations do not need to conflict with science, and a plausible model of divine influence may even be derived from emergent causation. In this article I offer an expanded theory of causation that reduces the distance between two types of causal forces that are often held to be incommensurable.

Keywords: determinism; divine action; emergence theory; evolution; mental causes; miracles; natural law; presumption of naturalism; quantum physics; theory of causation; top-down causes.

Physical science, it appears, leaves no place for divine action. To do science is to presuppose that the universe is a closed physical system, that interactions are regular and lawlike, that all causal histories can be traced,

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and that anomalies will ultimately have physical explanations. Traditional assertions that God acts in the world conflict with all four of these conditions: they presuppose that the universe is open, that God acts from time to time according to particular purposes, that the ultimate source and explanation of these actions is the divine will, and that no earthly account would ever suffice to explain God's intentions.

Moreover, one faces a certain threat of equivocation when one speaks of both God and physical objects as *causes*. Perhaps the meaning of cause used of a chemical catalyst and of God's upholding the universe diverges so widely that the same notion should not be used to express both claims. Only if one can provide some broader account of what features chemicals and providence share in common as causes can one make sense of Jewish, Christian, and Muslim claims for divine action in the world.

The problem of divine agency is therefore one of the most pressing challenges theists face in an age of science. Christians and Muslims in particular traditionally have been committed to a robust account of the actions of God or Allah within the natural order. But how can one attribute events to the causal activity of God when science is based on the assumption that any given event is part of a closed system of natural causes? What conceptual framework might allow believers to acknowledge the power of science without reducing the divine to a "God of the [few remaining] gaps" or to utter passivity? I assume, because one can hardly deny, that science has been massively successful in explaining events in the natural world. What causes most of the effects we observe in chemistry and physics is not up for grabs, and well-attested scientific explanations are not just one story among the rest. This is not to deny that scientific conclusions are always preliminary; they remain open to revision, and some will be falsified. Still, the fact that a given theory will possibly be revised in the future does not imply that it stands on the same level as all other accounts of the phenomena on the market today (Clayton 1997).

Questioning Determinism and Causal Closure

The problem is not just that science has a preference for non-divine causes. Far more serious, many have argued that the physical sciences presuppose the principle of *causal closure*. A core principle of physics is the principle of the conservation of energy: in classical physics predicting the dynamics of physical systems presupposes that the total energy of the system remains constant. (Of course, thermodynamics allows for calculating the evolution of systems that are far from thermodynamic equilibrium.) It is still standardly assumed that the total energy of the universe remains constant, although there are cosmological models that do not make this assumption. If one cannot establish values for the increase or decrease of energy in a system, one cannot compute many of its fundamental physical parameters and behaviors.

Combine these various requirements and one has the principle of causal or physical determinism. As William James notes, determinism "professes that those parts of the universe already laid down absolutely appoint and decree what other parts shall be. The future has no ambiguous possibilities hidden in its womb: the part we call the present is compatible with only one totality" (James 1956, 150). This determinism of physical causes involves the claim that the physical state of the world at a given time determines the physical state of the world for all future times. It is thus a *modal* notion, because it denies that it is physically possible that the present state of the world should give rise to more than one future state of affairs (Brighouse 1997).

Physical determinism is fundamentally a claim about causality—that all that happens is a necessary effect of antecedent efficient causes. At the same time, it claims that all physical occurrences are lawful: the universe is such that a given set of physical events can give rise to only one successor set. All versions of determinism accept the ontological thesis that the state of the universe up to and including the present time t determines the universe's state in subsequent moments. Obviously, if what happens at $t+1$ is determined by the physical state of the world at t, no place remains for divine action.

The challenge for theists is compounded by the fact that the ontological thesis usually begets an epistemological thesis: that future states could be predicted if one had enough knowledge of the past and present. Its most famous version is Laplace's thesis that all future and past events could be predicted from a complete knowledge of the present:

> An intelligence which knows at a given instant all forces acting in nature, as well as the momentary positions of all things of which the universe consists, would be able to comprehend the motions of the largest bodies of the world and those of the smallest atoms in one single formula, provided it were powerful enough to subject all data to analysis. To it, nothing would be uncertain; both future and past would be present before its eyes. (quoted in Margenau 1968, 3)[1]

Through their (often tacit) appeal to this epistemological thesis, debates about determinism frequently turn into debates about what is physically possible, leading to another set of challenges to theists. It is *physically possible*, in a broad sense of this term, that a divine agent exists—a being with no body who is utterly separate from this world. It seems, however, that the actions of such an agent could not be scientifically known, because all the scientific observer would detect would be anomalies in causal sequences in the physical world. In a stricter interpretation of the term, the existence of a divine being is not just unknowable but physically impossible, because God is not a physical thing. If the strict interpretation is correct, theism and physicalism are incompatible.

I argue that physics does not *require* either of these interpretations. Nonetheless, modern science has generally presupposed one or the other, and by and large the stricter view has predominated.

It is on these grounds, for example, that the "new synthesis" in evolutionary biology is often taken to represent a serious challenge to theism. Evolution requires that no outside causal force be responsible for the development of more complex systems and life forms; random genetic variation and selective retention through the environment are, strictly speaking, the only allowable causal determinants of the evolutionary process. For its part, theism requires that the development of life be intended by God, so that God is in some sense responsible for the outcome. Some Christian biologists, most notably Arthur Peacocke, have argued that God could have initiated a process of cosmic evolution that God knew would lead to the development of conscious life without anything further being required on God's part (Peacocke 2000, 35). But this response faces a serious dilemma. Either the development of life would have to be a necessary consequence of the Big Bang (which does not seem likely, given the quantum uncertainties involved), or God would have had to be ready to intervene, and perhaps actually *have* intervened, in order to bring about conscious life and to preserve it once it existed (which would contradict the hands-off position). Initially, at least, it looks like a standoff, such that evolution is incompatible with theism, and divine providence—God's action in the world subsequent to creation—is incompatible with evolution.

Needed: A New Theory of Causation

The challenge I have just sketched requires theologians to do some fundamental rethinking on the topic of divine action. The inherited tools and concepts are not adequate to make sense of divine action in an age of science. The theologian seems to be faced with a forced choice between two alternatives: either God acts as the Divine Architect only, creating a finely tuned machine and leaving it to function in a consistent manner expressive of its Designer, or God becomes the Divine Repairman, whose imperfect building of the machine in the first place requires him to return from time to time to fix errors he made the first time around. Though perhaps not impossible, it is certainly difficult to develop an alternative perspective that allows one to speak of a "different but epistemically equal" system of divine causes, alongside the network of scientific explanations, that is equally constitutive of physical events in the world.

Many attempts have been made to respond to this challenge. Some have found an opening in quantum indeterminacy. Perhaps, they argue, the physical world is fully lawlike and even physically closed (that is, the total amount of energy remains constant). But quantum physics, at least on the Copenhagen interpretation, reveals a world that is both law-governed and ontologically indeterminate: unobserved subatomic events do not have a precise location and momentum, and probabilistic laws leave some room for chance.

How much of an opening does quantum physics create for divine action? It does seem significant that quantum mechanics allows for multiple outcomes given the same initial conditions, insofar as this fact leaves room in principle for top-down influences. Still, "stochastic" or probabilistic laws are still laws. Perhaps they do not determine each individual case, but they do reflect a physical pattern that pertains to the overall system. Also, the laws say nothing about agents, much less free agents; hence, they cannot themselves provide the stronger sense of counterfactual free action that theists appear to need to make the case for divine action.

This lack has led some to set strongly dualist notions of mental causation over against the world of physical causes. Among these nonphysical types of causation are the "agent causation" of Richard Taylor (1973) and the ubiquitous divine causation ("double agency") of Austin Farrer (1967). Such approaches posit mental or divine causes that affect outcomes without introducing new energy into the physical world. Certainly views of this sort leave room for full human and divine agency. Unfortunately, they do not integrate easily with physical science as we now know it, and some versions actually contradict physical descriptions of the world.

What then of human agency? Do humans not enjoy freedom of will: "The stick moves the stone and is moved by the hand, which again is moved by the man" (*Physica* 256a, in Aristotle 1984, 1:427; cf. O'Connor 1995)? Theists have often argued that as long as humans are free, God could act in the world. After all, if humans can break the chain of physical causality, could not God do so all the more? But free will may be less of a trump card than it appears. The dominant view within philosophy has been *compatibilism*, the view that physical determinism is compatible with human agency and moral responsibility (see Hudson 1994).[2] The American legal system, for example, holds individuals responsible if they will and then carry out an illegal action (say, murder), even if the willing was determined by prior causes. According to compatibilism, the actions of agents express their character traits; it is irrelevant whether these traits, and consequently the actions themselves, are determined by antecedent causes. Perhaps the sense of being free is just mistaken; after all, even a fully determined will could still imagine itself (falsely) to be free. Finally, many scientists argue that neuroscience presupposes—and some would argue that it has already proven—that the only causal agency is physical; aside from brain states and the body's responses, there *is* no "actor" to be found.

Clearly, it is an urgent task for theologians to provide a clear account of what they mean when they assert that God acts as a causal force within the world. To succeed at this task we need nothing less than a new theory of causation. In this essay I offer a first sketch of such a theory. The argument presupposes that dualism is mistaken and seeks to show that, nonetheless, not all causes are physical causes.

The argument has three main parts. I first concede that the threat of equivocation cannot be overcome as long as one's theory of causality includes only physical and divine causes; the gap is just too wide. By contrast, if we find evidence within the natural world of vastly different types of causes, one can perhaps extend the line to include supernatural causal influences as well. The study of the natural world does in fact reveal rather different types of causal action, from classical Newtonian causality to gravity to the influence of quantum fields to the "holistic constraints" found in integrated systems—and on to the pervasive role of mental causes in human life, as in your comprehension of the sentence, "Please stop reading this sentence!"

The objection then arises: Are not all natural causal forces ultimately explainable in terms of the laws of the underlying physical reality—unlike divine causes, which are said to issue from a transcendent and free source? In the following sections I marshal the diverse evidence and arguments that point beyond classical notions of physical causality. Taken together, they now encourage us to accept that the category *cause* includes types of influences other than mechanistic ones.

The final section draws together the results of the earlier sections in support of a systematic theory of divine action. Emergent causal levels, reflecting the hierarchical structure of the natural world, help to elucidate the nature of divine action, though they are not identical to it. The differences between natural and supernatural causation that remain do represent a continuing burden to theists in an age of science. Given an adequately broad theory of causation, however, the burden may be bearable.

This is a high-stakes debate for contemporary theists. Traditional formulations remain attractive, but they face conceptual objections that some fear are insuperable. Can a scientifically acceptable concept of emergence be developed that will reenchant the world, allowing us to speak of it again as the ongoing handiwork of God? If so, what might this theology in a new key look like? Can we again find a way to affirm the divine, as Wordsworth once did, in "the light of setting suns, / And the round ocean and the living air, / And the blue sky, and in the mind of man"?

The Framework of Emergence

Experts have identified as many as twenty-eight levels of emergence (Morowitz 2002). For simplicity's sake, however, one could speak of four major transitions in the natural world that evidence the phenomenon of emergence: (1) quantum physics to macrophysical systems and chemistry; (2) chemistry to complex biological organisms and ecosystems; (3) the brain and central nervous system to the phenomena of consciousness, or mind; and (4) the emergence of spirit within the natural order, including the question of its ultimate nature and origin. Scientists and philosophers will be able to understand the emergence of life, mind, and spirit only if

they succeed in developing a broader conception of causal influence based on emergent levels in the natural world. That broader theory of causality, *mutatis mutandis*, can in turn contribute toward a more adequate notion of God's causal activity in the world.

As a first step in formulating a constructive theory of causality, recall the early stages in the development of the concept of emergence. Aristotle's biological research led him to posit a principle of growth within organisms that was responsible for the qualities or form that would latter emerge. Aristotle called this principle the *entelechy*, the internal principle of growth and perfection that directed the organism to actualize the qualities that it contained in a merely potential state. On this view, the adult form of the animal or human being *emerges out of* its youthful form. Aristotle insisted that at least four different kinds of cause are necessary to explain this emergence: *material* causes, or the ways that the matter of a thing affects it; *formal* causes, which operate through the form internal to the organism; *efficient* causes, which work between objects to move or change them; and *final* causes, which pull the organism, as it were, toward its final *telos*, or perfection.

Aristotle's influence on Hellenistic, Islamic, and Western medieval philosophy cannot be overstated. Through Thomas Aquinas, who directly adopted his theory of the four causes (*Summa Theologia*, Q44, A1–4), Aristotle was brought into the center of Roman Catholic theology, a place he continues to occupy among conscious and unconscious Thomists to the present day. Aquinas insisted that every event involved not only the efficient cause (what physicists would speak of today as *the* cause of an occurrence) but also the formal and material causes, that is, the influence of the matter and the form on the outcome. Baptizing Aristotle's theory of final causes, he introduced the notion of the overall purpose of God as one of the causal forces in every event, thereby making divine causal action a component in every action. Aristotle—or, more generally, Greek natural philosophy—also remained surprisingly dominant in early modern medicine, biology, and geology. In fact, biology was in many respects still under the influence of something very like this paradigm when Darwin began his work.

It is true that some contemporary theologians have attempted to preserve something like this final type of causality. One of the most sophisticated representatives is Wolfhart Pannenberg. In *Theology and the Kingdom of God* (1969, chap. 4) he adopts something like Aristotelian final causality, speaking of the power of the future as a causal constituent in every event (cf. Clayton 1985; 1988b). A similar adaptation or version of final causality is visible in Lewis Ford's "lure" of the future (1978), a notion that he adapts from Whitehead. Thomistic overtones also can be heard in theories of divine action that distinguish between primary and secondary causality—indirectly in the work of Austin Farrer (1967) and more directly in

the writings of David Burrell (1986; 1990). Such defenses of future causality in one guise or another cannot quickly be dismissed as metaphysical nonstarters.[3] Nonetheless, they have not won broad acceptance, presumably because modern scientific practice was in many ways defined by means of its exclusion of final or future causes from valid scientific theories.[4]

When science was still natural philosophy, emergence played a productive heuristic role. After about 1850, however, emergence theories were several times imposed unscientifically as a metaphysical framework in ways that blocked empirical work. Key examples include the neo-vitalists (e.g., H. Driesch's theory of entelechies) and neo-idealist theories of the interconnections of all living things (e.g., Bradley's theory of internal relations) around the turn of the last century, as well as the speculations of some of the British emergentists in the 1920s concerning the nature of mind. From these mistakes one can derive criteria for the use of emergence and some cautions concerning its misuse. Above all, speculation must never *replace* empirical science; it supplements it when broader questions are being raised. The concept of emergence is useful not as a metaphysic imposed on the sciences from the outside but as an inductive result that emerges out of a careful study of the sciences themselves.

Building the Case: Quantum Mechanics and the Question of Causation

It often is said that the development of quantum mechanics has transformed our understanding of the causal connections in the world. In one sense this is true: quantum physics countenances types of causal influence utterly foreign to Newtonian physics. In another sense, quantum physics does not genuinely move beyond the framework of physical causes in a way that helps to solve the puzzle of divine causal action—at least not until it is supplemented by a broader theory of emergence.

Consider, for example, the position of Werner Heisenberg (1962), who explained the Copenhagen interpretation by taking something like an Aristotelian view of quantum mechanics, according to which potentials are not fully actual but require the agency of an actual observer to become concrete. On this interpretation of the collapse of the wave function the observer acts as a sort of final cause, pulling a certain potential state into actual existence. Note that this view reverses the standpoint of classical (Newtonian) physics, which requires that the subject ultimately be explained in terms of physical laws.

For the Copenhagen theorists in general, when a definite measurement is made of a quantum system, the resulting macrophysical state results from two things: the preexisting quantum-physical probability distribution and the scientist's decision of what, when, and how to measure. Indeed, on this view the subject's role is in one sense the primary one: the

"world" is merely potential until the moment of observation, at which time the conscious observer resolves it into an actual state. The most extreme form of this position, propounded in some of John Wheeler's writings, holds that the entire universe may have existed in a state of quantum potentiality until the moment when the first observer emerged, at which point the universe was *retroactively* resolved into macrophysical structures such as stars and planets. At one point Wheeler even applied this logic backward as far as the creation of the universe:

> Is the very mechanism for the universe to come into being meaningless or unworkable or both unless the universe is guaranteed to produce life, consciousness and observership somewhere and for some little time in its history-to-be? The quantum principle shows that there is a sense in which what the observer will do in the future defines what happens in the past—even in a past so remote that life did not then exist, and shows even more, that "observership" is a prerequisite for any useful version of "reality." (quoted in Davies 1980, 126)

The debate between the various interpretations of quantum mechanics has not yet been resolved; indeed, there is reason to wonder whether it could ever be resolved physically. It is therefore in part a philosophical debate and, as it turns out, deeply influenced by metaphysical assumptions about causality. Interpretations pull in several different directions. Those who insist that explanations of the world be given exclusively in terms of physical causes strongly resist the Copenhagen interpretation, which depends in part on the causal activity of a conscious observer—even if abandoning Copenhagen means a massive loss of parsimony. It may *seem* like ontological exuberance of the worst sort to assert, with Bryce DeWitt, that "our universe must be viewed as constantly splitting into a stupendous number of branches" and that "every quantum transition taking place on every star, in every galaxy, in every remote corner of the universe is splitting our local world into myriads of copies of itself" (quoted in Davies 1980, 136; cf. DeWitt and Graham 1973). But many have held that the many-worlds theories represent a cost one should be willing to pay if it turns out that they are the only way to interpret quantum mechanics in terms of physical causes alone, so strong is their commitment to avoid appeals to observer- or intention-based (that is, final) causes.[5]

But what about the everyday evidence that subjects *do* play an irreducible part in the causal chain? This evidence inclines one to interpret the collapse of the wave function in the measurement event as a sign of the causal role of the observer—as a number of its leading theorists have in fact maintained. Instead of multiplying worlds unnecessarily, these theorists argue, one should see quantum mechanics as a (the?) point at which the explanatory story begins to require nonphysical, or even mental, causes. Thus, the quantum physicist Carl Friedrich von Weizsäcker (1952) argued that quantum physics was a sort of vindication of Kant's dualism, his sharp separation between the kingdom of causes and the kingdom of means and

ends. This was also the view taken by Eugene Wigner and his followers. Wigner used the quantum revolution to argue that "the minds of sentient beings occupy a central role in the laws of nature and in the organization of the universe, for it is precisely when the information about an observation enters the consciousness of an observer that the superposition of waves actually collapses into reality" (quoted in Davies 1980, 132). Interestingly, one of Roger Penrose's arguments against many-worlds theories also appeals to subject-based considerations. He calls them "zombie theories of the world" because "I feel particularly uncomfortable about my friends having all (presumably) disappeared down different branches of the universe, leaving me with nothing but unconscious zombies to talk to!" (Penrose 1979, 595). Penrose insists that one needs an adequate theory of consciousness *before* one can make sense of the many-worlds interpretation, at least in its many-minds forms.

Now, there also are serious objections to observer-based interpretations of quantum mechanics, objections that draw out its counterintuitive nature.[6] But the fact is that during most of the twentieth century physicists found themselves forced to entertain very un-Newtonlike forms of causality, including essentially nonphysical causes, in order to explain the anomalies of the quantum world. Indeed, quantum physics has recently challenged classical notions of causality in yet another way. "Entangled particles" are particles emitted from a common source that preserve certain symmetries even when widely separated in space. For example, measuring the spin of one entangled particle will instantaneously cause the other to exhibit the corresponding opposite spin, even if the two particles are 10 km apart at the instant of measurement. Because no causal influence can be propagated faster than the speed of light, these results suggest a radically new type of influence or connection.[7] So-called entanglement phenomena have been cited, for example, as evidence for holistic conclusions. Even mainline physicists such as Henry Stapp find in them signs of an overarching interconnection of all things:

> The principle of local causes asserts that what happens in one spacetime region is approximately independent of variables subject to the control of an experimenter in a far-away spacelike-separated region. . . . The statistical predictions from which this result follows . . . have been experimentally tested and confirmed. Bell's theorem shows that no theory of reality compatible with quantum theory can allow the spatially separated parts of reality to be independent. (Stapp 1977, 314)

In a more extreme vein, Stapp's comments have led Ken Wilber to claim that entanglement experiments provide increased justification for the holism of the Eastern traditions:

> It is common among the "new-paradigm" thinkers to claim that the basic problem with science is that, under the "Newtonian-Cartesian" worldview, the universe is viewed as atomistic, mechanistic, divided, and fragmented, whereas the new sciences (quantum/relativistic and systems/complexity theory) have shown that the

world is not a collection of atomistic fragments but an inseparable web of relations. This "web-of-life" view, they claim, is compatible with traditional spiritual worldviews, and thus this "new paradigm" will usher in the new quantum self and quantum society, a holistic and healing worldview disclosed by science itself. . . . The problem, in other words, was not that the scientific worldview was atomistic instead of holistic, because it was basically and generally holistic from the start. No, the problem was that it was a thoroughly *flatland holism*. It was not a holism that actually included all of the interior realms of the I and the WE (including the eye of contemplation). (Wilber 1998, 38, 57)[8]

Wilber's speculations go far beyond what most physicists would be willing to conclude. Still, the founders of quantum mechanics were the first to stress that whatever ontology will finally do justice to the results and theories of quantum physics will be radically different from the everyday picture of reality that we are used to in the macrophysical world and, for that matter, in traditional philosophy. Clearly quantum physics requires some radical rethinking of inherited notions of causality in science.

Psychological Causes

Classical physics holds that all causal forces ultimately are explainable in terms of the laws of the underlying physical reality. If this view is correct, it raises insuperable problems for any appeals to divine causes, since they are said to issue from a transcendent and free source. But there is another area of science, in addition to the one just examined, that suggests the inadequacy of reductionist physicalism. If there are genuinely psychological causes, there is at least one type of causality that stretches beyond physical causality. It would then appear that the genus *cause* may include species of influences that cannot finally be parsed in terms of physics.

I have already noted the four major transitions in the natural world that evidence the phenomenon of emergence. In the case of the emergence of consciousness from the human brain and central nervous system the evidence for another form of causality is perhaps intuitively the most compelling. Obviously the social sciences (psychology, sociology, anthropology, and so on) assume that human beings are causal agents and that our thoughts, wishes, and intentions make a difference in the world. But in the last few decades the natural sciences of the human person—neurobiology, primatology, cognitive science, and evolutionary psychology—also have begun to acknowledge the realm of the mental as an emergent phenomenon. The main difficulty today, I suggest, no longer lies in showing the irreducibility of mental phenomena to physical laws but rather in demonstrating that mental phenomena can have "downward" causal effects on the body and the world (which will be necessary if one is to speak of God's effects on the world).

What emerges in the human case may not be a separate mind or soul. Instead, it is a particular *psychosomatic unity*, an organism that can do things both mentally and physically. Although mental functions supervene upon

physiological structures, mental and physical attributes are interconnected and exhibit causal influences in both directions (Clayton 2000; 2004). To say that human beings are psychosomatic unities is to say that we are complexly patterned entities within the world who evidence diverse sets of properties and causes operating at different levels of complexity. A living body and a functioning brain are *necessary* conditions for personhood, yet the irreducible gap between the third-person vocabularies of the neurosciences and the first-person vocabularies of psychology and intuition suggests that they are not *sufficient* conditions. Personhood is not fully translatable into "lower-level" terms; persons evidence causal and phenomenological properties (qualia) that are uniquely personal.

Studies of the human person must be multidimensional because persons are the result of causal influences that operate at the physical, biological, psychological, and perhaps spiritual levels—levels that, although interdependent, are not mutually reducible. In particular, psychology does not need to be at war with the experience of human actors in the world on the question of mental causation: there are genuine mental causes that are not themselves reducible to the physical systems on which they depend. As Theo Meyering writes, "macro- and micro-causes may be simultaneously operative at various levels of reality without mutual causal rivalry and thus without necessarily excluding each other" (2000, 199). The causal history of the mental cannot be told in physical terms alone because the outcome of mental events is not fully determined by phenomena at the physical level. The subjective states of experiencing joy or being self-conscious have an irreducibly mental component; such phenomena exercise a type of causal influence that includes but is also more than the physical and biological states on which they supervene.

Now, the critic may object that talk of mental causes is like returning to occult causes in the physical world or vitalist causes in the biological world. But science stopped appealing to such causes because of the recognition that the realms of physics and biology operate in a fully lawlike manner, a recognition derived directly from explanatory successes in these sciences. Is it true that human beings are analogous to rocks and cells, that their behaviors can be exhaustively predicted and explained in a bottom-up manner? I have argued that we have good evidence to think not. Indeed, the hierarchy of the sciences itself offers evidence of principles that are increasingly divergent from bottom-up physical causality (see Peacocke 1993). Causal explanations based on selection pressures play a role in the biological sciences (from cell structures through neural systems to ecosystem studies) that is different from the causal explanations of fundamental physics, just as explanations appealing to intentions as causes play a role in explaining human behavior that is without analogy at the level of cell biology.[9] Top-down causal effects are present at multiple levels, though the nature of the wholes that influence the behavior of parts varies across the levels.

The structure of DNA, for example, contains a record of the top-down action of the environment on cells and organisms through evolutionary history, and gene expression is environmentally influenced throughout ontogenesis. Similarly, in all intentional systems such as human action, the goals in light of which agents act and interpret their actions must be said to have a causal influence on their actions.

Double Agency and Divine Persuasion

Our argument to this point has important implications for theologians. It suggests that divine-action claims are not equally defensible at all levels of the natural world. Claims that there may have been a divine influence in causal histories involving intentional agents must be assessed differently than claims that God has altered a purely physical chain of events. To maintain that God influences human moral intuitions and religious aspirations is more plausible than to argue that God fixed the broken plumbing system in one's house (unless one also called a plumber to do the repairs). One reason for the difference is that we do not now and may never possess laws of human behavior. In contrast to natural scientists, social scientists can at most ascertain broad patterns of human response, and even these evidence a virtually unlimited number of personal and cultural exceptions. Within the human realm, it seems, uniqueness and idiosyncracy are the norm. No laws are broken when we speak of an individual action in a nonstandard way; indeed, this is almost what we *mean* by an individual action! "Psychological miracles"—divine causal influence on the thought, will, and emotions of individual persons—could thus be frequent occurrences. If (and only if) downward mental causation is a viable notion, God could bring about changes in individuals' subjective dispositions without negating the laws that we know to hold in physics and biology.[10]

But what kind of causal influence would this be? The great British philosophical theologian Austin Farrer developed a sophisticated account of divine action that he called the double-agency view (Farrer 1959; cf. McLain and Richardson 1999). On this view, every action in the world includes a causal role for one or more agents or objects in the world (the secondary causes) and a role for God as the primary cause of what occurs. Kathryn Tanner summarizes and defends something like Farrer's position:

> The theologian talks of an ordered nexus of created causes and effects in a relation of total and immediate dependence upon divine agency. Two different orders of efficacy become evident: along a "horizontal" plane, an order of created causes and effects; along a "vertical" plane, the order whereby God founds the former. Predicates applied to created beings . . . can be understood to hold simply within the horizontal plane of relations among created beings. (1988, 89)

Such a view of action implies that God's action in the world should be understood as something more like divine persuasion. Responding to Tanner, Tom Tracy concludes,

There are, therefore, important respects in which the free acts of creatures can be regarded as God's acts. If we deny that God is the *sufficient cause* of the creature's free acts, we can immediately go on to affirm that God acts with the infinite resources of omnipotence to *guide* those choices by shaping the orienting conditions under which they are made. In untraceably many, varied, and subtle ways, God continuously brings to bear the pressure of the divine purpose for us without simply displacing our purposes for ourselves. God's action goes before our own, preparing us (in spite of ourselves) for the unsurpassably great good that God has promised us. (Tracy 1994, 101f.)

The approach I have taken does alter how God's causal agency is said to contribute to human actions in the world, at least in comparison to classical views of divine action. On most classical views, God's decision to bring about an effect in the world was taken to be sufficient for that effect to occur; no concurrence of any finite person or object was required. On this view, by contrast, God must persuade the agent in question to act in a particular way for the event to occur. This, again, implies a special role for mental causes, understood as instances of emergent causality within the natural world that are dependent on the causal laws of biology but not reducible to them. Intentional agents can be persuaded, whereas (as far as we know) rocks cannot be persuaded to act on their own, no matter how good the arguments. Though it limits the efficacy of the divine will in the world, I nonetheless believe that this position is sufficient to sustain a viable and scientifically acceptable form of theism for today.[11]

Consequently, theists do not need to imagine that God brings about human actions or physical events by divine fiat alone. Divine causality is better understood as a form of causal influence that prepares and persuades. On the one hand, this result makes it difficult to conceive a divine influence on rocks or other purely physical systems apart from the laws and initial conditions established by God at creation. On the other hand, it does continue to ascribe to God a crucial causal role in "luring" humanity and in influencing the interpersonal, moral, intellectual, and aesthetic dimensions of human personhood. The resulting position emphasizes the genuine openness in history. One cannot know in advance that God will bring about the ends that God desires to accomplish, although one can know that, if God is God, the final state of affairs will be consistent with God's nature (Pannenberg 1980). In all of these respects, the affinity of this view with process theology's understanding of the God-world relation is clearly visible (see Griffin 2001).

Evolution as a Test Case

Evolution represents a particularly difficult test case for this theory of divine causal influence. There is no point in lowering the bar at the outset in order to make things easier for theists: I take contemporary evolutionary theory as scientists actually teach it as the starting point. The standard model requires that the evolution of life be a product of a process of ran-

dom genetic mutation, where the environment selects for the fittest individuals. However, any theist who wishes to avoid deism must assert that God in some way guides the process of evolution to bring about the divine creative intent (conscious life, persons, salvation history).

In most of biological evolution conscious beings are not present to be influenced, so the type of causality defended in the previous paragraphs cannot be employed, at least not directly. But the recent synthesis of biology and information theory does open the door to an at least analogous type of causal influence. The dimension of information became central in biology following the discovery of the genetic code responsible for the informing of the cell and organism as a whole. Recent work has interpreted biological structures (morphology) and the organism's interaction with its environment as processes involving the storage, use, and exchange of information—a sort of cybernetic or semantic version of Aristotle's formal causes. Even nutrition has been construed as the ingestion of highly structured (informationally rich) matter with low-information energy as a by-product (Puddefoot 1996).

This thinking together of information and causality has several explanatory advantages. For example, it is necessary to combine the two concepts in order to make sense of epigenetic effects—top-down causal influences—in developmental and cell biology. The data now show that a two-way interaction occurs between the DNA of a cell and the cell as a whole. Since particular proteins in the cell function selectively to cause particular segments of the genome (that is, particular elements of genetic information) to be expressed, the determining influences are top-down as well as from below. In a similar manner, social behavioral studies in primatology show how the broader environment pervasively influences the development of the organism without contradicting genetics. The effects of broader systems or wholes are indispensable parts of the complete biological explanation. Thus, Steven J. Gould writes, "Minor adjustment within populations may be sequential and adaptive. . . . Evolutionary trends may represent a kind of higher-level selection upon essentially static species themselves, not the slow and steady alteration of a single large population through untold ages" (Gould 1980, 15).

The informational approach clearly opens up parallels with information processing in the sphere of mental activity. No biological laws are broken if complicated biological systems such as the brain give rise to emergent mental properties and if these properties in turn constrain brain functioning. Because much of cognitive activity concerns information retention, retrieval, and processing, it is natural to understand mental causation as involving the interplay of informational and biological causes. But the interplay of informational and biological causes does not occur only in thought; to take such a position would be to fall back into dualism rather than understanding mentality as emergent in complex biological systems.

In fact, wherever form or structure influences biological process—and such influences are pervasive in the biosphere—one can speak of informational causation (in the sense of Fred Dretske's [1993] "structuring causes" but not generally as "triggering causes").

Although I do not think that the scientific study of evolution provides evidence of final causality (pace Behe 1996), it does seem that informational or morphological factors play a role in causal explanations of evolutionary emergence. Developing forms, be they protein structures or anatomical structures, combine with genetic (bottom-up) and environmental (top-down) influences; together these three causal factors represent the three major determinants of biological evolution. The eye of faith may see final causality—ultimate purposes that pull the whole process toward its final telos—but scientific biology can neither confirm or deny such claims. Scientifically one can speak of the purposes and intentions of the various agents that evolve and act within the biosphere, but to speak of the purpose of the process as a whole always involves the transition to metaphysics or theology.

What of that transition? Once one has shown the compatibility of evolution and conscious mental causation, as I have attempted to do here, one can at least begin the process of attempting to reconcile evolution with theism. The first step in the argument was to establish sufficient parallels between downward causal influences in biology and mental causation so that the credibility of the latter could be established without recourse to a dualistic theory of mind. I argued that information theory in biology helps to accomplish this goal. The next step is to see if one can construe divine influence on psychological processes in a way that is analogous in some ways to mental influences on biological processes. Here, however, a greater degree of difference must be acknowledged. By definition, God cannot be just a cause alongside others in the natural world in the way that mental causes can. Nor does an infinite divine being belong to the finite causal order in the way that persons do. Nonetheless, the information model, understood within the framework of emergence theory, allows for divine causal constraints on the aspirations of persons in a way that does not abrogate the functioning of natural law. No physical laws are broken if there is an exchange of information between a divine source and conscious human agents. The type of influence is at least formally analogous to the chemical effects produced when an agent shifts her attention from one object to another—an everyday occurrence. By contrast, a direct divine intervention to change the chemistry of a cell would be a troubling miracle.

Toward a Theory of Emergent Causality

I attempt now to put these various resources together into a single theory of emergent causality. As a parameter, I accept the epistemic priority of

contemporary science as a source of justified explanations about the natural world. The challenge for this project stems from the fact that explanations in the physical sciences today depend primarily on efficient causation. That is, the success of modern science seems to have been based on its preference for explanations given in terms of traceable and reconstructible causal histories in the natural world. On the inherited view any talk of form, matter, or purpose becomes causal only when it is reduced to those activating forces that directly or immediately activate change in a physical object. A causal process is a linear chain of events, each of which causes its immediate successor.

The challenge that philosophers and theologians face is to sketch a new theory of causation. But how is one to reintroduce talk of formal and final causes alongside the efficient causes that are the bread and butter of modern science? The grounds and motivation for the argument must be based on the changes that have occurred as science has moved further and further from the once-regnant ideal of universal reduction to physics. Resources for the new approach can be found, inter alia, in entanglement phenomena in quantum mechanics, mental causes in psychology, information theory and epigenesis in biology, and the structure of emergence that appears again and again as one climbs the ladder of complexity in the natural world.

Causal relations *up* the emergent hierarchy are uncontroversial, since they rely on efficient causality. The slogan of earlier modern or Laplacian science might be expressed as "causes propagate upward; explanation, and hence ontology, reduces downward." The Laplacian model in scientific explanation involves explaining complex behaviors (or: the behavior of complex bodies) in terms of fundamental forces acting on their constituent parts. It might *look* mysterious that a cell can divide and divide again or the amoeba can engage in goal-directed behavior; but, once one has understood the biochemistry of cell division, the catalytic effect of enzymes, and the basic genetic architecture and functioning of the cell, no unanswered questions remain. The aggregation of these myriad physical particles and forces tells the complete causal history of cell functioning. With this bottom-up account in place, no other causal story is necessary. Or so it seemed.

Emergence, however, shows that upward propagation of causes is not the whole story. The state of the whole—the whole chemical system within which particles interact, the whole cell, the whole organism, the whole ecosystem, the brain as a whole—affects the behavior of the particles and the causal interactions that they have. Admittedly, some argue that no actual downward causal forces are involved. Carl Gillett maintains that "all individuals are constituted by, or identical to, micro-physical individuals, and all properties are realized by, or identical to, micro-physical properties" (2003, 28). Likewise, certain branches of complexity theory,

including complexity theorists such as John Holland (1998) who use the word *emergence*, also allow only upward causation, although they do grant that something new and unpredictable (at least in lower-level terms) emerges. We might speak of these positions as involving at most *weak emergence*, emergence without downward causation. By contrast, I have argued that the phenomena allow for, and may actually require, the notion of a downwardly propagating causal influence—a view that we might call *strong emergence*.

In this essay I began with the most compelling area, the relationship of the mental to the physical. To make the position as uncontroversial as possible, I have not posited a separately existing substance called *soul* or *mind*, only the existence of mental predicates. Physicalists construe mental phenomena as properties of a physical object, in this case the brain, the microphysical causal properties of which are sufficient to account for the effects that we call mentality. In opposition to the physicalist interpretation, I have argued that the explanatory power of mental causation—for example, the ability of our ideas and thoughts to cause bodily movements such as speaking, walking, or raising an arm—is great enough that the limitation of causal forces to the microphysical level is unjustified. The onus is on those who would deny any causal efficacy to the emergent level of mentality.

I then turned to the question of evolution. It seemed like a war to the finish: evolution appears incompatible with theism, and divine providence or action in the world seems incompatible with evolution. (Sadly, much of the public battle, at least in the United States, is still fought in these dichotomous terms.) One must ask: What is the rational response to a problem that cannot be solved either from the bottom alone (through genetics and biochemistry) or from the top alone (by negating biology and imposing a theological answer)? One looks for a means to bring several different disciplines together to solve the problem—not by making them identical (which is false) or treating them as incompatible (which is inadvisable) but by placing them in a dialectical relationship. Specifically, I suggested, the contradiction is overcome if what evolution demands and what theology requires are not contradictory but complementary. Indeed, the best overall explanation is obtained when one pursues this hypothesis.

Contemporary evolutionary theory excludes vital forces or causal influences from outside. Fortunately, theism requires only that the product of the evolutionary process reflect the divine intention to create rational, moral creatures who can be in conscious relationship with the divine. This might have occurred by God's initiating a process that God knew in advance would necessarily produce such creatures without the need for any further divine guidance, though the scientific picture today makes complete predetermination seem unlikely. In the case of evolution, however, it proved possible to find an analog to the downward causation that we experience

in conscious volition. According to the analog, God could guide the process of emergence through the introduction of new information (formal causality) and by holding out an ideal or image that could influence development without altering the mechanisms and structures that constrain evolution from the bottom up (final causality).

Certain caveats and limitations pertain to the argument. First, science cannot provide evidence for final causality; such language is irreducibly metaphysical or theological. Scientific explanations of biological phenomena still must be sought within the framework of evolutionary biology, and the conclusions and constraints of that discipline are not short-circuited by this response. Next, the framework of guided emergence will not amount to the sort of control of the evolutionary process traditionally defended by theists. Guidance via the informational content of the whole or the goals of conscious agents in the world—agents whose goals may go beyond the world as a whole—is not a form of efficient or determining causation; in the end it is closer to the luring nature of formal causes associated with Aristotelian philosophy. But it *is* sufficient to provide an updated version of what was once meant by divine providence, albeit without the omnipotence and predestination that often undergirded this doctrine.

Finally, the informational final causes that I have explored do not "prove God," for one still can do adequate science without introducing them. Advocates of intelligent design (Dembski 2004) or irreducible complexity (Behe 1996), by contrast, put forward evidence that they think should convince nontheistic scientists of the inadequacy of their position. In order to convey the epistemic ambiguity intended by my position, one might say that there is a quasi-purposiveness in nature. Elsewhere I have called this, following Kant, *purposiveness without purpose*. The Kantian parallel suggests viewing such assertions as having an as-if status: the biological world develops as if it were being guided by a divine hand. Of course, one may believe something more theologically and argue for more metaphysically. But for purposes of the discussion with science, all one needs to show is that scientific conclusions do not require one to speak of this guidance as a mere fiction, and this, I believe, the argument has accomplished.

NOTES

This essay is based on my book *Mind and Emergence* (Clayton 2004). An earlier draft appeared in *God, Life, and the Cosmos: Christian and Islamic Perspectives* (Peters, Iqbal, and Haz 2002). I am grateful to the editors of that book and to Ashgate, its publisher, for permission to publish this revised and expanded version of the chapter.

1. In popular writings it is sometimes assumed that scientists, who are not omniscient, will be able to predict the future if determinism is true. But chaos theory, the physics of systems far from thermodynamic equilibrium, now suggests that prediction will be impossible even in fully deterministic systems when they are chaotic.

2. Indeterminists, of course, deny this claim, arguing instead for genuine or counterfactual freedom: you did this action now, but you might have done something different even in identical circumstances. As Jean-Paul Sartre put it, "the indispensable and fundamental condition of all action is the freedom of the acting being" (1956, 436).

3. Thus, the critique of Pannenberg's future ontology as "counterintuitive" (Clayton 1988b, 650) must be taken as overly hasty.

4. Note that there are ways of introducing divine causal influence other than the Aristotelian-Thomist strategy; one thinks of theologies of process and theologies of emanation. The doctrine of emanation, at least in its most famous (Neoplatonic) form, defends the emergence of the entire hierarchy of being out of the One and the movement of finite beings back up the ladder of derivation to their ultimate source. This Neoplatonist model, of which orthodox theologians were always skeptical, allows for both a downward movement of differentiation and causality and an upward movement of increasing perfection. Ultimately, diminishing distance from the Source would lead (in principle) to a final mystical (re)unification with the One. Unlike static models of the world, emanation models allow for a fluid movement downward and upward through the various species as well as between the physical, psychological, and intellectual spheres. In those cases in which the emanation is understood in a temporal sense, as with Plotinus, the theory of emanation provides an important antecedent to doctrines of biological or universal evolution.

5. If the claims made on behalf of decoherence theories stand up to examination, much of the heated debate surrounding the Copenhagen interpretation will turn out to be moot; see, for example, Zurek 1991; 2002.

6. One objection imagines that a meter is set up to permanently register whether the radioactive particle has decayed at the end of one minute (assume an experimental setup in which there is a 50 percent probability of this occurring). Two photographs are then automatically taken of the meter reading, first photo A and then photo B. The photographs are developed, but no one looks at them. Imagine that ten years pass during which no subject observes either the meter or the photos. At the end of that time a subject looks at photo B and observes that the meter registers a radioactive decay. On Wigner's view, at that moment, but not before, the superposition of states will be collapsed, the particle will (retroactively) have decayed, the meter will (retroactively) register its decay, and photo A (which no one has yet looked at) will suddenly show a picture of the meter in its "on" position. Before that moment photo A was still indeterminate; the observation of photo B makes A determinate—despite the fact that A was taken *before* B!

7. Alternately, they might suggest a radically different type of object: a single object with two parts that remains one even when its parts are separated by vast distances.

8. When concepts such as these are fleshed out into the full form of the more radical Eastern mystics, the results can be startling: "The reason is that in quantum physics the elements are not physical themselves; they do not exist as objects. Their very existence depends on the idea of their existence beforehand. They are treated as 'tendencies to exist' rather than as already existing possibilities like the sides of a flipped coin. In the quantum world the quantum coin's sides do not appear unless someone calls for them to appear" (Wolf 1984, 17). And "thus we conclude that the 'new physics' introduces the element of consciousness into the material world. This consciousness will not arise from the molecule itself, as seen as a material unit, but will arise as a 'risk-taking' psyche—that is, one that chooses. These choices cannot be made willy-nilly. 'Reason' must begin to make its appearance, which surpasses the simple mechanism of cause and effect. We know that atoms do not follow the laws of cause and effect except statistically or on the average. To explain the evolution of learning, associative memory, and possibly even the more primitive forms of memory called habituation and sensitization, we must face the quantum. States of consciousness, feelings, emotional states, and psychology as a science may depend on the recognition that mind, the consciousness of the universe, arises through quantum physics" (Wolf 1984, 18–19).

9. These emerging orders of explanation also may involve an increasing role for top-down explanations. In intentional explanations it is even more clear that the goal for which the agent acts, or the broader context within which she understands her actions, influences the particular behaviors or thoughts.

10. Whether there is a God, and whether God in fact carries out these actions, are of course other questions that I do not seek to resolve here.

11. It remains metaphysically possible, of course, that a God who created the universe *could* bring about any effect within that universe that God might choose to accomplish. The position seeks merely to describe the standard mode of divine influence in the world.

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