CONTINGENCY IN PHYSICS AND COSMOLOGY: A CRITIQUE OF THE THEOLOGY OF WOLFHART PANNENBERG

by Robert John Russell

Abstract. The concept of contingency serves to bridge the doctrine of creation and natural science in Wolfhart Pannenberg's theology. My paper first analyzes the relation of *creatio ex nihilo* and *creatio continua*. Next I suggest three categories of contingency: global, local, and nomological. Under each category I assess Pannenberg's use of physics, cosmology, and philosophy of science. Although I agree with Pannenberg's emphasis on continuous creation and on the role of science in renewing the doctrine of creation, I argue for a shift in the discussion from Pannenberg's topics to others, such as the anthropic principle, quantum physics, and thermodynamics.

Keywords: anthropic principle; contingency; cosmology; creation; inertia.

> The existence of the world as a whole and of all its parts is contingent.
>
> Wolfhart Pannenberg

The concept of contingency serves as a critical bridge between the theological doctrine of creation and the scientific understanding of the universe in the theology of Wolfhart Pannenberg, and it has ramifications throughout his theological program. As he explicitly states in his provocative article "The Doctrine of Creation and Modern Science" (hereafter referred to as the "Doctrine"), "any contemporary discussion regarding theology and science should first focus on the question of what modern science, and especially modern physics, can say about the contingency of the world as a whole and of every part in it"

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(Pannenberg 1988, 9). The purpose of this paper is to begin such a discussion by probing Pannenberg's theological interest in contingency and then by evaluating Pannenberg's arguments for empirical contingency in terms of physics and cosmology. Although I will focus specifically on the "Doctrine," some reference to other works by Pannenberg will be introduced as appropriate.

While Pannenberg uses contingency in a variety of ways, for purposes of discussion they can be grouped into three categories: global, local, and nomological contingency. The first two involve *empirical as well as ontological* claims about the physical world as a whole and of each event in that whole. The third refers to the *laws* of nature and history, and in turn includes several kinds of contingency: as the presupposition behind, as well as a characteristic of, any scientific law; as the dependence of historical sequences on their term for meaning; and as the first instantiation of new types of sequences. A fourth basic category of contingency, the dependence of the present on the future as the being of God with its reversal of ontological priority, as well as the more general significance on nomological contingency in Pannenberg's entire theological program, would require a much more extended discussion than this paper affords.

In each case, however, the theological significance of contingency is the dependence of the world upon God and the challenges (and promises) that come from the natural sciences. I agree very strongly with Pannenberg's concern to reformulate the doctrine of creation to stress continuous creation and to uncover the role of science in offering the doctrine of creation new meanings although I believe this may require significant change in what is claimed theologically. My concern will be with Pannenberg's particular choice of areas in science. Specifically Pannenberg refers to "the beginning" when discussing global contingency and the principle of inertia when discussing local contingency. I would prefer to broaden and shift the areas in each case, arguing for the anthropic principle as one way to thematize global contingency and stressing quantum physics and thermodynamics as the paradigmatic areas for understanding local contingency. In addition, while Pannenberg gives a rich discussion of nomological contingency he does not fully explore its promising connections through physics and cosmology to local and global contingency.

Contingency and its Empirical Meaning as a Theological Issue

In the "Doctrine" Pannenberg's fundamental assertion is that ". . . the existence of the world as a whole and of all its parts is contingent. The existence of the whole world is contingent in the sense that it need not

exist at all. It owes its being to the free activity of divine creation. So does every part of the world" (Pannenberg 1988, 8). Here Pannenberg combines two assertions about the world: that the existence of the world as a whole and that the existence of all its parts is contingent. Each of these in turn has an empirical and an ontological meaning. Pannenberg then relates each claim to theology through the doctrine of creation and to science and the philosophy of science. First, then, what are the theological issues at stake?

The central affirmation of Jews and Christians is that the God who saves is the God who creates. In Christian theology the meaning of creation has been articulated through two broad models: *creatio ex nihilo* (creation out of nothing) and *creatio continua* (continuous creation). The *ex nihilo* model maintains that God is the source of all that is and that God's creative activity is free and purposeful. Being God's creation, the world as a whole is *contingent*; it need not be at all nor need it be the way it is. It is neither a part of God, an emanation from God's being, a necessary principle, nor a divine material order.

As the *ex nihilo* model stresses the absolute transcendence of God, the *continua* model emphasizes God's immanence in, and ever present relationship with, the processes and history of the world. God is seen as active in each moment bringing the world towards a future of ultimate completion and glorification. Although less developed than the *ex nihilo* tradition in church history, continuous creation theology is the older tradition and it clearly underscores the irreducible contingency of the world on God the creator.

In some periods of Christian thought the doctrine of creation was interpreted as a narrative history or cosmogony of the origin of the world: God created the world "in the beginning" out of nothing (*ex nihilo*). In this interpretation the continued existence of the world since its creation is the result of divine *conservation*: God sustaining, preserving, and governing the world. In the first half of this century, however, many neo-orthodox, liberal, and existentialist Protestant theologians turned to a strictly ontological, ahistorical interpretation of creation explicitly independent of *any* scientific meaning (such as Barth 1960, 3/2:3-19; Tillich [1951] 1967, 1:254; Gilkey 1959). For these thinkers the sheer existence of the universe is a sufficient datum for theology; scientific accounts of the universe are essentially irrelevant. On the other hand, physical cosmology and evolutionary biology do play an irreducible role in the discussion of *ex nihilo* among a few contemporary theologians and scientists. Typically these writers emphasize the value of the *continuous creation* tradition and explore its rich metaphors from biology, physics, and cosmology (e.g., Barbour 1966; Peacocke 1979).

Where does Pannenberg fit in all this theologically? Although the text in the "Doctrine" is tantalizingly brief (Pannenberg 1988, 8-9), Pannenberg begins with the assertion that the central affirmation of the doctrine of creation is the contingency of the world, and that contingency involves *both* the world as a whole and each part of it. The former, the contingency of the whole world, is clearly an assertion about *creatio ex nihilo*. The latter, the contingency of each part, could merely reflect the doctrine of providence or conservation, but Pannenberg does not stop there. Instead he asserts that creation and conservation are closely linked; in fact, since the doctrine of creation focuses upon each moment in time, conservation is actually a form of continuous creation. "The world was not just placed into existence once, at the beginning of all things, in such a way that it would have been left on its own afterwards. Rather, every creature is in need of conservation of its existence in every moment, and according to theological tradition such conservation is nothing else but a continuous creation. This means that the act of creation did not only take place in the beginning; it occurs at every moment" (Pannenberg 1988, 8). Hence, in my opinion, Pannenberg understands the doctrine of creation to include both *creatio ex nihilo* as the overarching concept and *creatio continua* as the description of creation in each moment.[1] What is most germane for this paper is that in Pannenberg's view these concepts share in common the concept of *contingency*.[2]

Moreover, as his discussions over inertia, field theory, temporal irreversibility, and other scientific topics show in this and other papers, Pannenberg clearly separates himself from those who reject *any* connection between theological and scientific language. In the "Doctrine" Pannenberg is particularly committed to interpreting the doctrine of creation in the light of modern science; hence, in opposition to strict neo-orthodoxy, liberal or existentialist thought, he wishes to find at least an indirect connection between the claims of creation theology and the insights of science.[3]

I believe this is an extremely valuable theological perspective. Pannenberg is moving to recover the tradition of continuous creation within the doctrine of creation, to identify contingency as a *common* element in both forms of creation theology, and to reappropriate a cosmological and scientific context for theological hermeneutics.

Yet, how fruitful is Pannenberg's particular choice of scientific topics and language in his discussion of the contingency of the world as a whole (global contingency) and the contingency of each part of the world (local contingency)? And how do these relate to the contingency of the laws of nature (nomological contingency)?

Global Contingency

I would grant that in a purely ontological hermeneutic for *ex nihilo* the relevance of science to theology would be lost, a situation which neither he nor I would find attractive. But does his particular thematization about "the beginning" best suit Pannenberg's commitment to finding a scientific framework for interpreting the global contingency of the world? To be direct, *does* science really support even metaphorical language about a "beginning" of the universe? Alternatively, are there more adequate ways to discuss global contingency within a scientific framework?

Did the world have a "beginning"? Although alternative cosmologies are continually being explored, most physics and astrophysics are done today in terms of a standard set of models arising out of Albert Einstein's general theory of relativity and collectively called Big Bang cosmology. These models all depict the universe as expanding from an initial explosion of enormous temperature and density some fifteen billion years ago, but they differ in their predictions for the future. In the "closed" model the expansion will slow down and will continue until the universe reaches a maximum size, after which contraction will begin until the universe is once again arbitrarily small, some 50 to 100 billion years from now. In the "open" model the universe will continue expanding forever, growing steadily colder and more dilute. In *both* models, however, the universe has a finite age. Does this then suggest a "beginning"?

It probably does not. Granted that in these scenarios all that is seems contingent on an initial starting point of unimaginable characteristics—an event of zero volume, infinite temperatures, infinite density, and infinite gravitational forces! Still many scientists take these infinities and other technical problems surrounding "t=0" as indicating a problem in the model and not necessarily as something fundamental about the universe. Hence, although Big Bang cosmology is extremely successful in giving coherence to a variety of scientific fields from solar physics to particle physics, one expects its eventual replacement by another model which deals more effectively with the very early universe and the problem of "t=0."

Inflationary models and theories in quantum gravity and superunification are being explored as promising alternatives.[4] For example, some of these theories predict that the universe never contracts to zero size in either past or future, but rather that it has "bounced" or "oscillated" throughout an infinite past and may continue to do so into the future forever.[5] In any case it would seem a contradiction in terms if on

the basis of science one could describe a state of the universe such as "t = 0" which was fundamentally uncaused.[6]

Yet even if science seemed to suggest that something radically unique occurred fifteen billion years ago, would it lend support to or provide an interpretive framework for a doctrine of creation "at the beginning"? In a carefully crafted statement Ernan McMullin gives a guarded yet very clever response: "What one *could* readily say, however, is that if the universe began in time through the act of a Creator, from our vantage point it would look something like the Big Bang that cosmologists are now talking about. What one cannot say is, first, that the Christian doctrine of creation 'supports' the Big Bang model, or second, that the Big Bang model 'supports' the Christian doctrine of creation" (McMullin 1981, 39).

Pannenberg could be read as wanting just that kind of support, especially given his language about creation "at the beginning"; if so, the case would have to be made in much more detail. Still I strongly share his concern that theology and science be related in some measure. If the meaning of creation is *entirely* restricted (constricted!) to an ontological relation between God and the world as much of contemporary theology has argued, the relevance of *any* physical cosmology to theology is lost. Hence, although Pannenberg's choice of language about creation "at the beginning" could present problems both in terms of scientific cosmology, if it were taken outside its highly contextualized meaning in general relativity, and for the doctrine of creation, if *ex nihilo* were restricted to "the beginning," I do not believe Pannenberg wants to argue forcefully in this way.[7] I believe he is attempting in a more general way to find some empirical significance for the doctrine of creation and this goal is extremely important. It is in this vein that I would suggest an alternative candidate for the scientific *thematization* of global contingency.

Why does this *universe exist?* Cosmology may provide an alternative formulation of Pannenberg's concern for the global contingency of the universe. Some scientists insist that the existence of *this* universe is intimately related to the particular laws which govern it, to its specific physical character, and to the evolution of life. These ideas have been taken up in one or another fashion in the anthropic principle (Carter 1974, 291; Barrow & Tipler 1986).

In the weak form of the anthropic principle one asks why we are living approximately fifteen billion years after the Big Bang. Why not five billion or twenty-five billion, or perhaps five million? Actually the answer to this turns out to be simple, although it is only possible given the remarkable range of discoveries in our century subsumed into

contemporary cosmology. We now understand that it took approximately fifteen billion years for the universe to cool, for galaxies to form, for the first generation of stars to evolve and go supernova thus producing the heavy elements and scattering them to where new second generation stellar systems were being born, for those systems to produce planets, and finally for biological evolution to work another four to five billion years before, in the case of our planet, homo sapiens evolved. So our placement in *this* universe is not surprising.

However, the principle can be turned into a stronger form, and now the question of contingency takes a new turn. Assuming that life inevitably evolved in this universe, would life have evolved if the universe as a whole were even slightly different? In order to answer this question we need a way to characterize our universe as a whole and then to compare it with other possible universes. The global features of our universe are intimately related to the precise values of the physical constants scattered throughout the laws of physics. By theoretically allowing these values to vary we can generate an infinite number of possible universes, each characterized by slightly different values of the constants; and, in principle, we can try to determine whether these alternative universes could produce life.[8]

The result is that only an extremely small subset of those possible universes could *ever* produce life. Calculations indicate that, if there were a change in these values of one part per million or in some cases just one part per *billion*, the resulting universe would never produce life! So life seems strongly contingent on the fine tuning of the constants of nature.

Hence, the real question of global contingency can be framed in this way: why do the physical constants of nature have these particular, precise values—values uniquely consistent with life? Perhaps our is the *only* actual universe; perhaps that for various reasons the constants of nature *must* have these values. Yet these values are precisely those required for life! If no scientific reason can be given for their occurrence we would have a remarkable model of the kind of global contingency I believe Pannenberg is seeking. Instead of "t=0," an uncaused moment, we would have an unexplainable conflation of arbitrary constants, an unnecessary animate universe!

Another way to state this would be that, if this is truly the only universe as the strong anthropic principle demands, then its *global ontological contingency* (the sheer existence of the universe as such) and its *global empirical contingency* (the particular character of the universe as a whole) are conjoined. If Pannenberg's hope is to reintroduce cosmological arguments into the *ex nihilo* tradition (against the restriction to ontological arguments in much of twentieth-century theology), the strong form of the anthropic principle could be superbly appropriate.

However, the question does not stop here. The anthropic principle certainly has its critics, as indicated by the controversy over a massive study on the subject by John Barrow and Frank Tipler (Barrow & Tipler 1986). Some scientists advance "many-worlds" arguments that *all* possible values of the natural constants are realized through an uncountably infinite set of *real* universes. Clearly then, our existence in this universe would be explained and the sense of the contingency of the natural constants lost. Yet others dismiss the idea of "many-worlds" since the possibility of other universes sounds unfalsifiable and hence outside the scope of science.

Will the anthropic principle become even more a part of scientific research, or will it be abandoned in favor of more empirically grounded perspectives? Hopefully this question will be resolved soon. Meanwhile, the anthropic principle clearly provides a framework of some scientific value for discussing the universe as a whole. Like the issue of "t=0," the anthropic principle raises as many questions as it answers; yet, its model-independence and its reliance on data from many specializations in physics makes it a prime candidate for Pannenberg's concept of global contingency and thus for relating the doctrine of creation to contemporary cosmology (Russell 1987a).

Local Contingency

Pannenberg also argues that the existence of each part of the world is contingent. Similar to its global counterpart, local contingency is central to the doctrine of creation but now with an emphasis on the continuous activity of God in every moment and event. Yet "this entire conception of God's creative activity was greatly challenged in the seventeenth century by the introduction of the principle of inertia" (Pannenberg 1988, 9). Pannenberg takes this point extremely seriously. He insists that the point of departure for any discussion about theology and science should begin with *this* particular historical challenge in mind as stated in the quotation I used at the beginning of this article. Moreover, Pannenberg raised the issue of inertia previously as the *first* of five "Theological Questions to Scientists" (hereafter referred to as "Questions"): "Is it conceivable, in view of the importance of contingency in natural processes to revise the principle of inertia or at least its interpretation?" (Pannenberg 1981). Hence, it is imperative that we see clearly what Pannenberg means by this problem.

According to Pannenberg, René Descartes maintained that if no external forces are at work, "each part of natural matter tends to preserve its status" via the principle of inertia. For Descartes inertia was not a *vis insita*; instead it was inertia in the immutability of God. In

contrast Baruch Spinoza identified essence and persistance-in-being. This provided a new metaphysical foundation for the Newtonian/ Cartesian concept of inertia which no longer depended on divine preservation. Hence, although creation "at the beginning" was still allowable, the argument for continuous conservation was forfeit, resulting in "the emancipation of nature from its dependence on . . . a continuous concursus of a transcendent God" (Pannenberg 1981, 8). Meanwhile, with the original meaning of continuous creation now lost, apologetic theology retreated to the fruitless strategy of a "God of the gaps." However, since with Descartes and Spinoza God could not act as a force or cause within nature, the gaps strategy itself was eventually abandoned. Pannenberg thus concludes that ". . . deism must be seen as the consequence of the introduction of the principle of inertia into modern physics" (Pannenberg 1988, 9).

Can modern science lead us out of the "inertia deadlock"? In "Questions" Pannenberg suggests that matter is now understood by science as "made up of events rather than of solid bodies and . . . the latter are already the products of the regularities of events; (consequently) their inertia or self-persistence is no more self-evident than any other natural regularity" (Pannenberg 1981, 8-9). Hence, Pannenberg believes that this contemporary, scientific view of matter could provide a new framework for discussing the continuous activity of God.

Thus, we are left with the question at two levels: Is the concept of inertia undergoing a change in current physics, and is this change, or rather its metaphysical implications, along the lines that Pannenberg suggests? It is certainly true that the meaning of inertia in modern physics is strikingly different in several ways from its classical definition; whether Pannenberg has characterized this change, and its metaphysical implications correctly is more problematic. At least five areas of change in physics should be noted:

First, the locus of Pannenberg's concern is Newtonian mechanics, where inertia is defined as an intrinsic property of matter measured by its resistance to acceleration. Yet even in mechanics, the definition of acceleration requires a frame of reference. Newton's answer, that absolute space provided the framework, was never universally accepted, and in the ensuing decades the meaning of inertia underwent extensive discussion (McMullin 1978a and 1978b; see also Buckley 1979, 159-204).

In the late nineteenth century Ernest Mach appealed to the existence of the "fixed stars" in the universe, defining inertia not as an intrinsic property of matter but as the result of the geometrical relationship between objects. In this view the inertia of an individual particle would be meaningless without the existence of the rest of the universe. A form

of Mach's principle was embodied in Einstein's general theory of relativity (1916) adding yet another shift in the Newtonian meaning of inertia.

Second, in 1905 Einstein published his special theory of relativity in which space and time are combined into four-dimensional space-time. One of the corollaries of special relativity was the identification of two properties of matter previously thought to be independent: inertia (or mass, m) and energy (e), as expressed in Einstein's famous equation, $e = mc^2$, where c is the speed of light. Unfortunately this equation is sometimes interpreted as allowing for the transformation of *matter* into energy as though the universe were in the process becoming "dematerialized." On the contrary it represents the equivalence of two *properties* of matter: mass, the passive principle or the ability to resist change, and energy, the principle of activity or the ability to do work. Nevertheless, the measure of inertia can vary as a function of relative velocity. Moreover, when combined with quantum physics in quantum field theory it provides the basis for the transformation of one kind of matter (e.g., electrons) into another (e.g., photons).

Third, a decade after publishing special relativity Einstein completed his general theory of relativity. Here two fundamental principles, space-time and matter, were joined through a set of nonlinear field equations. Instead of an absolute framework, space-time became a dynamic participant with matter in shaping the universe.

General relativity takes a middle position between Isaac Newton and Mach regarding inertia. Accelerated motion due to gravitational forces is dissolved into geodesic (natural) motion along a curved surface; hence, gravity is no longer a cause of deflection or acceleration but a source of space-time curvature, and the meaning of inertia as resistance to *gravitational* acceleration is dropped.

Still other forces such as electromagnetism can cause accelerated motion and hence involve inertia. Einstein hoped to unify all motion into a geometrical perspective. Although he never achieved this goal, the result could have marked the end of the concept of inertia in classical (nonquantum) physics.

Fourth, the greatest shift in contemporary physics from its classical perspective lies in quantum mechanics. According to the Heisenberg uncertainty principle, for example, the momentum (mass times velocity) and position of a particle cannot be determined with complete accuracy. Similarly, through the de Broglie relations particles are assigned a wavelength while momentum is attributed to waves, each changing the classical meaning of inertia.

Still, although quantum theory is universally employed, physicists disagree over its interpretation.[9] The dominant school of thought,

pioneered by Niels Bohr, stresses the epistemological limitations of physics, the loss of picturability of microprocesses, and the need for complementary models to interpret data. Others believe that the statistical character of quantum data is a reflection of an ontological indeterminacy in nature while some feel that quantum theory will ultimately be replaced by a more deterministic theory. Other views appeal to the role of consciousness in the observation process as the source of quantum ontology. Clearly in this highly controversial field the classical meaning of inertia has been left far behind although the outcome is unsettled. Moreover, while controversial, the insights to be gained from quantum physics are indispensable not only for the meaning of mass/inertia but much more generally for the meaning of local (and even global) contingency.

Fifth, adding to the complexity of the debate, quantum mechanics was successfully combined with special relativity over half a century ago, yielding a new generation of theories, perspectives, and questions. For example, in quantum field theory (such as quantum electrodynamics or quark theory), the particulate character of matter is not a sign of an underlying atomistic ontology but of a confluence of fluctuations in fundamental quantum fields. The masses of "particles" represent stable states in the energy spectrum of the interaction of these fields. In many of these theories infinities occur which make the interpretation of mass even more complex.

In summary, each of these developments in contemporary physics qualifies the concept of inertia both as resistance to change and as *vis insita* in an important way. Special relativity does not suggest that "matter is less material" but rather that it possesses fewer independent properties and that its passive and active principles are deeply related. By relating mass to space-time through the legacy of Mach's principle, general relativity suggests that matter's resistance to acceleration may be linked to the distribution of other matter in the universe, and that ultimately even curved motion may be seen as unaccelerated. Quantum physics brings a reinterpretation of causality and a loss of classical realism, while in quantum field theory the whole concept of particles is overturned.

Clearly then the answer to Pannenberg's somewhat rhetorical question is that the meaning of inertia *is* being revised within physics (as he well knows!). The really difficult question is how to relate these radical changes either to each other or to the concept of contingency and from there to the doctrine of God. I invite Pannenberg to participate actively in this research area, an area which we are only beginning to explore systematically. Perhaps his suggestion that matter is eventlike and composed of other events will provide a useful metaphor for the discussion.

Quantum Physics, Thermodynamics and Local Contingency: A Note in Passing

One might well argue that quantum physics and nonlinear nonequilibrium thermodynamics offer highly promising though controversial ways to relate contemporary physics and the full spectrum of theological problems including the doctrine of creation and the doctrine of God. Much of the literature in theology and science explores these relationships in some detail (for example, Barbour 1966, 273-316 and references; Bartholomew 1984; Moltmann 1985; Peacocke 1979; Polkinghorne 1986). Although Pannenberg does discuss the general nomological relation of statistical and deterministic laws in various places (as I indicate in the next section), I am not aware of an extended analysis by him of the theological implications of quantum physics. Similarly his intriguing reference to irreversibility, entropy, and contingency in the "Doctrine" and in "Questions" lays the groundwork for a thorough examination of these rich areas.

One might argue against exploring the theological implications of quantum physics as long as the philosophical issues remain controversial. I do not agree. I believe that there are several conclusions which have been accorded almost universal agreement already (Herbert 1985; Pagels 1983; Barbour 1966), conclusions impacting epistemology and metaphysics which can and should be appropriated theologically. Principal among these are the irreducibly statistical character of the data; the loss of classical realism, strict objectivity, atomistic materialism and Laplacian determinism; the necessity of contradictory linguistic models; the pervasive inference concerning nonlocality via quantum correlations; and the irreducible role quantum physics plays in explaining so much of macroscopic, ordinary experience.

Somewhat less controversial are the striking arguments for the evolution of order from chaos in systems governed by nonlinear, nonequilibrium thermodynamics. The insights to be gained here are also seminal for a contemporary theological interpretation of the physical meaning of local contingency.

Nomological Contingency

Central to Pannenberg's theological agenda is his view that what is experienced as law in nature is an expression of God's faithfulness. At the same time the contingency of natural events reflects an aspect of nomological contingency which is crucial to the possibility of God's freedom in relation to the world. Several forms of nomological contingency are implied by the discussion in the "Doctrine":

Abstractive (or conditional) nomological contingency. According to Pannenberg, scientific laws serve to focus attention on uniformities in natural phenomena. They are abstractions from concrete natural processes. "The description of nature by hypothetical statements of natural law presuppose their material as contingently given. These statements do not focus on this contingency, however, because their intention is the formulation of uniformities that occur in the natural phenomena, their contingency notwithstanding" (Pannenberg 1988, 10). In particular, they provide formulae which can be applied to specific cases only by specifying additional "initial and marginal conditions which are contingent in relation to the uniformity affirmed in the equation" (Pannenberg 1988, 10). Hence they are at best approximations rather than complete and exhaustive descriptions.

I am in full agreement with Pannenberg here; I think this is a standard position in the philosophy of science and may be left as it stands.

Formal nomological contingency. In the paragraph cited above, however, Pannenberg also asserts that natural constants occur within scientific formulae as contingent factors given *de facto*. Here a more subtle issue arises, since it is precisely *these* natural constants which lead to the discussion of the anthropic principle and related arguments about the universe as a whole. If one truly believes that the constants of nature are arbitrary (i.e., nomological contingency) then one would expect a many-worlds type resolution to the issue raised by the anthropic principle; all possible universes exist and that we have evolved in the universe which has constants amenable to life. Alternatively, the success of the strong form of the anthropic principle, that this is the only possible universe (i.e., global contingency), would undercut the contingency of the natural constants which occur throughout the equations of physics, since then the constants would *not* be arbitrary but *somehow necessary*.

It seems then that one *cannot* have it both ways: Pannenberg's claims for nomological and global contingency are mutually constraining. In this spirit we could pose the following tentative hypothesis: *One cannot consistently claim nomological and global contingency within the framework of standard cosmology.*

Actually, a third form of nomological contingency is related to this hypothesis as well:

Absolute nomological contingency. Pannenberg also suggests that the laws of nature are themselves "contingent products of the creative

freedom of God" (Pannenberg 1988, 11). Can physics allow this claim?

Perhaps not. Some proponents of the strong form of the anthropic principle would argue that even the *laws* of nature, and not just the natural constants, are necessary if the actual universe is to coincide with the requirements of evolution. Even if this is true, one could turn to the logic underlying all fundamental natural law; it would seem that even the fundamental laws represent only one type of logic, namely two-valued logic.[10] Does this fact point to a still higher level of abstraction, the set of all possible systems of logic, and hence to a sense of contingency surrounding the logic embodied in our universe? One could go further and imagine an infinite ladder of levels, each more general than the preceding (Russell 1987b, 15). At which level does God create, or is God free to create within the contingency of each level? Perhaps the consistency of all these levels is a sign of the faithfulness of God. In any case if Pannenberg's contention of nomological contingency is read in this way it would seem to me to be quite consistent with cosmology even if something like the strong anthropic principle were upheld.

First instantiation contingency. Perhaps the most important form of nomological contingency is Pannenberg's argument that some, or perhaps all, of the laws of nature have a first instantiation. It is certainly clear that, even if there were a moment of absolute origination of the universe, not all of the laws of nature were manifested at that time. For example, in a cooling universe atoms first occur when electrons are finally able to combine stably with protons; hence chemical properties and the rules they obey have a first instantiation. Similar arguments hold for macromolecules and for all the other steps in biological evolution.

What about the corollary that some "first instantiation" may *not yet* have occurred? This form of contingency is suggested in the "Doctrine" where Pannenberg discusses the compatibility of historical and scientific descriptions of the same sequence of events. Especially in historical perspective connections between events may be "constituted in the course of the contingent sequence itself" and hence perceived "only at the end of the sequence in question" (Pannenberg 1988, 10). Thus, new sequences may begin in time with their meaning only disclosed at their term, and this leads to a form of contingency which is of central theological importance to Pannenberg.

Similarly in the second part of "Questions" Pannenberg argues that every scientific law has a first instantiation, and it is only with such instantiations that a mathematical formula becomes a law of nature. This allows Pannenberg to hold that all natural processes are unique, a contention which ultimately involves the irreversibility of time.

Yet the *critical* importance of first instantiation contingency in Pannenberg's theology is demonstrated by the *crucial* role it plays in his argument protecting the historicity of the Resurrection from the attack of science in *Jesus—God and Man* (Pannenberg 1968). In a terse and compact paragraph Pannenberg argues that the contention that the Resurrection event would violate the laws of science overlooks nomological contingency:

> ... Only a part of the laws of nature are ever known. Further, in a world that as a whole represents a singular, irreversible process, an individual event is never completely determined by natural laws. Conformity to law embraces only one aspect of what happens. From another perspective, everything that happens is contingent, and the validity of the laws of nature is itself contingent. Therefore, natural science expresses the general validity of the laws of nature but must at the same time declare its own inability to make definitive judgments about the possibility or impossibility of an individual event, regardless of how certainly it is able, at least in principle, to measure the probability of an event's occurrence. The judgment about whether an event, however unfamiliar, has happened or not is in the final analysis a matter for the historian and cannot be prejudged by the knowledge of natural science (Pannenberg 1968, 98).

A more extended discussion of singular events in science and in history, and their role in the formation of general hypotheses, was given in *Theology and the Philosophy of Science* (Pannenberg 1976). In Section Six of Part One Pannenberg focused on sequences of events which can be interpreted both in terms of general laws and as successive individual temporal events. He then describes a more general class of successive events called *contingent sequences* where "the connection in the succession ... comes into being gradually, as each event takes place, with each event related to the preceding members of the series" (Pannenberg 1976, 63). Even the form of contingent sequences is unique and historical: "Both individual events and contingent sequences of events are entities which are unrepeatable in their specific facticity" (Pannenberg 1976, 64). Yet he argues that contingent entities can serve to demonstrate nomothetic structures if one assumes that "the world as a whole is a unique process in time." With this assumption Pannenberg can argue that "historical studies are not further removed from reality than natural science" (Pannenberg 1976, 66).

Can one maintain both regularity or continuity, and at the same time contingency and novelty, in nature and history? How does Pannenberg's position on first instantiation contingency merge with his general philosophy of science? I feel that if one stresses the revolutionary character of scientific paradigms following Thomas Kuhn and Paul Feyerabend, for example, then first instantiation arguments seem more convincing. If certain paradigms are radically incommensurable, if there are no meta-paradigmatic rules by which the next paradigm can be constructed out of the existing paradigm, then the occurrence of

radically new phenomena and theories are to be expected although *never predicted.*

Yet many philosophers, especially those who claim a form of critical realism, believe that scientific theories are convergent, citing either linguistic continuity (similar words are used in old and new paradigms), historical continuity (a research community continues over a period of successive paradigms), or substantive continuity (succeeding paradigms refer to the same phenomena and data). Perhaps the strongest argument is that a successful new paradigm must *contain* the old one it replaces as a limiting case. Often the containment is expressed mathematically: the equations of the old paradigm are limiting cases of the new equations under the appropriate approximation conditions. Examples would include semi-classical approximations to quantum theory, the correspondence principle, Bohr's use of classical language in describing the measurement process, and classical relativity as the low velocity limit of special relativity. Moreover, the language of the new paradigm is often taken from the old although the meanings are changed: we speak of mass, velocity, and position in special relativity and quantum physics as well as in classical mechanics.

Pannenberg's own position on the philosophy of science shows a certain tension between continuity versus incommensurability. I would agree that we must be radically open to new and unpredictable phenomena; yet not just *anything* new can happen, since the new will eventually fall within a theory which somehow includes and fulfills the old. Moreover, the value of the theories of science would be severely undercut if they were radically relativized by first instantiation contingency; indeed this would run counter to Pannenberg's program to draw on science for theology. Just how we reconcile radical openness to the new with the requirement of continuity or natural regularity and the search for unity poses a rich challenge to our task of relating science and theology.

For example, in the context of the quotation from *Jesus—God and Man*, how is the radical newness of the Resurrection as a contingent first instantiation to include within it the world view of the Hebrew Holy Scripture with its own interpretation of life after death, or the common experience of morality in everyday life? Of course this the subject of much of Pannenberg's work; the issue now before us is whether there is a similarity between Christology and science regarding the way in which older views are contained within the new and regarding the limits of what can be believed about the new if it is to have some continuity with the old.

Nomological contingency linked to global contingency. Pannenberg's arguments about contingency typically combine all four types of

nomological contingency with a characteristic assertion about global contingency. For example, the key assertion in the following citation from *Jesus—God and Man* seems to be that "the world process as a whole . . . is a unique succession of events":

> A law always requires a multiplicity of individual cases in which it is realized. It brings to expression the typical element of analogous cases in distinction from their variant particularities. For this reason, a law or a system of laws can never embrace all sides of the whole of reality. It always embraces only one side of the real event, the side that repeats itself, the typical, and neglects the other side, the contingent particularities. *The world process as a whole, however, is a unique succession of events.* Its entire set of interrelationships cannot, therefore, be understood in terms of law. . . . Because the total process of the world is a unique and irreversible course of events, even contemporary natural science does not speak of this total process as the test case of a law embracing the whole, but speaks of a history of nature (Pannenberg 1968, 395; italics added).

Clearly then the meaning of nomological contingency is intertwined with the global assertion about the uniqueness and contingency of the whole universe and with its internal character as a single irreversible process. In these more complex instances in Pannenberg's thought we see the interconnections of his ideas about contingency, temporality, and history.

Yet the basic assertion about the uniqueness and irreversibility of the world returns us to physics: Does it support or at least provide a framework for discussing such a claim? The analysis of this paper is meant to suggest that it does, but also that since each of these concepts—uniqueness of events, nature as event, the world as a whole—is undergoing enormous change in current scientific thought, the outcome will strongly influence the viability of Pannenberg's conclusions.

A Final Note on the Future as Source of Contingency

Although it is beyond the scope of this article, an additional important theme regarding the concept of contingency in Pannenberg's thought is the future. In *Theology and the Kingdom of God* (Pannenberg 1969) he refers to the future as the power and being of God. According to Pannenberg both nature and history are contingent. We confront God in the indeterminateness of events which are ". . . in fact acts of God from whose future they spring" (Pannenberg 1969, 57). This argument then serves as a basis for understanding the future as personal, and ultimately for identifying the future with the Kingdom of God.

Actually Pannenberg balances contingency with unity since "contingency is not enough to give events a personal quality. The required additional factor is the identity of the power that is operative in a series

of contingent events, a unity behind contingent self-expressions" (Pannenberg 1969, 58). Yet he argues that if contingency is replaced with ". . . deterministic models of reality, the notion of a personal power behind those events is untenable" (Pannenberg 1969, 58). Thus there must be an irreducible element of contingency in nature if Pannenberg's work is to proceed.

Much of this argument depends on Pannenberg's complex and unusual ontological reversal in which the future is given priority over the past as the determining reality. Here we find his basic disagreement with Alfred North Whitehead and Aristotle and the greatest challenge to dialogue with physicists. Further work in this area could be very fruitful.

Conclusions

In the "Doctrine" Pannenberg begins with the call for discussion between modern science and creation theology. The key element in this discussion is the concept of contingency, a concept which Pannenberg uses in several ways: as an arbitrary feature of the world either considered as a whole (which I suggested calling global contingency) or in each event of the world process (local contingency), and as a dependent characteristic of natural law (nomological contingency). Although not systematically developed, Pannenberg takes the doctrine of creation to mean an event "at the beginning" as well as a process continuing at each moment of time.

Pannenberg's central thesis regarding contingency is that the principle of inertia in classical physics posed a fundamental challenge to the claim that the world is locally contingent and hence to the doctrine of (continuing) creation. He proposes that the changes taking place in the concept of inertia in contemporary physics will alleviate this impasse.

I agree strongly with Pannenberg's general program to reformulate the doctrine of creation by uncovering the role of science both in providing its original context, undermining it, and now in offering it new meaning. However, I have two reservations about his specific approach.

First, I am uneasy with his uncritical use of physico-historical language regarding creation "at the beginning" when discussing global contingency. Instead I believe that the anthropic principle, although itself a controversial subject in scientific circles, provides a more adequate conceptualization of global contingency than the concept of an ultimate or absolute beginning.

Second, I am also concerned with his choice of inertia to thematize the challenge of classical physics to local contingency. While the principle of inertia played a pivotal historical role in classical physics (and its

intricacies still elicit intense study by historians of science), contemporary physics poses a vast number of germane topics for a discussion of local contingency, making inertia a somewhat anachronistic target. I am especially puzzled over the lack of attention to the meaning of contingency in quantum physics, relativity theory, or thermodynamics (and, if one moved outside of physics, then in genetics and evolutionary biology, etc.). Indeed many would argue that quantum physics is now the *paradigm* of contingency in physics. Although its interpretation is highly controversial its existence simply cannot be ignored if one wants to discuss contingency in modern science.

In general I appreciate the kind of nomological contingency Pannenberg suggests. Still I find some tension between the claim that scientific laws are relevant for theology and the incommensurability position which I presume Pannenberg would defend. Moreover I am doubtful whether one can consistently claim both nomological and global contingency within the framework of standard Big Bang cosmology, an assertion which I tentatively frame as a *hypothesis* for future exploration.

Perhaps most lacking in "The Doctrine" and elsewhere is reference to the writing of others who have made particularly important advances in relating the doctrine of creation and the natural sciences, notably Ian Barbour and Arthur Peacocke.

While beyond the scope of this paper, the "Doctrine" contains tantalizing suggestions about the theological importance of classical field theories and the irreversibility of time. When these and other topics, including nonlinear thermodynamics and quantum field theory, are folded into a more detailed analysis of the doctrine of creation, the Spirit, the ontological power of the future, and the doctrine of God, they should bring deep insights from science to the heart of Pannenberg's theological program.

In summary I am grateful to Pannenberg for providing an exciting and stimulating springboard for extended and promising further discussions in theology and science, with his special focus on "... the question what modern science and especially modern physics can say about the question of the contingency of the world as a whole and of every part in the universe."

NOTES

1. Wolfhart Pannenberg was the 1987 Fellow in Religion and Science at the Center for Theology and the Natural Sciences, Berkeley, California. During his visit to the Center a number of issues were clarified in conversations with the author which will be indicated by quotations in these notes.

For example, regarding the doctrine of creation Pannenberg said: "The distinction between continuous creation as related to the concept of preservation, of providence, and an act of creation at the beginning is only a distinction that occurs within a given

concept of time, while the comprehensive affirmation is *creatio ex nihilo* which applies everywhere, in every part of the doctrine of creation. . . ."

At some point, however, these issues will require much more systematic attention on Pannenberg's part. For example, are *creatio ex nihilo* and *creatio continua* relatively separate strands of the creation tradition, or is the latter inherently dependent on the former although it is historically an older tradition? Is there material or merely prescriptive content to *creatio ex nihilo*? How does the doctrine of creation relate to other doctrines? (See, e.g., Hefner 1984).

2. In conversations at Berkeley Pannenberg used the author's phrases for distinguishing between several kinds of contingency, remarking that ". . . *creatio ex nihilo* corresponds to the issue of contingency, especially global contingency, but global contingency as entailing local contingency and nomological contingency."

3. When asked about the empirical meaning to *creatio ex nihilo* in addition to its strictly ontological meaning, Professor Pannenberg said that *creatio ex nihilo does* have an empirical meaning, although such a meaning arises within and is conditioned by the context of a particular scientific theory of time. Hence, since science and the philosophy of science shape the meaning of such concepts as a beginning of time, these concepts are "only indirectly related to the concept of creation. . . ."

4. A number of striking features of the universe, such as its homogeneity and isotropy and the fact that its curvature is almost exactly flat, are presupposed rather than explained in standard Big Bang theory. One attempt at accounting for these features is to modify the evolution of the *very* early universe (under 10^{-35} sec) in terms of the inflationary scenarios developed by MIT physicist Alan Guth and colleagues. Still issues raised by inflation have led others to dismiss such scenarios as "metaphysical" (meaning here "untestable even in principle"). A very readable discussion of this issue appeared in *Astronomy*, entitled "Has Cosmology Become Metaphysical?" (Ellis & Rothman 1987). For a longer treatment of inflation see Trefil (1983). These questions while controversial lend additional insight into the meaning of global contingency and invite detailed analysis. For this paper, however, I chose to move directly to the anthropic principle (to be discussed below) since by focusing on the universe as a whole instead of a portion of its internal history the anthropic principle tends to address a more general issue than inflation, and since inflationary scenarios still assume a $t=0$ framework.

5. In some scenarios the universe ceases "bouncing" after a finite number of recontractions (Barrow & Tipler 1986, Ch. 10, 613-82).

6. Quantum physics raises a serious challenge to classical notions of deterministic or Laplacian causality. It does not overturn the more general meaning of causality, much less challenge methodological causality! Moreover, until quantum physics is combined with cosmology in a successful theory, the issue is limited to processes within the universe rather than with the universe itself.

7. I asked Pannenberg if he really meant, as the language of his paper suggests, that *creatio ex nihilo* applies *only* to the beginning of creation, and his answer was that he did not. "*Creatio ex nihilo* applies to the *whole* cosmic process. . . . It relates to the entire concept of creation and not only to the beginning." Moreover he felt that a deeper analysis of the problem would involve the meaning of eternity as the fullness of time and the relation of time and eternity.

Pannenberg indicated that he "mentioned the issue of the beginning only in passing" without really focusing on it, and then in "reporting on the traditional theology of creation." My concern is that any language about a beginning, particularly when the phrase is used uncritically and outside of its detailed scientific context, can sound anthropomorphic in the very way which Pannenberg wants to avoid in discussions, for example, of purpose and the doctrine of creation.

8. "Life" in anthropic principle literature usually refers to carbon-based intelligent life, but in some instances radically different forms of life have been considered (see Barrow & Tipler 1986, Ch. 8, 510-75).

9. For a very helpful survey of historical and philosophical issues in quantum mechanics, see Jammer 1974.

10. Quantum physics is a possible exception. Some argue that the paradoxes of quantum physics suggest that nature at the microlevel obeys nondistributive or multivalued logic (see Jammer 1974, Ch. 8, 341-416).

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