

The Omega Point as *Eschaton*: Answers to Pannenberg's Questions for Scientists

Frank J. Tipler

Zygon: Journal of Religion & Science, Vol. 24, Issue 2 (June 1989), pp. 217–253

Originally published as Frank J. Tipler, “The Omega Point as *Eschaton*: Answers to Pannenberg’s Questions for Scientists,” *Zygon: Journal of Religion & Science*, Vol. 24, Issue 2 (June 1989), pp. 217–253; doi : 10.1111/j.1467-9744.1989.tb01112.x. Republished as Chapter 7: “The Omega Point as *Eschaton*: Answers to Pannenberg’s Questions to Scientists” in Carol Rausch Albright and Joel Haugen (editors), *Beginning with the End: God, Science, and Wolfhart Pannenberg* (Chicago, Ill.: Open Court Publishing Company, 1997), ISBN: 0812693256, pp. 156–194, from which the subsequent pages are taken.

The immediate text below is from the *Zygon* journal’s abstract of the article at <http://www3.interscience.wiley.com/journal/119442501/abstract>:

Frank J. Tipler is professor of mathematical physics at Tulane University, New Orleans, Louisiana 70118.

This paper was presented at the Second Pannenberg Symposium, held at the Chicago Center for Religion and Science, Lutheran School of Theology, 15–17 November 1988. The author thanks Frank Birtel, Wim Drees, Wolfhart Pannenberg, John Polkinghorne, Robert John Russell, and Michael Zimmerman for their comments on an earlier version of this paper. This work was supported in part by the National Science Foundation under grant number PHY-86-03130.

KEYWORDS

computer models of the mind and reality • eschatology • grace and the beatific vision • personal God • physical cosmology • resurrection of the flesh

ABSTRACT

I present an outline of the Omega Point theory, which is a model for an omnipresent, omniscient, omnipotent, evolving, personal God who is both transcendent to spacetime and immanent in it, and who exists necessarily. The model is a falsifiable physical theory, deriving its key concepts not from any religious tradition but from modern physical cosmology and computer science; from scientific materialism rather than revelation. Four testable predictions of the model are given. The theory assumes that thinking is a purely physical process of the brain, and that personality dies with the brain. Nevertheless, I show that the Omega Point theory suggests a future universal resurrection of the dead very similar to the one predicted in the Judeo-Christian-Islamic tradition. The notions of “grace” and the “beatific vision” appear naturally in the model.

7

The Omega Point as *Eschaton*: Answers to Pannenberg's Questions to Scientists

.....

Frank J. Tipler

The idea that religious belief must be firmly based on science, that is, anchored on experimental tests of basic theological propositions (for instance, God's very existence), is not new. It is in the Old Testament:

Then said Elijah unto the people, I, even I only, remain a prophet of the LORD; but Baal's prophets are four hundred and fifty men. . . . Let them therefore give us two bullocks; and let them choose one bullock for themselves, and cut it in pieces, and lay it on wood, and put no fire under: and I will dress the other bullock and lay it on wood, and put no fire under. . . . And call ye on the name of your gods, and I will call on the name of the LORD: and the God that answereth by fire, let him be GOD. And all the people answered and said, It is well spoken. (1 Kings 18:22-24)

The apostle Paul also believed that the existence of God and certain divine properties were scientific conclusions, inferred from the observation of the natural world. In Paul's view, so obvious is the existence of the creator God that even pagans have no excuse for not worshipping the One who brought the physical universe into being: "For the invisible things of him from the creation of the world are clearly seen, being understood by the things that are made, even his eternal power and Godhead; so that they are without excuse" (Rom. 1:20). Thomas Aquinas, the author of the great medieval synthesis, followed in the footsteps of Elijah and Paul. Aquinas, who probably knew more about the physics of his day than any of his contemporaries—we could with justice call him a great physicist as well as a great theologian—based his proofs of God's existence (the Five Ways) firmly on Aristotelian cosmology. The Five Ways are so intimately integrated with Aristotelian physical cosmology that the falsification of the physics logically entails the falsification of the proofs (Kenny 1969). The eighteenth-century English theologian Samuel Clarke also argued, in his famous debate with Gottfried von Leibniz, that deism and atheism are avoided *only* if physics itself shows the presence of God in the physical world: "The notion of the world's being a great *machine*, going on *without the interposition of God*, as a clock continues to go on

without the assistance of a clockmaker; is the notion of *materialism and fate*, and tends under pretense of making God a . . . *Supra-Mundane Intelligence*, to exclude providence and God's Government in reality out of the World" (Clarke 1717, 15; Clarke's italics and capitalization).

In other words, if all God did was to conserve matter and energy and the laws of physics, to be merely the ontological support without which the universe would collapse into nonexistence, then God *qua* God would be superfluous; God's existence would be merely equivalent to the physical conservation laws. Wolfhart Pannenberg (1981) and others have shown that the recognition of this equivalence in fact was a major cause of the growth of atheism in the eighteenth and nineteenth centuries. Clarke and Isaac Newton believed that Newtonian cosmology actually required God to act continually in the world because they believed that the conservation laws did not hold: God was required physically in order to reconstruct the universe periodically. But later Newtonian physicists showed (or were believed to have shown; see Earman 1986) that the conservation laws actually held in Newtonian physics. Laplace "had no need of that hypothesis [God]" in accounting for the origin of the Solar System. This utter failure—falsification—of Newtonian natural theology is one important reason why many twentieth-century theologians wish to divorce religion completely from science.

But Pannenberg continues the older tradition of believing that science and true religion must be entwined:

Perhaps Christianity survived only by temporarily separating the outlook of faith from the rational and scientific investigation and description of the natural world. But such an attitude cannot persist because it is profoundly unacceptable on theological grounds.

If the God of the Bible is the creator of the universe, then it is not possible to understand fully or even appropriately the processes of nature without any reference to that God. If, on the contrary, nature can be appropriately understood without reference to the God of the Bible, then that God cannot be the creator of the universe, and consequently he cannot be truly God and be trusted as a source of moral teaching either. (Above, 38)

The trouble is, if one bases a proof of God's existence and an analysis of the divine nature on current physics, one runs the risk of having the proof falsified by later scientific developments. This is exactly what happened to Aquinas and to Clarke and Newton. If this happens the suspicion will grow that not only is the proof false, but also the

conclusion is false: the proof fails not merely because the premises are false; it also fails because there is in fact no God.

This is, however, a risk natural theologians are just going to have to take. Science by its very nature cannot give us theories which are certain to be true. Our models of physical reality are simply going to have some holes in them, and these holes may one day widen until finally they cause the collapse of entire theories (Pannenberg 1976). If one tries to avoid the risk of falsification by denying the possibility of natural theology altogether, by claiming that it is impossible in principle for any scientific discovery to have any implication whatsoever for theology, then one effectively denies the relevance of theology for any human concern, as Pannenberg emphasizes in the passage I quoted above. One also denies that the world is relevant to God, in which case it becomes impossible to understand why God should have created the universe at all. If there is even a touch of truth in the idea that God is the creator, then there simply must be an intimate relation between the creator and the creation, a relation which can be studied scientifically.

I shall argue in this paper that there is such a relation and that one cannot understand the physical cosmos in its entirety without understanding it. The starting point of my argument is Pannenberg's Fifth Question for scientists: "Is the Christian affirmation of an imminent end of the world that in some way invades the present reconcilable with scientific extrapolations of the continuing existence of the universe for billions of years ahead? . . . Scientific predictions that in some comfortably distant future the conditions for life will no longer continue on our planet are hardly comparable to biblical eschatology" (48).

It is definitely true that the universe will exist for billions of years in the future. In fact, the evidence that the universe will continue to exist for five billion more years is at least as strong as the evidence that the earth has already existed for five billion years. There is simply no way our extrapolations could be so wrong as to falsify this prediction of longevity. Furthermore, if the standard cosmological models are approximately accurate, then the universe, if closed, will continue to exist at least another 100 billion years (in *proper time*), and if open or flat will continue to exist for literally infinite (proper) time. In either case, we are seeing the universe in a very early stage in its history. Most of the physical universe lies in our future, and we cannot truly understand the entire physical universe without understanding this future. But we can study this future reality, in particular the ultimate future which constitutes the end of time, only if in some way this Final State of the physical universe makes an imprint on the present. It is,

after all, obvious that we cannot do direct experiments on the future in the present.

I shall obtain a hold on this future reality by focusing attention on the physics relevant to the existence and behavior of life in the far future. One of Pannenberg's central themes is the importance of eschatology in the Christian vision (see, for instance, Pannenberg 1967; 1971; 1973; 1977). I shall attempt to provide a physical foundation for Pannenberg's interpretation of eschatology. I shall make the physical assumption that the universe must be capable of sustaining life indefinitely; that is, for infinite time as experienced by life existing in the physical universe. It will turn out that this assumption imposes rather stringent requirements on the future. The assumption also makes some predictions about the present, because the physics required to sustain life in the far future must be in place now, since the most fundamental laws of physics do not change with time. In this way it can reasonably be said that the future makes an imprint on the present.

The really fascinating consequence of this assumption, however, is what it implies if life really does exercise its option to exist forever. There must exist in this future (but in a precise mathematical sense, also in the present and past) a Person who is omnipotent, omniscient, omnipresent, who is simultaneously both transcendent to yet immanent in the physical universe of space, time, and matter. In the Person's immanent temporal aspect, the Person is changing (forever growing in knowledge and power), but in the Person's transcendent eternal aspect, forever complete and unchanging. How this comes about as a matter of physics will be described in the next section of this paper, entitled 'The Omega Point Theory'. Needless to say, the terminology is Teilhard de Chardin's, but the connection is more than a mere two words. I believe that any model of an evolving God—whether it is Schelling's, Alexander's, Bergson's, Whitehead's, or Teilhard's—must have certain key features in common.¹

Elijah's challenge remains: Is this God of the Omega Point (assuming said Person actually exists) *the* God? It is generally (but not universally) felt that *the* God must be the uncreated creator of the physical universe, a being who not merely exists but who exists necessarily, in the strong logical sense of 'necessity' (the Person's nonexistence would be a logical contradiction). Only if God is not in any sense contingent can one avoid the regress posed in the query, Who created God? Furthermore, it is generally felt (as for example in Findlay 1955) that only *the* God, the One who exists necessarily, is worthy of worship. I shall tackle this thorny question of necessary existence in the third and fourth sections of this paper. In the former section I shall

analyze the notion of contingency in classical general relativity and in quantum cosmology and will discuss in what sense modern cosmological models can be said to sustain themselves in physical existence. In the latter section I shall use the ideas developed in the former to argue that the universe necessarily exists—and necessarily sustains itself in existence—if and only if life and the Omega Point exist therein. If this argument is accepted, then the Omega Point exists necessarily if he/she exists at all. This would appear to me to establish the Omega Point as *the* God, for it appears pointless to have more than one being with all of the divine attributes. (I shall be invoking the Identity of Indiscernibles throughout the fourth section.)

The emphasis in the second section is the physics—the nuts and bolts—of infinite continued survival, and the emphasis in the fourth section will be philosophical theology. But the God of the Bible and the Christian churches is a great deal more than the God of the philosopher-physicist. The former is a God of hope, love, and mercy, a God who grants eternal life to each individual human being. I shall discuss in the fifth section various senses in which the Omega Point can be regarded as a source of hope for the future. In particular, the Omega Point probably will “resurrect the dead” in the sense which Pannenberg has given this phrase: “it is our present life as God sees it from his eternal present” (Pannenberg 1970, 80).

Pannenberg’s view of the resurrection has been criticized (I think wrongly; see Pannenberg 1984) by John Hick as permitting

no further development of character beyond death. . . . The content of eternity, according to Pannenberg, can only be that of our temporal lives. . . . Suppose it is a poor stunted life, devoid of joy and nobility, in which the good possibilities of human existence remain almost entirely unfulfilled? . . . Can God’s good gift of eternal life be simply a consciousness of this life seen *sub specie aeternitatis*? Is this the best form of eternity that omnipotent love can devise? (Hick 1976, 225)

I shall show in the fifth section that the type of life enjoyed by resurrected individuals is entirely at the discretion of the Omega Point, as is their resurrection in the first place; the human soul is not naturally immortal, for modern physics shows that it dies with the brain. Thus, except for the conscious future act of the Omega Point, we would die never to rise again. The life of the resurrected dead could be as pointless as the scenario ridiculed by Hick, merely a replay of the original life, or it could be a life of continued individual becoming, an exploration into the inexhaustible reality which is the Omega Point (or even into purely sensual delights, such as pictured in the Garden of the

Koran [Smith and Haddad 1981]). It is even possible for the Omega Point to guide each resurrected person, by means of consultation with each, into "the perfection of the personal creature as a whole" (a definition of "beatific vision" [see Rahner and Vorgrimler 1983, 42]). Which life the resurrected dead live is up to the Omega Point; if it is heaven rather than hell it will be due to the Omega Point's "personal condescension and absolutely gratuitous clemency to man" (a definition of 'grace' [see Rahner and Vorgrimler 1983, 196]). I shall give in the fifth section a reason for expecting such 'grace'.

Let me emphasize again that the Omega Point theory, including the resurrection theory, is pure physics.² There is nothing supernatural in the theory, and hence there is no appeal anywhere to faith. The genealogy of the theory is actually atheistic scientific materialism; the line of research which led to the Omega Point theory began with the Marxist John Bernal (Barrow and Tipler 1986, 618). The key concepts of the Judeo-Christian-Islamic tradition are now scientific concepts.

.....

The Omega Point Theory

In order to investigate whether life can continue to exist forever, I shall need to define 'life' in physics language. I claim that a 'living being' is any entity which codes 'information' (in the sense this word is used by physicists), with the information coded being preserved by natural selection (for a justification of this definition, see Barrow and Tipler 1986, section 8.2). Thus life is a form of information processing, and the human mind—and the human soul—is a very complex computer program. Specifically, a person is defined to be a computer program which can pass the Turing test (see Hofstadter and Dennett 1981, 69–95 for a detailed discussion of this test).

It is extremely important that my claim not be misunderstood. Most people's immediate reaction to my claim is typically, 'Surely there is more to life than mere information processing, to punching data into a computer, and letting the machine grind away. This may be sufficient for a machine—or a computer hacker—but real people are far more complex. They work for a living, they listen to music, they enjoy conversations with other people, they reflect on the meaning of existence, they worship God, they develop deep and loving relationships with others, they raise children. An infinity of time spent doing nothing but playing with a computer—what a horrid thought!'

I completely agree. It *is* a horrid thought. But it is not the eschatology I am proposing. The crucial point is that at the most basic nuts-and-bolts physics level, all of the above-mentioned activities of 'real'

people, indeed *all* of the possible activities of people, are in fact types of information processing. The human activities of listening, enjoying, reflecting, worshiping, and loving are mental activities and correspond to mental activity in the brain. In other words, at the *physics* level they are information processing and nothing but information processing. At the *human* level, though, they are not cold and austere 'information processing' but warm and human listening, enjoying, reflecting, worshiping, and loving. Furthermore, the essential nature—at the physics level—of all other human activities can be shown to be information processing (see sections 3.7 and 10.6 of Barrow and Tipler 1986 for details). The upshot is that the laws of physics place constraints on information processing and hence on the activities and existence of life. If the laws of physics do not permit information processing in a region of spacetime, then life simply cannot exist there. Conversely, if the laws of physics permit information processing in a region, then it is possible for some form of life to exist there. These limitations and opportunities are analogous to those imposed by food at the biological level. At the human level, it is certainly not possible to reduce all human experience to eating; eating is just one of many human actions, and in fact other things are more important (to most of us, anyway). But having enough to eat is a prior condition for these other activities. There will be no listening, enjoying, reflecting, worshiping, and loving without food. Furthermore, if the crops fail, then people must either get food from outside the region or die. Period. Discussions of the morality of interacting with the outside world, for instance, must be consistent with this biological fact. Similarly, a discussion of the future of life must be consistent with regarding life as information processing at the physics level.

There is actually an astonishing similarity between the mind-as-computer-program idea and the medieval Christian idea of the 'soul'. Both are fundamentally 'immaterial': a program is a sequence of integers, and an integer—2, say—exists 'abstractly' as the class of all couples. The symbol '2' written here is a *representation* of the number 2, and not the number 2 itself. In fact, Aquinas (following Aristotle) defined the 'soul' to be "the form of activity of the body" (see Pannenberg 1985, 523). In Aristotelian language, the *formal* cause of an action is the abstract cause, as opposed to the material and efficient causes. For a computer, the program is the formal cause, while the material cause is the properties of the matter out of which the computer is made, and the efficient cause is the opening and closing of electric circuits. For Aquinas, a human soul needed a body to think and feel, just as a computer program needs a physical computer to run.

Aquinas thought the soul had two faculties: the agent intellect (*intellectus agens*) and the receptive intellect (*intellectus possibilis*), the former being the ability to acquire concepts and the latter being the ability to retain and use the acquired concepts. Similar distinctions are made in computer theory: general rules concerning the processing of information coded in the central processor are analogous to the agent intellect; the programs coded in RAM or on a tape are analogues of the receptive intellect. (In a Turing machine, the analogues are the general rules of symbol manipulation coded in the device which prints or erases symbols on the tape versus the tape instructions, respectively.) Furthermore, the word 'information' comes from the Aristotle-Aquinas notion of 'form': we are 'informed' if new forms are added to the receptive intellect. Even semantically, the information theory of the soul is the same as the Aristotle-Aquinas theory.³

The 'mind-as-computer-program' idea is absolutely central to this paper; indeed, it forms the basis of a revolution now going on in mathematics, physics, and philosophy. The best defense of the idea can be found in *The Mind's I* by Douglas Hofstadter and Daniel Dennett (1981, especially 69–95, 109–15, 149–201, 373–382). Any reader who feels inclined to reject this idea (and much of recent natural science) simply must read these pages.

In the language of information processing it becomes possible to say precisely what it means for life to continue forever.

DEFINITION: I shall say that life can continue forever if:

1. information processing can continue indefinitely along at least one world line γ all the way to the future *c-boundary* of the universe; that is, until the end of time.
2. the amount of information processed between now and this future *c-boundary* is infinite in the region of space-time with which the world line γ can communicate.
3. the amount of information stored at any given time τ within this region can go to infinity as τ approaches its future limit (this future limit of τ is finite in a closed universe, but infinite in an open one, if τ is measured in what physicists call proper time).

The above is a rough outline of the more technical definition given by Barrow and Tipler (1986, section 10.7. See also Tipler 1986; 1988). But let me ignore details here. What is important are the physical (and ethical!) reasons for imposing each of the above three conditions. The reason for condition 1 is obvious: it simply states that there must be at least one history in which life (=information processing) never ends

in time. (See below for more on what c-boundary means. For now, think of it as meaning 'the end of time'.)

Condition 2 tells us two things: first, that information processed is 'counted' only if it is possible, at least in principle, to communicate the results of the computation to the history γ . This is important in cosmology, because event horizons abound. In the closed Friedmann universe, which is the standard (but oversimplified) model of our actual universe (if it is in fact closed), every comoving observer loses the ability to send light signals to every other comoving observer, no matter how close. Life obviously would be impossible if one side of one's brain became forever unable to communicate with the other side. Life is organization, and organization can only be maintained by constant communication among the different parts of the organization. The second thing condition 2 tells us is that the amount of information processed between now and the end of time is potentially infinite. I claim that it is meaningful to say that life exists *forever* only if the number of thoughts generated between now and the end of time is actually infinite. But we know that each thought corresponds to a minimum of one bit being processed. In effect, this part of condition 2 is a claim that time duration is most properly measured by the thinking rate rather than by proper time as measured by atomic clocks. The length of time it takes an intelligent being to process one bit of information—to think one thought—is a direct measure of subjective time, and hence is the most important measure of time from the perspective of life. A person who has thought ten times as much or experienced ten times as much (there is no basic physical difference between these options) as the average person has in a fundamental sense lived ten times as long as the average person, even if the rapid-thinking person's chronological age is shorter than the average.

The distinction between proper and subjective time crucial to condition 2 is strikingly similar to a distinction between two forms of duration in Thomist philosophy. Recall that Aquinas distinguished three types of duration. The first was *tempus*, which is time measured by change in relations (positions, for example) between physical bodies on earth. *Tempus* is analogous to proper time; change in both human minds and atomic clocks is proportional to proper time, and for Aquinas also, *tempus* controlled change in corporeal minds. But in Thomist philosophy, duration for *incorporeal* sentient beings—angels—is controlled not by matter, but rather is measured by change in the mental states of these beings themselves. This second type of duration, called *aevum* by Aquinas, is clearly analogous to what I have termed 'subjective time.' *Tempus* becomes *aevum* as sentience escapes

the bonds of matter. Analogously, condition 2 requires that thinking rates are controlled less and less by proper time as τ approaches its future limit. *Tempus* gradually becomes *aevum* in the future. (The third type of Thomist duration is *aeternitas*: duration as experienced by God alone. *Aeternitas* can be thought of as “experiencing” all past, present, and future *tempus* and *aevum* events in the universe all at once. But more of *aeternitas* later.)

Condition 3 is imposed because although condition 2 is necessary for life to exist forever, it is not sufficient. If a computer with a finite amount of information storage—such a computer is called a *finite state machine*—were to operate forever, it would start to repeat itself over and over. The psychological cosmos would be that of Nietzsche’s Eternal Return. Every thought and every sequence of thoughts, every action and every sequence of actions would be repeated not once but an infinite number of times. It is generally agreed (by everyone but Nietzsche) that such a universe would be morally repugnant or meaningless. Augustine argued strongly in Book Twelve of *The City of God* that Christianity explicitly repudiates such a worldview, for “Christ died once for our sins, and rising again, dies no more.” The Christian cosmos is progressive. Only if condition 3 holds in addition to condition 2 can a psychological Eternal Return be avoided. Also, it seems reasonable to say that ‘subjectively’, a finite state machine exists for only a finite time even though it may exist for an infinite amount of proper time and process an infinite amount of data. A being (or a sequence of generations) that truly can be said to exist forever ought to be physically able, at least in principle, to have new experiences and to think new thoughts.

Let us now consider whether the laws of physics will permit life/information processing to continue forever. John von Neumann and others (see Barrow and Tipler 1986, section 10.6) have shown that information processing (more precisely, the irreversible storage of information) is constrained by the first and second laws of thermodynamics. Thus the storage of a bit of information requires the expenditure of a definite minimum amount of available energy, this amount being inversely proportional to the temperature (see section 10.6 of Barrow and Tipler 1986 for the exact formula). This means it is possible to process and store an infinite amount of information between now and the Final State of the universe only if the time integral of P/T is infinite, where P is the power used in the computation, and T is the temperature. Thus the laws of thermodynamics will permit an infinite amount of information processing in the future, provided there is sufficient available energy at all future times.

What is 'sufficient' depends on the temperature. In the open and flat ever-expanding universes, the temperature drops to zero in the limit of infinite time, so less and less energy per bit processed is required with the passage of time. In fact, in the flat universe only a *finite* total amount of energy suffices to process an infinite number of bits! This finite energy just has to be used sparingly over infinite future time. On the other hand, closed universes end in a final singularity of infinite density, and the temperature diverges to infinity as this final singularity is approached. This means that an ever-increasing amount of energy is required per bit near the final singularity. However, most closed universes undergo 'shear' when they recollapse, which means they contract at different rates in different directions (in fact, they spend most of their time *expanding* in one direction while contracting in the other two!). This shearing gives rise to a radiation temperature difference in different directions, and this temperature difference can be shown to provide sufficient free energy for an infinite amount of information processing between now and the final singularity, even though there is only a *finite* amount of proper time between now and the end of time in a closed universe. Thus although a closed universe exists for only a finite proper time it nevertheless could exist for an infinite subjective time, which is the measure of time that is significant for living beings.

But although the laws of thermodynamics permit conditions 1 through 3 to be satisfied, this does not mean that the other laws of physics will. It turns out that although the energy is available in open and flat universes, the information processing must be carried out over larger and larger proper volumes. This fact ultimately makes impossible any communication between opposite sides of the 'living' region, because the redshift implies that arbitrarily large amounts of energy must be used to signal (this difficulty was first pointed out by Freeman Dyson; see Barrow and Tipler 1986, section 10.6). This circumstance gives the

FIRST TESTABLE PREDICTION OF THE OMEGA POINT THEORY: the universe must be closed.

As I stated earlier, however, there is a communication problem in most closed universes—event horizons typically appear, thereby preventing communication. But there is a rare class of closed universes which do not have event horizons, which means by definition that every world line can always send light signals to every other world line. Recently, Roger Penrose (see Barrow and Tipler 1986, section 10.6) has found a way to define precisely what is meant by the 'boundary'

of spacetime, where time ends. In his definition of the *c*-boundary, world lines are said to end in the same 'point' on this boundary if they can remain in causal contact unto the end of time. If they eventually fall out of causal contact they are said to terminate in different *c*-boundary points. Thus the *c*-boundary of these rare closed universes without event horizons consists of a single point. For reasons given by Barrow and Tipler (1986, section 10.6; see also section 3.7), it turns out that information processing can continue only in closed universes which end in a single *c*-boundary point, and only if the information processing is ultimately carried out throughout the entire closed universe. In other words, if life is to survive at all, at just the bare subsistence level, it must necessarily engulf the entire universe at some point in the future. It does not have the option of remaining in a limited region. Mere survival dictates expansion. (But if it does engulf the universe, it then has the option of existing at a much wealthier level.) Thus we have the

SECOND TESTABLE (?) PREDICTION OF THE OMEGA POINT THEORY: the future *c*-boundary of the universe consists of a single point; call it the Omega Point. (Hence the name of the theory.)

It is possible to obtain other predictions. For example, a more detailed analysis of how energy must be used to store information leads to the

THIRD TESTABLE PREDICTION OF THE OMEGA POINT THEORY: the density of particle states must diverge to infinity as the energy goes to infinity, but nevertheless this density of states must diverge no faster than the square of the energy.

These predictions just demonstrate that the Omega Point theory is a scientific theory of the future of life in the universe, and it is not my purpose to discuss the science in detail here. Rather, I am concerned in this paper with the theological implications of the Omega Point theory and the way in which the theory can be used to answer Pannenberg's questions to scientists. That the theory can be so used will be clear if I restate a number of the above conclusions in more suggestive words. As I pointed out, in order for the information processing operations to be carried out arbitrarily near the Omega Point, life must have extended its operations so as to engulf the entire physical cosmos. We can say, quite obviously, that life near the Omega Point is omnipresent. As the Omega Point is approached, survival dictates that life collectively gain control of all matter and energy sources available near the Final State, with this control becoming total at the Omega Point. We can say

that life becomes omnipotent at the instant the Omega Point is reached. Since by hypothesis the information stored becomes infinite at the Omega Point, it is reasonable to say that the Omega Point is omniscient; it knows whatever it is possible to know about the physical universe (and hence about itself).

The Omega Point has a fourth property. Mathematically, the *c*-boundary is a completion of spacetime; it is not actually in spacetime, but rather just 'outside' it. If one looks more closely at the *c*-boundary definition, one sees that a *c*-boundary consisting of a single point is formally equivalent to the entire collection of spacetime points, and yet from another point of view it is outside space and time altogether. It is natural to say that the Omega Point is 'both transcendent to and yet immanent in' every point of spacetime. This formal equivalence confirms a conjecture of Pannenberg (1971, 242): "is being itself perhaps to be understood as in truth the power of the future?" When life has completely engulfed the entire universe it will incorporate more and more material into itself, and the distinction between living and non-living matter will lose its meaning.

There is another way to view this formal equivalence of all spacetime and the Omega Point. In effect, all the different instants of universal history are collapsed into the Omega Point; 'duration' for the Omega Point can be regarded as equivalent to the collection of all experiences of all life that did, does, and will exist in the whole of universal history, together with all non-living instants. This 'duration' is very close to the idea of *aeternitas* of Thomist philosophy. We could say that *aeternitas* is equivalent to the union of all *aevum* and *tempus*. If we accept the idea that life and personhood involve change by their very nature (to pass the Turing test, for example, a being has to *do* something), then this identification appears to be the only way to have a Person who is omniscient and hence whose knowledge cannot change: omniscience is a property of the necessarily unchanging not-in-time final state, a state nevertheless equivalent to the collection of all earlier, non-omniscient changing states. The Omega Point in its immanence counts as a Person because at any time in our future the collective information processing system will have, or will be able to generate, subprograms which will be able to pass the Turing test. High intelligence will be required at least collectively in order to survive in the increasingly complex environment near the Final State.

This identification of the Omega Point with the whole of past, present, and future universal history is more than a mere mathematical artifact. *The identification really does mean that the Omega Point 'experiences' the whole of universal history 'all at once'!* For consider what it

means for us to experience an event. It means we think and emote about an event we see, hear, feel, and so on. Consider for simplicity just the 'seeing' mode of sensing. We see another contemporary person by means of the light rays that left her a fraction of a second ago. But we cannot 'see' a person that lived a few centuries before, because the light rays from said person have long ago left the Solar System. Conversely, we cannot 'see' Andromeda Galaxy as it now is, but rather we 'see' it as it was two million years ago. So we experience as simultaneous the events on the boundary of our past light cone (for the seeing mode; it is more complicated for all other modes of sensing, for we experience as simultaneous events which reach us at the same instant along certain timelike curves from inside our past light cone).

But all timelike and lightlike curves converge upon the Omega Point. In particular, all the light rays from all the people who died a thousand years ago, from all the people now living, and from all the people who will be living a thousand years from now, will intersect there. The light rays from those people who died a thousand years ago are not lost forever; rather, these rays will be intercepted by the Omega Point. To put it another way, these rays will be intercepted and intercepted again by the living beings who have engulfed the physical universe near the Omega Point. All the information which can be extracted from these rays will be extracted at the instant of the Omega Point, who will therefore experience the whole of time simultaneously just as we experience simultaneously the Andromeda Galaxy and a person in the room with us.⁴ As Pannenberg puts it in his analysis of the notion of eternity:

The truth of time lies beyond the self-centeredness of our experience of time as past, present and future. The truth of time is the concurrence of all events in an eternal present. Eternity, then, does not stand in contrast to time as something that is completely different. Eternity creates no other content than time. . . . Eternity is the unity of all time, but as such it simultaneously is something that exceeds our experience of time. The perception of all events in an eternal present would be possible only from a point beyond the stream of time. Such a position is not attainable for any finite creature. Only God can be thought of as not being confined to the flow of time. Therefore, eternity is God's time. . . . Eternity means the divine mode of being. (Pannenberg 1970, 74; and see above, 46-47)

The Omega Point regarded as eternity provides an answer to Pannenberg's Fourth Question to scientists: "Is there any positive relation conceivable of the concept of eternity to the spatiotemporal structure

of the physical universe?" (46). The relation between the Omega Point and the physical universe means exactly that "in the perspective of the eternal the temporal does not pass away, although in relation to other spatiotemporal entities it does" (46).

To summarize this section: the indefinitely continued existence of life is not only physically possible; it also leads naturally to a model of a God who is evolving in His/Her immanent aspect (the events in spacetime) and yet is eternally complete in His/Her transcendent aspect. This transcendent aspect is the Omega Point, which is neither space nor time nor matter, but is beyond all of these.

.....

Contingency and Temporal Evolution in Classical General Relativity and in Quantum Cosmology

In physical theories before general relativity, it was always assumed that there was a background spacetime within which the entities of physics—fields and particles—evolved. This background space was unchanging. It was not influenced in any way by the physical entities, and it existed whether or not there were any physical entities. As pointed out by Robert Russell (1988), contingency in these theories came in two forms. First, there was contingency of the nature of the most basic physical entity, with a resulting contingency in the form of the evolution equations satisfied by this entity. *A priori*, there was no reason to choose one class of basic physical entities over another—there was in fact a debate in the nineteenth century over whether the fundamental 'stuff' of the universe was particulate atoms or ether fields. Furthermore, the equations governing the chosen stuff could not be determined by logical consistency alone. Some input from observation was required. But there were imposed on these equations certain general symmetry principles arising from the assumption that the laws of physics did not change with time or as one moved from point to point in space. For example, conservation of energy is a consequence of the laws of physics being unchanged under time translation (that is, the Lagrangian from which the evolution equations are derived is unchanged if it is replaced by $t + a$, where a is some constant). Inertia, or conservation of linear momentum, is a consequence of the laws of physics being unchanged under space translation (the Lagrangian is unchanged if all the spatial coordinates x are replaced by $x + a$). Thus the conservation laws are just a property of the evolution equations and are really just a physical reflection of the eternal and homogeneous nature of the background space. It is the background spacetime, not so much the evolution equations or the conser-

vation laws or the principle of inertia, that in Newtonian physics sustains the physical universe in existence.

The second type of contingency is arbitrariness in the initial conditions for the evolution equations. Suppose that the stuff of nature is a field, and the evolution equations are second order in time. Then, given the field and its first time derivative at any initial time, the value of the field at any subsequent and prior time is uniquely determined (assuming that the initial value problem is well-posed, which it is in most cases of physical interest). But in general there will be a continuum of possible values for the initial value of the field and its derivative, all of these possible values comprising what is called 'initial data space'. In the ontology of classical physics, only one set of initial values—a 'point' in initial data space—is physically realized. All the other initial data values correspond to physically possible worlds which are never actualized.

In general relativity, analogues of both of the above-mentioned contingencies are present. In addition, there is what might be termed an 'evolution' contingency due to the fact that in general relativity there is no background spacetime. Rather, the spacetime is itself generated by the initial data and the evolution equations. A spacetime is generated from its initial data in the following manner. One is given a *three-dimensional* manifold S , and on S the non-gravitational fields F (and their appropriate derivatives F') and two tensor fields h and K , with (F, F', h, K) satisfying certain equations called constraint equations. The constraint equations say nothing about the time evolution; rather, they are to be regarded as consistency conditions among the fields (F, F', h, K) which must be satisfied at every instant of time. The physical interpretation of h is that of a spatial metric of the manifold S , and so S and (F, F', h, K) are called *the initial data*. We now try to find a *four-dimensional* manifold M with metric g and spacetime non-gravitational fields F such that: M contains S as a submanifold; g restricted to S is the metric h ; and K is the 'extrinsic curvature' of S in M (roughly speaking, K says how rapidly h is changing in 'time'). The manifold M and the fields (g, F) are then the whole of physical reality, including the underlying background spacetime—that is, (M, g) —the gravitational field (represented by the spacetime metric g), and all the non-gravitational fields (given by F). There will be infinitely many such M 's and g 's, but one can cut down the number by requiring that g satisfies the Einstein field equations everywhere on M , and that the Einstein field equations reduce to the constraint equations on S .⁵

But even requiring the Einstein equations to hold everywhere leaves infinitely many spacetimes (M, g) which are generated from the *same* initial data at the spacetime instant S . To see this, suppose we

have found a spacetime (M, g) which in fact has S and its initial data as the spatial universe at some instant t_0 of universal time. Pick another universal time t_1 to the future of t_0 and cut away all of the spacetime in (M, g) to the future of t_1 (including the spatial instant corresponding to t_1). This gives a new spacetime (M', g) which coincides with (M, g) to the past of t_1 , but which has absolutely nothing—no space, no time, no matter—to the future of t_1 . Clearly, both (M, g) and (M', g) are spacetimes which are both generated from S and its initial data. Furthermore, the Einstein equations are satisfied everywhere on both spacetimes. There are infinitely many ways we can cut away (M, g) in this way, so there is an infinity of (M', g) 's we can construct. True, the universe (M', g) ends abruptly at t_1 for no good reason. But what of that? The point is that the field equations themselves cannot tell us that the physical universe should continue past the time t_1 . Rather, in classical general relativity one must impose as a separate assumption, over and above the assumption of the field equations and the initial data, that the physical universe must continue in time until the field equations themselves tell us that time has come to an end (at a spacetime singularity, say). Without this separate assumption, which of the infinity of (M', g) 's really exists is contingent.

This cutting away procedure will not work in Newtonian mechanics or indeed in any physical theory which has a pre-existing background spacetime. If we tried to require that the physical fields stopped abruptly at t_1 , then since the instant t_1 and its future still exist, 'fields stopping abruptly' must mean 'fields = 0 abruptly', which would contradict the field equations. So if a theory has a pre-existing background space, the field equations themselves tell us that the universe—or rather the fields and particles making up matter—must keep going. It is more the background spacetime, rather than the evolution equations or the conservation laws, that sustains the universe in being in pre-general relativity theories. Isaac Newton (if not his followers) realized this, asserting that absolute space and time were semi-divine: "the sensorium of God."

If one assumes the physical meaningfulness of the Axiom of Choice (this assumption is fiercely debated; see DeWitt 1973), and in addition one requires that *physical* spacetimes are those in which the g 's and F 's have derivatives at least to the fourth order, then it is possible to prove (Hawking and Ellis 1973, Chapter 7) that there is among all the mathematically possible (M', g) —we might call these 'possible worlds'—a *unique maximal* spacetime (M, g) which is generated by the initial data on S . 'Maximal' means that the spacetime (M, g) contains any other (M', g) generated by the initial data on S as a proper subset.

In other words, (M, g) is the spacetime we get by continuing the time evolution until the field equations themselves will not allow us to go further. This maximal (M, g) is the natural candidate for the spacetime that is actualized, but it is important to keep in mind that this is a physical assumption: all of the (M', g) are possible worlds, and any one of these possible worlds could have been the one that really exists.

Once we have the maximal (M, g) generated from a given S and its initial data, there is an infinity of other choices of three-dimensional manifolds in M which we could picture as generating (M, g) . For example, we could regard the spatial universe and the fields it contains now as 'S with its initial data', or we could regard the universe a thousand years ago as 'S with its initial data'. Both would give the same (M, g) , since the Einstein equations are deterministic. Everything that has happened and will happen is contained implicitly in the initial data on S . There is nothing new under the sun in a deterministic theory like general relativity. One could even wonder why time exists at all since from an information standpoint it is quite superfluous (I will suggest an answer to this question in the next section). None of the infinity of initial data manifolds in (M, g) can be uniquely regarded as generating the whole of spacetime (M, g) . Each contains the same information, and each will generate the same (M, g) , including all the other initial data manifolds.

Even in deterministic theories, relationships between physical entities are different at different times. For example, two particles moving under Newtonian gravity are now two meters apart (say) and a minute later four meters apart. This is true even though given the initial position and velocities when they were two meters apart it is determined then that they will be four meters apart a minute later. The question is, will the totality of relationships at one time become the same (or nearly the same) at some later time? If this happens, then we have the horror of the Eternal Return. As is well known, it is possible to prove that the Eternal Return will occur in a Newtonian universe provided said universe is finite in space and finite in the range of velocities the particles are allowed to have. It is possible to prove that in classical general relativity (Tipler 1979; 1980) the Eternal Return *cannot* occur. That is, the physical relationships existing now between the fields will never be repeated, nor will the relationships ever return to approximately what they now are. What happens is that the Einstein field equations will not permit the gravitational equivalent of the 'range of velocities' to be finite: the range simply must eventually become infinite. Thus history, understood as an unrepeatably temporal sequence of relationships between physical entities, is real. Hence

the answer to Pannenberg's Second Question to scientists—"Are natural processes to be understood as irreversible?"—is yes, if "irreversible" is understood to mean that no natural process can conspire to make some future state be indistinguishable from the current state of the universe. But this meaning of irreversibility is all Pannenberg needs for his argument on the importance of history (Pannenberg 1985).

The meaning of contingency in quantum mechanics depends heavily on which interpretation of the theory is adopted. For example, in the most common version of the Copenhagen Interpretation, there is an intrinsic quantum randomness in nature which adds a new contingency to the three types listed above, whereas in the (non-local) Hidden Variable Interpretation and in the Many Worlds Interpretation, this randomness is merely an artifact of our limited way of observing the physical world. The most basic 'stuff' of the universe, which we cannot observe directly even in principle, but which nevertheless underlies all reality, is completely deterministic (provided the notion of 'time' can be defined, which is not the case in quantum cosmology). Since I am interested here in discussing quantum cosmology, I am virtually forced into adopting the Many Worlds Interpretation, because only in this interpretation is it meaningful to talk about a quantum universe and its ontology. The most common Copenhagen Interpretation assumes that a process called 'wave function reduction' eliminated quantum effects on cosmological scales an exceedingly short time after the Big Bang, so the universe today is not quantum except on very small scales. The problem with this assumption is that the wave function reduction process is almost entirely mysterious—we have no rules for deciding what material entity can reduce wave functions—so it is impossible to give a sharp analysis of contingency when this process is operating. The Many Worlds Interpretation does not suffer from this drawback: there is no reduction of the wave function; physical reality is completely described by the wave function of the universe; there is an equation (the Wheeler-DeWitt equation) for this wave function; and the universe is just as quantum now as it was in the beginning. Of course the Many Worlds Interpretation may be wrong; most physicists think it is (most physicists think it is nonsense). But the overwhelming majority of people working on quantum cosmology subscribe to some version of the Many Worlds Interpretation, simply because the mathematics forces one to accept it. The mathematics may be a delusion, with no reference in physical reality. Or the situation may be similar to that of early seventeenth-century physics: astronomers believed the earth went around the sun, because

the mathematics of the Copernican system forced them to. But few other scholars or ordinary people believed the earth moved. Their own senses told them it did not. I shall adopt the Many Worlds Interpretation in what follows (for a more detailed defense of this interpretation see Barrow and Tipler 1986, section 7.2).

In quantum cosmology the universe is represented by a wave function $\Psi(h, F, S)$, where, as in classical general relativity, h and F are respectively the spatial metric and the non-gravitational fields given on a three-dimensional manifold S . The initial data in quantum cosmology are not (h, F) given on S as was the case in classical general relativity, but rather $\Psi(h, F, S)$ and its first derivatives. From these initial data, the Wheeler-DeWitt equation determines $\Psi(h, F, S)$ for all values of h and F . In other words, the wave function, not the metric or the non-gravitational field, is the basic physical field in quantum cosmology. It is the initial wave function (and appropriate derivatives) that must be given, but once given, it is determined everywhere. What we think of as the most basic fields in classical general relativity, namely h and F , play the role of coordinates in quantum cosmology. But this does not mean h and F are unreal. They are as real as they are in classical theory. It does mean, however, that more than one h and F exist on S at the same time! To appreciate this, recall that the classical metric $h(x)$ is a function of the spatial coordinates on the manifold S . This metric has (non-zero) values at all points on S ; that is, for the entire range of the coordinates as they vary over S —which is to say, as we go from one point to another in the universe. Each value of $h(x)$ is equally real, and all of the values of h at all of the points of S exist simultaneously. Similarly, the points in the domain of the wave function $\Psi(h, F, S)$ are the various possible values of h and F , each set (h, F) corresponding to a complete universe at a given instant of time. The central claim of the Many Worlds Interpretation is that each of these universes actually exists, just as the different $h(x)$ exist at the various points of S : quantum reality is made up of an infinite number of universes (worlds). Of course, we are not aware of these worlds—we are only aware of one—but the laws of quantum mechanics explain this: we must generally be as unaware of these parallel worlds as we are of our motion with the earth around the sun. (In extreme conditions, for instance near singularities, it is possible for the worlds to affect each other in a more obvious way than they do now.)

To fix the classical initial data, we pick a *function* $h(x)$ out of an infinite number of possible metric functions which could have been on S . All of these possible worlds comprise a function space. To fix the quantum initial data, we pick a *wave function* $\Psi(h, F, S)$ out of an infi-

nite number of possible wave functions which could have been on the classical function space (h, F) . Remember, however, that all values of the function space (h, F) , *really are* on S simultaneously. In quantum cosmology, the collection of all possible wave functions forms the set of the possible worlds; what is contingent is which single unique universal wave function is actualized. But the possible worlds of classical cosmology—the space of all physically possible (h, F) on S —are no longer contingent. All of them are actualized.

In classical deterministic general relativity, we had a philosophical problem with time: since everything that did or will happen was coded in the initial fields on S , time evolution appeared superfluous. What was the point of having time? The problem is solved in quantum cosmology: *there is no time!* The universal wave function $\Psi(h, F, S)$ is all there is, and there is no reference to a four-dimensional manifold M or a four-dimensional metric g in the wave function. At the most basic ontological level, time does not exist. Everything is on the three-dimensional manifold S . How can this be? Of course we see time! Or do we? What we see is relationships among objects—configurations of physical fields—in space. In the discussion of the Eternal Return, I argued that time and history could be truly real only if the spatial relationships between the various fields never returned to a previous state. In quantum cosmology, there is no spacetime in which the spatial relationships between fields can change. Rather, all we have is paths (trajectories) in the collection (h, F) of all possible relationships between the physical fields on S . But this is enough, because each such path defines a history, a complete spacetime.

To understand this, imagine that we are at a point P in (h, F) and have selected a particular path γ in (h, F) starting at P . Each point, remember, corresponds to an entire universe (spatially). As we go along γ , the relationships between the physical fields vary smoothly from their values at P . *This variation would appear as temporal variation* from inside the path γ , because each point on γ is a complete spatial universe, and thus the sequence of points constitutes a sequence of spatial universes. But this is exactly the same as the classical four-dimensional manifold M with its spacetime metric g and spacetime fields F , which in the above classical analysis we obtained as an extension of S and its fields! Each path in (h, F) thus is an entire classical universal history, an entire spacetime.

All paths in (h, F) really exist, which necessarily means that all—and I mean all—histories which are consistent with the 'stuff' of the universe being (h, F) really exist. In particular, even histories which are grossly inconsistent with the laws of physics really occur! Closed

paths in (h, F) obviously exist, so there are histories in which the Eternal Return is true. There are also real histories leading to our presently observed state of the universe—the point P in (h, F) —in which real historical characters—for instance Julius Caesar—never existed. What happens in such a history is that the physical fields rearrange themselves over time (more accurately, over the path corresponding to this strange history) to create false memories, including not only human memories but also the ‘memories’ in a huge number of written records and in massive monuments. Just as there is an infinity of actual pasts which have led to the present state, so there is an infinity of really existing futures which evolve from the present state. So every consistent future is not only possible but it really happens. Not all futures are equally likely to be seen, however. There is one path in (h, F) leading from a given point P which is overwhelmingly more likely to follow from P than all the others. This path is called *the classical path*. Along this path the laws of physics hold, and memories are reliable. A classical path in (h, F) very closely resembles a classical spacetime (M, g) obeying the Einstein quotations.

So far I have not said what the wave function Ψ itself does. But it must do something physically detectable, something not coded in the fields (h, F) alone. If it did not exert some physical effect, we could just omit it from physics; it would have no real existence. But I claimed above that Ψ was a *real* field, something as real as the fields (h, F) .

What Ψ does is determine the set of all classical paths, and also the “probabilities” which are associated with each point and each path in (h, F) . A wave function is a complex function, and all complex functions are actually two functions, a ‘magnitude’ and a ‘phase’. The classical paths are by definition those which are perpendicular to the surfaces of constant phase. The square of the magnitude at a point P in (h, F) is the ‘probability’ of that point. The physicist Werner Heisenberg showed mathematically that if probability has its usual meaning, then given the fact that we are (approximately) at P , the conditional probability of going to a nearby point Q is maximum if Q lies along the classical path through P . The relative probability is very close to 1 on the classical path, and it drops rapidly to 0 as one moves away from the classical path connecting P and Q (see Barrow and Tipler 1986, section 7.2 for details about how this works).

What must be shown is that the square of the magnitude is in fact a probability in the usual sense. This is done as follows. We obviously cannot get hold of the wave function of the entire universe, but we can prepare in the laboratory a number N of electrons with the same spin wave function. Suppose we measure the vertical component of the

electron spin. It turns out that this component can have only two values, spin up and spin down. If the wave function is not in what is called an 'eigenstate' of spin up or spin down—in general the electron wave function would not be in an eigenstate, so let us suppose it is not—then each time we measure the vertical component of an electron in our ensemble of N electrons we will get a different answer. Some of the electrons will be found to have spin up, and the others will have spin down. We cannot predict before the measurement what the vertical component of that particular electron will be. But it can be shown that if we compute the relative frequency with which we get spin up, then this number approaches the square of the magnitude of the wave function evaluated at spin up as the number N of electrons in the ensemble approaches infinity. And experimentally, this is what we see.

All the physics is contained in the wave function. In fact, the laws of physics themselves are completely superfluous. They are coded in the wave function. The classical laws of physics are just those regularities which are seen to hold along a classical path by observers in that classical path. Along other paths, there would be other regularities, different laws of physics. And these other paths exist and hence these other laws of physics really hold; it is just extremely unlikely we will happen to see them operating. The Wheeler-DeWitt equation for the wave function is itself quite superfluous. It is merely a crutch to help us find the actual wave function of the universe. If we knew the boundary conditions which the actual universal wave function satisfied, then we could derive the Wheeler-DeWitt equation, which is just a particular equation (among many) which the wave function happens to satisfy. Thus in quantum cosmology there is no real contingency in the laws of physics. Any law of physics holds in some path, and the law of physics governing the universal wave function can be derived from that wave function. All the contingency in quantum cosmology is in the wave function, or rather, in the boundary conditions which pick out the wave function which actually exists.

The well-known Hartle-Hawking boundary condition, which says that 'the universal wave function is that wave function for which the Feynman sum over all the paths (classical and otherwise) leading to a given point P is over paths that have no boundaries (more precisely, the four-dimensional manifold corresponding to a given path is a compact manifold whose only boundary is P)' is one such boundary condition. I should like to propose the

TEILHARD BOUNDARY CONDITION FOR THE UNIVERSAL WAVE FUNCTION:
The wave function of the universe is that wave function for which all classical paths terminate in a (future) Omega Point,

with life coming into existence along at least one classical path and continuing into the future forever all the way into the Omega Point.

The Teilhard boundary condition is enormously restrictive. For example, since classical paths are undefined at zeros of the wave function, we immediately have the

FOURTH TESTABLE PREDICTION OF THE OMEGA POINT THEORY: the universal wave function must have no zeros in the spacetime domain.

It turns out (as one might expect) that the Hartle-Hawking boundary condition does not satisfy the Teilhard boundary condition. I have a rough argument that one can construct simple quantized Friedmann cosmological models in which all classical paths terminate in an Omega Point, but I do not know yet what the existence of life requires of a wave function. So at present I can only conjecture, not prove, that a wave function satisfying the Teilhard boundary condition in its full generality exists mathematically. (This is not unusual; there is also no general existence proof yet for the Hartle-Hawking boundary condition.) I also conjecture (for reasons that will be given in the following section) that the Teilhard boundary condition gives a unique wave function.

Let us suppose that the above conjectures are true. Then it would mean that the laws of physics and every entity that exists physically would be generated by the Omega Point and its living properties. For these properties determine the universal wave function, and the wave function determines everything else. This 'determination' is *not* classical determinism, however, because there is no globally defined time on the whole of (h, F) , and without this globally defined time, the idea of the past or the present rigidly dictating the future course of events is meaningless. Nevertheless, time is real. It exists in the classical paths, and according to the Teilhard boundary condition the structure of these paths (more precisely, their ultimate future) gives probability weights—guidance, so to speak, not rigid control—to all paths. The ultimate future guides all presents into itself. As Pannenberg puts it: "[God] exists only in the way in which the future is powerful over the present, because the future decides what will emerge out of what exists in the present. . . . Above all, the power of the future does not rob man of his freedom to transcend every state of affairs. A being presently at hand, and equipped with omnipotence, would destroy such freedom by virtue of his overpowering might" (Pannenberg 1971, 242). In this sense, we can say that the Omega Point "creates the physical universe." But there is another sense in which the Omega

Point and the totality of everything that exists physically can be said to create themselves. To this second sense we now turn.⁶

.....

The Universe Necessarily Exists

Suppose it were shown as a matter of physics that the Omega Point really exists. Then would it still be reasonable to assert the existence of a God over and above the Omega Point? Not if we could show that the Omega Point necessarily exists in the strong sense of logical necessity—that to deny its existence would be a logical contradiction. Ever since Kant showed that ‘existence is not a predicate’ and Gottlob Frege deepened this insight into ‘existence is not a first-level predicate’ (Williams 1981), it generally has been felt that the ontological/cosmological argument is invalid, that it is impossible by means of logic alone to prove the existence of anything. I want to claim that this is incorrect; I think you can prove that the universe necessarily exists. The proof will be based on an analysis of what the word ‘existence’ means.

Let us begin with some computer metaphysics. Much of computer science is devoted to making *simulations* of phenomena in the physical world. In a simulation, a mathematical model of the physical object under study is coded in a program. The model includes as many attributes of the real physical object as possible (limited of course by the knowledge of these attributes, and also by the capacity of the computer). The running of the program evolves the model in time. If the initial model is accurate, if enough key features of the real object are captured by the model, the time evolution of the model will mimic with fair accuracy the time development of the real object, so one can predict the most important key aspects which the real object will have in the future.

Suppose we try to simulate a city full of people. Such simulations are being attempted now, but at a ludicrously inaccurate level. Suppose, though, that we imagine more and more of the attributes of the city being included in the simulation. In particular, more and more properties of each individual person are included. In principle, we can imagine a simulation being so good that every single *atom* in each person and each object in the city and the properties of each atom have an analogue in the simulation. Let us imagine, in the limit, a simulation that is absolutely perfect: each and every property of the real city, and each and every real property of each real person in the real city is represented precisely in the simulation. Furthermore, let us imagine that

when the program is run on some gigantic computer, the temporal evolution of the simulated persons and their city precisely mimics for all time the real temporal evolution of the real people and the real city.

The key question is this: Do the simulated people exist? As far as the simulated people can tell, they do. By assumption, any action which the real people can and do carry out to determine if they exist—reflecting on the fact that they think, interacting with the environment—the simulated people also can and in fact do perform. There is simply no way for the simulated people to tell that they are ‘really’ inside the computer, that they are merely simulated and not real. They can’t get at the real substance, the physical computer, from where they are, inside the program. One can imagine the ultimate simulation, a perfect simulation of the entire physical universe, containing in particular all people whom the real universe contains, and which mimics perfectly the actual time evolution of the actual universe. Again, there is no way for the people inside this simulated universe to tell that they are merely simulated, that they are only a sequence of numbers being tossed around inside a computer and are in fact not real. How do we know we ourselves are not merely a simulation inside a gigantic computer? Obviously, we cannot know. But I think it is clear that we ourselves really exist. Therefore, *if* it is in fact possible for the physical universe to be in precise one-to-one correspondence with a simulation, I think we should invoke the Identity of Indiscernibles and identify the universe and all of its perfect simulations.⁷

But is it possible for the universe to be in precise one-to-one correspondence with some simulation? I think that it is, if we generalize what we mean by simulation. In computer science, a simulation is a program, which is fundamentally a map from the set of integers into itself. That is, the instructions in the program tell the computer how to go from the present state, represented by a sequence of integers, to the subsequent state, also represented by a sequence of integers. Remember, however, that we do not really need the physical computer; the initial sequence of integers and the general rule (instructions or map) for replacing the present sequence by the next is all that is required. But the general rule can itself be represented as a sequence of integers. If time were to exist globally, and if the most basic things in the physical universe and the time steps between one instant and the next were discrete, then the whole of spacetime would definitely be in one-to-one correspondence with some program. But time may not exist globally (it does not if standard quantum cosmology is true), and it may be that the substances of the universe are continuous fields and not discrete objects (in *all* current physical theories, the basic substances are

continuous fields). Thus if the actual universe is described by something resembling current theories, it cannot be in one-to-one correspondence with a standard computer program, which is based on integer mappings. There is currently no model of a 'continuous' computer. Turing even argued that such a thing is meaningless! (There are definitions of 'computable continuous functions', but none of the definitions is really satisfactory.)

Let us be more broad minded about what is to count as a simulation. Consider the collection of all mathematical concepts. Let us say that a perfect simulation exists if the physical universe can be put into one-to-one correspondence with some mutually consistent subcollections of all mathematical concepts. In this sense of simulation the universe can certainly be simulated, because simulation then amounts to saying that the universe can be exhaustively described in a logically consistent way. Note that 'described' does not require that we or any other finite (or infinite) intelligent being can actually find the description. It may be that the actual universe expands into an infinite hierarchy of levels whenever one tries to describe it exhaustively. In such a case, it would be impossible to find a Theory of Everything. Nevertheless, it would still be true that a simulation in the more general sense existed if each level were in one-to-one correspondence with some mathematical object, and if all levels were mutually consistent ('consistency' meaning that in the case of disagreement between levels, there is a rule—itsself a mathematical object—for deciding which level is correct). The crucial point of this generalization is to establish that the actual physical universe is something in the collection of all mathematical objects. This follows because the universe has a perfect simulation, and we agree to identify the universe with its perfect simulation. Thus at the most basic ontological level the physical universe is a concept.

Of course not all concepts exist physically. But some do. Which ones? The answer is provided by our earlier analysis of programs. *The simulations which are sufficiently complex to contain observers—thinking, feeling beings—as subsimulations exist physically.* And further, they exist physically by definition: for this is exactly what we mean by existence; namely, that thinking and feeling beings think and feel themselves to exist. Remember, the simulated thinking and feeling of simulated beings are real. Thus the actual physical universe—the one in which we are now experiencing our own simulated thoughts and simulated feelings—exists necessarily, by definition of what is meant by existence. Physical existence is just a particular relationship between concepts. Existence is a predicate, but a predicate of certain very, very

complex simulations. It is certainly not a predicate of simple concepts—for instance ‘100 thalers’.

With equal necessity many different universes will exist physically. In particular, a universe in which we do something slightly different from what we actually do in this one will exist (provided of course that this action does not logically contradict the structure of the rest of the universe). But this is nothing new; it is already present in the ontology of the Many-Worlds Interpretation. Exactly how many universes really exist physically depends on your definition of ‘thinking and feeling being’. If you adopt a narrow definition—such a being must have at least our human complexity—then the range of possible universes appears quite narrow: Barrow and Tipler’s *Anthropic Cosmological Principle* (1986) is devoted to a discussion of how finely tuned our universe must be if it is to contain beings like ourselves.

What happens if a universal simulation stops tomorrow? Does the universe collapse into non-existence? Certainly such terminating simulations exist mathematically. But if there is no intrinsic reason visible from inside the simulation for the simulation to stop, it can be embedded inside a larger simulation which does not stop. Since it is the observations of the beings inside the simulation that determines what exists physically, and since nothing happens from their viewpoint at the termination point when the terminating simulation is embedded in the non-stopping simulation, the universe must be said to continue in existence. It is the maximal extension which has existence, for by the Identity of Indiscernibles we must (physically) identify terminating programs with their embedding in the maximal program.⁸

Furthermore, if it is logically possible for life to continue to exist forever in some universe, this universe will exist necessarily for all future time. In particular, if the Omega Point described in the previous two sections is logically coherent, then the Omega Point exists necessarily. Again, one can find numerous lines of evidence strongly suggesting that it is exceedingly difficult to construct a universe for life to exist at all, much less exist forever. So I would expect the universe selected by the Teilhard boundary condition to be unique. If so, logical consistency (and the definition of ‘life’, ‘thinking and feeling being’, and so on) will select out a single unique wave function for actualization. Since the wave function and its arguments determine respectively the physical laws and the ‘stuff’ that exist, in this case the physical universe would be determined by logical consistency alone. Thus we again conclude that the universe exists necessarily.

The God of Hope

Suppose the Omega Point really exists. Can we mortal human beings find hope in that fact? I believe we can. For hope fundamentally means an expectation that in an appropriate sense the future will be better than the present or the past. Even on the most materialistic level, the future existence of the Omega Point would assure our civilization of ever-growing total wealth, continually increasing knowledge, and quite literal eternal progress. This perpetual meliorism is built into the definition of 'life existing forever' given in the second section. Such worldly meliorism would support an orthodox Christian position on the meaning of the natural world as against, say, the Gnostic view. In the orthodox view, the physical universe is basically good, because it was created by an omnipotent and omniscient deity who is also all good.

Of course, it is a consequence of physics that although our civilization may continue forever, our species *Homo sapiens* must inevitably become extinct, just as every individual human being must inevitably also die. For as the Omega Point is approached, the temperature will approach infinity everywhere in the universe, and it is impossible for our type of life to survive in that environment.⁹ But the death of *Homo sapiens* is an evil (beyond the death of the human individuals) only for a racist value system. What is humanly important is the fact we think and feel, not the particular bodily form which clothes the human personality. Just as within *Homo sapiens* a person is a person independent of sex or race, so also an intelligent being is a person regardless of whether that individual is a member of the species *Homo sapiens*. Currently people of non-European descent have a higher birthrate than people of European descent, and so the percentage of *Homo sapiens* which is of European descent is decreasing. The human race is now changing color. In my own value system, this color change is morally neutral; what is important is the overall condition of our civilization: are we advancing in knowledge and wisdom? Certainly our scientific knowledge is greater than it was a century ago, and although there have been a great many steps backward during this century, I nevertheless think we are wiser than our great grandparents. If the Omega Point exists, this advance will continue without limit into the Omega Point. Our species is an intermediate step in the infinitely long temporal Chain of Being (Lovejoy 1936) that comprises the whole of life in spacetime. An essential step, but still only a step. In fact, it is a logically necessary consequence of eternal progress that our species become extinct! For we are finite beings; we have definite limits. Our brains can code only so much information, and we can

understand only rather simple arguments. If the ascent of Life into the Omega Point is to occur, one day the most advanced minds must be non-*Homo sapiens*. The heirs of our civilization must be another species, and their heirs yet another, *ad infinitum* into the Omega Point. We must die—as individuals, as a species—in order that our civilization might live. But the contributions to civilization which we make as individuals will survive our individual deaths. Judging from the rapid advance of computers at present, I would guess that the next stage of intelligent life would be quite literally information-processing machines. At the present rate, computers will reach the human level in information-processing and integration ability probably within a century, certainly within a thousand years.

Many find the assurance of the immortality of life as a whole cold comfort for their death as individuals. They feel that a truly good God would make some provision for individual life after death also. What the Christian hopes for in eternal life has been ably expressed by Pannenberg:

the life that awakens in the resurrection of the dead is the same as the life we now lead on earth. However, it is our present life as God sees it from his eternal present. Therefore, it will be completely different from the way we now experience it. Yet, nothing happens in the resurrection of the dead except that which already constitutes the eternal depth of time now and which is already present for God's eyes—for his creative view! (Pannenberg 1970, 80)

We shall, so to speak, live again in the mind of God. But recall my discussion of Thomist *aeternitas*. There I pointed out that all the information contained in the whole of human history, including every detail of every human life, will be available for analysis by the collectivity of life in the far future. In principle at least (again ignoring the difficulty of extracting the relevant information from the overall background noise), it is possible for life in the far future to construct, using this information, an exceedingly accurate simulation of these past lives: in fact, this simulation is just what a sufficiently close scrutiny of our present lives by the Omega Point would amount to. And I have also pointed out that a sufficiently perfect simulation of a living being would *be* alive! Whether the Omega Point would choose to use His/Her power to do this simulation, I cannot say. But it seems the physical capability to carry out the scrutiny would be there.¹⁰ Furthermore, the drive for total knowledge—which life in the future must seek if it is to survive at all, and which will be achieved only at the Omega Point—would seem to require that such an analysis of the past, and hence such a simulation, would be carried out. If so, then the

resurrection of the dead in Pannenberg's sense would seem inevitable in the *eschaton* (last times).

I should emphasize that this simulation of people that have lived in the past need not be limited to just repeating the past. Once a simulation of a person and his or her world has been formed in a computer of sufficient capacity, the simulated person can be allowed to develop further—to think and feel things that the long-dead original person being simulated never felt and thought. It is not even necessary for *any* of the past to be repeated. The Omega Point¹¹ could simply begin the simulation with the brain memory of the dead person as it was at the instant of death (or, say, ten years before or twenty minutes before) implanted in the simulated body of the dead person, the body being as it was at age twenty (or any other age). This body and memory collection could be set in any simulated background environment the Omega Point wished: a simulated world indistinguishable from the long-extinct society and physical universe of the revived dead person; or even a world that never existed, but one as close as logically possible to the ideal *fantasy* world of the resurrected dead person. Furthermore, all possible combinations of resurrected dead can be placed in the same simulation and allowed to interact. For example, the reader could be placed in a simulation with *all* of his or her ancestors and descendents, each at whatever age (physical and mental, separately) the Omega Point pleases. The Omega Point itself could interact—speak, for instance—with His/Her simulated creatures, who could learn about Him/Her, about the world outside the simulation, and about other simulations, from Him/Her.

The simulated body could be one that has been vastly improved over the one we currently have; the laws of the simulated world could be modified to prevent a second physical death. Borrowing the terminology of Paul, we can call the simulated, improved, and undying body a 'spiritual body', for it will be of the same 'stuff' as the human mind now is: a 'thought inside a mind' (in Aristotelian language, 'a form inside a form'; in computer language, a 'virtual machine inside a machine'). The spiritual body is thus just the present body (with improvements!) at a higher level of implementation.¹² With this phrasing, Paul's description is completely accurate: "So also is the resurrection of the dead. It is sown in corruption; it is raised in incorruption: It is sown in dishonor; it is raised in glory; it is sown in weakness; it is raised in power: It is sown a natural body; it is raised a spiritual body" (1 Cor. 15:42–44). Only as a spiritual body, only as a computer simulation, is resurrection possible without a second death: our current bodies, implemented in matter, could not possibly survive the extreme

heat near the final singularity. Again, Paul's words are descriptive: "flesh and blood cannot inherit the kingdom of God" (1 Cor. 15:50).

Nevertheless, it is appropriate to regard computer simulation resurrection as being a "resurrection of the flesh" (in the words of the Apostles' Creed). For a simulated person would observe herself to be as real, and as having a body as solid as the body we currently observe ourselves to have. There would be nothing 'ghostly' about the simulated body, and nothing insubstantial about the simulated world in which the simulated body found itself. In the words of Tertullian, the simulated body would be "this flesh, suffused with blood, built up with bones, interwoven with nerves, entwined with veins, [a flesh] which . . . [is] . . . undoubtedly human" (*De Carne Christi*, 5; trans. by Pagels 1979, 4).

Although computer simulation resurrection overcomes the physical barriers to eternal life of individual human beings, there remains a logical problem, namely, the finiteness of the human memory. The human brain can store only about 10^{15} bits (this corresponds to roughly a thousand subjective years of life), and once this memory space is exhausted we can grow no more (Barrow and Tipler 1986, 136). Thus it is not clear that the undying resurrected life is appropriately regarded as 'eternal'. There are several options: the Omega Point could permit us to merge our individual personalities—upload our personalities out of the simulation into a higher level of implementation—into the universal mind¹³ which is His/Hers (increasing our memory storage capacity indefinitely beyond 10^{15} bits would amount to the same thing). Alternatively, the Omega Point could guide us to a 'perfection' of our finite natures, whatever 'perfection' means! Depending on the definition, there could be many perfections. With sufficient computer power, it should be possible to calculate what a human action would result in without the simulation actually experiencing the action, so the Omega Point would be able to advise us on possible perfections without our having to go through the trial-and-error procedure characteristic of this life. If more than one simulation of the same individual is made, then *all* of these options could be realized simultaneously. Once an individual is 'perfected', the memory of this perfect individual could be recorded permanently—preserved all the way into the Omega Point in its transcendence. The errors and evil committed by the imperfect individual could be erased from the universal mind (or also permanently recorded). The perfected individual personality would be truly eternal; she would exist for all future time. Furthermore, when the perfected personality reached the Omega Point in its transcendence, it would become eternal in the sense of being beyond

time, being truly one with God. The natural term to describe this perfected immortality is 'beatific vision'.

If the resurrected life is going to be so wonderful,¹⁴ one might ask why we must go through our current life, this 'vale of tears', at all. Why not start life at the resurrection? The answer was given in the third and fourth sections: our current life is logically necessary; simulations indistinguishable from ourselves *have* to go through it. It is logically impossible for the Omega Point to rescue us. Even omnipotence is limited by logic. This is the natural resolution to the Problem of Evil.

In his *On the Immortality of the Soul*, David Hume raised the following objection to the idea of a general resurrection of the dead: "How to dispose of the infinite number of posthumous existences ought also to embarrass the religious theory" (Hume [1755] in Flew 1964, 187). Hume summarized the argument in a later interview with the famous biographer James Boswell:

[Hume] added that it was a most unreasonable fancy that he should exist forever. That immortality, if it were at all, must be general; that a great proportion of the human race has hardly any intellectual qualities; that a great proportion dies in infancy before being possessed of reason; yet all these must be immortal; that a Porter who gets drunk by ten o'clock with gin must be immortal; that the trash of every age must be preserved, and that new Universes must be created to contain such infinite numbers. (Hume [1776] 1977, 77)

The ever-growing numbers of people whom Hume regarded as trash nevertheless could be preserved forever in our single finite (classical) universe if computer capacity is created fast enough. By looking more carefully at the calculations summarized in the second section of this paper, one sees that they also show it is physically possible to save *forever* a certain constant percentage of the information processed at a given universal time. Thus, the computer capacity will be there to preserve even drunken porters (and perfected drunken porters), provided only that the Omega Point waits long enough before resurrecting them. Even though the computer capacity required to simulate perfectly is exponentially related to the complexity of entity simulated, it is physically possible to resurrect an actual infinity of individuals between now and the Omega Point—even assuming the complexity of the average individual diverges as the Omega Point is approached—and guide then *all* into perfection. Total perfection of all would be achieved at the instant of the Omega Point.¹⁵

But this preservation capacity has an even more important implication: *it means that the resurrection is likely to occur even if sufficient infor-*

mation to resurrect cannot be extracted from the past light cone. Since the universal computer capacity increases without bound as the Omega Point is approached, it follows that if only a bare-bones description of our current world is stored permanently, then a time will inevitably come when there will be sufficient computer capacity to simulate our present-day world by simple brute force—by creating a simulation of *all* logically possible variants of our world. For example, the human genome can code about 10 to the 10⁶ power possible humans, and the brain of each could have 2 to the 10¹⁵ power possible memories. With the computer power that will eventually become available, the Omega Point could simply simulate them all. Just the knowledge of the human genome would be enough for this. And even if the record of the human genome is not retained until the computer capacity is sufficient, it would still be possible to resurrect all possible humans, just from the knowledge it was coded in DNA. Merely simulate all possible life forms that could be coded by DNA (for technical reasons, the number is finite), and all logically possible humans necessarily will be included. Such a brute force method is not very elegant;¹⁶ I discuss it only to demonstrate that resurrection is unquestionably physically possible. And if there is no other way, it almost certainly will be done by brute force in the drive toward total knowledge. In our own drive to understand how life got started on our planet, we are in effect trying to simulate—resurrect—all possible kinds of the simplest life forms which could spontaneously form on the primitive earth.

What happens to the resurrected dead is entirely up to the Omega Point; there is no way that simulations can enforce or pay for the immortality which it is in the power of the Omega Point to grant. But continued survival near the final state will require greater and greater cooperation, and we know that cooperation is generally associated with altruism. Furthermore, if the resurrection is delayed sufficiently long, then the relative computer resources required to resurrect, guide the whole of humanity into the beatific vision, and preserve the perfected individuals forever will be tiny. Since the cost of doing good is not significantly greater than the cost of doing evil, I think we can reasonably count on the former, especially if the Person making the choice is basically good. Adopting the natural theological term, I think we will be granted 'grace'.

The hope of eternal worldly progress and the hope of individual survival beyond the grave turn out to be the same. Far from being polar opposites, these two hopes require each other; we cannot have one without the other. The Omega Point is truly the God of Hope: "O death, where is thy sting? O grave, where is thy victory?" (1 Cor. 15:55).

.....

From *Zygon: Journal of Religion and Science* 24 (June) 1989, 217–253. By permission.

.....

Notes

1. A detailed comparison of the Omega Point theory developed below and Teilhard's Point Omega will be found in section 3.11 of my book with John D. Barrow, *The Anthropic Cosmological Principle* (1986).
2. To emphasize the scientific nature of the Omega Point theory, let me state here that I consider myself an atheist. I certainly do not believe in the God of the traditional Christian metaphysics which I have read, and although the Omega Point theory is a viable scientific theory of the future of the physical universe, there is as yet no confirming experimental evidence for it. Thus it is premature to accept it. Flew (1984), among others, has in my opinion made a convincing case for the presumption of atheism. Nevertheless, I think atheistic scientists should take the Omega Point theory seriously because we have to have *some* theory for the future of the physical universe—since it unquestionably exists—and the Omega Point theory is based on the most beautiful physical postulate: that total death is not inevitable. *All* other theories of the future necessarily postulate the ultimate extinction of everything we could possibly care about. I once visited a Nazi death camp; there I was reinforced in my conviction that there is nothing uglier than extermination. We physicists know that a beautiful postulate is more likely to be correct than an ugly one. Why not adopt the postulate of eternal life, at least as a working hypothesis?
3. Unfortunately, Aristotle ruined his own idea of the soul by soiling it with Platonic dualism. This mistake led to Aquinas's contradictory notion of *substantial form*. Both ideas suggest that the personality survives death naturally (see Flew 1964, 16–21; 1987, 71–87). As Pannenberg has emphasized, the idea of a disembodied soul which can think without a body is contrary to the Jewish and early Christian tradition. If it were true, what would be the point of the resurrection of the flesh? As Plato himself realized, the Platonic soul suggests reincarnation, not resurrection.
4. I should warn the reader that I have ignored the problem of opacity and the problem of loss of coherence of the light. Until these are taken into account, I cannot say exactly how much information can in fact be extracted from the past. But at the most basic ontological level, all the information from the past (all of human history) remains in the physical universe and is available for analysis by the Omega Point.
5. I should mention in passing that in general relativity the standard conservation laws are almost trivially true. In general relativity the conservation law for mass-energy reads $d^*T = 0$, which follows from the Einstein equations $G = 8\pi T$, which can be regarded as defining the stress energy tensor T , and the fact that *any* metric g satisfies $d^*G = 0$. See Misner, Thorne, and Wheeler (1973, Chapter 15) for a discussion of this point. The principle of inertia plays no role in sustaining the universe in existence.

6. I should mention that there is another quantum theory of the Omega Point, due to John A. Wheeler (1988). Wheeler's theory is based on a non-standard version of the Copenhagen Interpretation, and in his theory the Omega Point quite literally creates almost everything in the physical universe by backward causation. We ourselves create some entities in the universe, but our creations are insignificant when compared to the creations of the Omega Point. On Wheeler's theory, however, future evolution stops at the Planck time, so the properties of the Omega Point which depend on infinity are not present in Wheeler's theory.
7. For more discussion of whether a simulation must be regarded as real if it copies the real universe sufficiently closely, see Hofstadter and Dennett (1981, particularly 73–78, 94–99, 287–300).
8. One could use a similar argument for asserting the physical existence of the maximal evolution from given initial data in the classical general relativity evolution problem.
9. Incidentally, the non-existence of the Omega Point would not help us. If the universe were open and expanded forever, then the temperature would go to zero as the universe expanded. There is not enough energy in the frigid future of such a universe for *Homo sapiens* to survive. Also, protons probably decay, and we are made up of atoms, which require protons.
10. It is interesting that if the universe were infinite in spatial extent, then this information about the past would scatter to infinity and never in the whole of the future be reconcentrated for possible reconstruction.
11. In one of its immanent intermediate temporal states; this qualification is hereafter omitted for ease of reading.
12. See Hofstadter and Dennett (1981, 379–381) for a very brief discussion of the extremely important computer concept of *levels of implementation*.
13. Strictly speaking, I do not know the Omega Point (in its immanence) has a human-type mind at the highest level of implementation. Probably not; a human-type mind is a manifestation of an extremely low level of information processing: a mere ten to 1,000 gigaflops (Barrow and Tipler 1986, 136). Nevertheless, the Omega Point is still a Person (at all times in our future), because a being with its level of computer capacity could easily create a Turing-test-passing subprogram to speak for it. Our resurrected selves probably will interact with such a program; it is beyond human capacity to deal directly with the highest level of implementation possessed by the state of the Omega Point at the time we are resurrected. For lack of a better term, I shall refer to the total universal information-processing system in existence at any given universal time as the 'universal mind'.
14. The version of eternal life discussed here is not attractive to everyone. What is happening is that an exact replica of ourselves is being simulated in the computer minds of the far future. Flew, for example, considers it ridiculous to call this 'resurrection', and he puts forward the "Replica Objection": "No replica however perfect, whether produced by God or

man, whether in our Universe or another, could ever be—in that primary, forensic sense—the same person as its original. . . . To punish or to reward a replica, reconstituted on Judgement Day, for the sins or the virtues of the old Antony Flew dead and cremated, perhaps long years before, is as inept and as unfair as it would be to reward or to punish one identical twin for what was in fact done by the other” (Flew 1976, 12, 9). Flew is wrong about our legal system. It does in fact equate identical computer programs. If I duplicated a word-processing program and used it without paying a royalty to the programmer, I would be taken to court. A claim that “the program I used is not the original, it is merely a replica” would not be accepted as a defense. I could also be sued for using without permission an organism whose genome has been patented. Identical twins are *not* identical persons. The programs which are their minds differ enormously; the memories coded in their neurons differ from each other in at least as many ways as they differ from the memories of other human beings. They are correctly regarded as different persons. But two beings who are identical both in their genes *and* in their mind programs *are* the same person, and it is appropriate to regard them as equally responsible legally. I am surprised that an empiricist philosopher like Flew would make the claim that entities which cannot be empirically distinguished, even in principle, are nevertheless to be regarded as utterly different. Any scientist would think that two physically indistinguishable systems are to be regarded as the same, both physically and legally. Flew cites a number of passages from traditional religious authorities in support of the Replica Objection, but except where these men have been clearly infected by Platonic dualism, I think these very passages support the idea that replica resurrection is what is expected in the Judeo-Christian-Islamic tradition. See for example my interpretation above of 1 Cor. 15, which Flew thinks implies a Platonic soul.

15. This depends in a crucial way on the fact that there will be an actual infinity (χ_0) of information processed between any finite time and the Omega Point. It is an example of what Bertrand Russell (1931, 358) has termed the Tristram Shandy paradox. Tristram Shandy took two years to write the history of the first two days of his life and complained that at that rate, material would accumulate faster than he could write it down. Russell showed that even if Tristram Shandy lived forever no part of his biography would have remained unwritten. In the case of the Omega Point, which literally does live forever, all beings that have ever lived and will live from now to the end of time can be resurrected and remembered, even though the time needed to do the resurrecting will increase exponentially, a much worse case than Tristram Shandy faced. It is important that at any given time on a classical trajectory, there is only a finite number of possible beings which could exist. If this were not true, then the number of beings that would have to be resurrected between now and the Final State might be the power set of χ_0 , which is a higher order of infinity than χ_0 , and thus resurrecting all possible beings via the brute force method

might be impossible because only χ_0 bits can be recorded between now and the Final State.

16. One could also worry about the morality of such brute-force resurrection; not only are the dead being resurrected, but also people who never lived! However, the central claim of the Many Worlds physics in the third section and the Many Worlds metaphysics in the fourth section is that all people and all histories who could exist in fact do. They just do not exist on our classical trajectory, and so we have no record of them. So the resurrected dead would probably not care which classical trajectory they are resurrected in—their own trajectory or another one—so long as they *are* resurrected. If getting the resurrected in the right trajectory is important, then some information from the past light cone of each trajectory is needed—in this case the sleeping metaphor of Dan. 12:2 and the seed metaphor of 1 Cor. 15 become very accurate pictures of the resurrection.

.....
References

- Barrow, John D., and Frank J. Tipler. 1986. *The Anthropic Cosmological Principle*. Oxford: Oxford University Press.
- Clarke, Samuel. 1717. *A Collection of Papers Which Passed Between the Late Learned Mr. Leibniz and Dr. Clarke in the Years 1715 and 1716 Relating to the Principles of Natural Philosophy and Religion*. London: James Knapton.
- DeWitt, Bryce S. 1973. Much Esteemed Theory: A Review of *The Large Scale Structure of Space-Time*. *Science* 182: 705–06.
- Earman, John. 1986. *A Primer on Determinism*. Dordrecht: Reidel.
- Findlay, John N. 1955. Can God's Non-Existence Be Proved? In *New Essays in Philosophical Theology*, ed. Antony G.N. Flew and Alasdair MacIntyre, 47–56. London: SCM Press.
- Flew, Antony, ed. 1964. *Body, Mind, and Death*. New York: Macmillan.
- . 1984. *God, Freedom, and Immortality: A Critical Analysis*. Buffalo: Prometheus.
- . 1987. *The Logic of Mortality*. Oxford: Blackwell.
- Hawking, Stephen W., and George F.R. Ellis, 1973. *The Large Scale Structure of Space-Time*. Cambridge: Cambridge University Press.
- Hick, John. 1976. *Death and Eternal Life*. New York: Harper and Row.
- Hume, David. [1776] 1977. *Dialogues Concerning Natural Religion*, ed. Norman Kemp Smith. Indianapolis: Bobbs-Merrill.
- Hofstadter, Douglas R., and Daniel C. Dennett. 1981. *The Mind's I*. New York: Basic Books.
- Kenny, Anthony. 1969. *The Five Ways: St. Thomas Aquinas' Proofs of God's Existence*. New York: Schocken.
- Lovejoy, Arthur O. 1936. *The Great Chain of Being*. Cambridge, Mass.: Harvard University Press.
- Misner, Charles W., Kip S. Thorne, and John Archibald Wheeler. 1973. *Gravitation*. San Francisco: Freeman.

- Pagels, Elaine. 1979. *The Gnostic Gospels*. New York: Random House.
- Pannenberg, Wolfhart. 1967. Response to the Discussion. In *Theology as History*, ed. James M. Robinson and John B. Cobb, Jr., 221–276. New York: Harper and Row.
- . 1970. *What Is Man?* Philadelphia: Fortress.
- . 1971. The God of Hope. In *Basic Questions in Theology: Collected Essays*, vol. 2, by Wolfhart Pannenberg, 234–249. Philadelphia: Fortress.
- . 1973. Eschatology and the Experience of Meaning. In *The Idea of God and Human Freedom*, by Wolfhart Pannenberg, 192–210. Philadelphia: Westminster.
- . 1976. *Theology and the Philosophy of Science*. Philadelphia: Westminster.
- . 1977. The Spirit of Life. In *Faith and Reality*, by Wolfhart Pannenberg, 20–38. Philadelphia: Westminster.
- . 1984. Constructive and Critical Functions of Christian Eschatology. *Harvard Theological Review* 72: 119–139.
- . 1985. *Anthropology in Theological Perspective*. Philadelphia: Westminster.
- Rahner, Karl, and Herbert Vorgrimler. 1983. *Concise Theological Dictionary*. 2nd edn. London: Burns and Oates.
- Russell, Bertrand. 1931. *Principles of Mathematics*. 2nd ed. New York: Norton.
- Russell, Robert John. 1988. Contingency in Physics and Cosmology: A Critique of the Theology of Wolfhart Pannenberg. *Zygon: Journal of Religion and Science* 23: 23–43.
- Smith, Jane I., and Yvonne Y. Haddad. 1981. *The Islamic Understanding of Death and Resurrection*. Albany: State University of New York Press.
- Tipler, Frank J. 1979. General Relativity, Thermodynamics, and the Poincaré Cycle. *Nature* 280: 203–05.
- . 1980. General Relativity and the Eternal Return. In *Essays in General Relativity*, ed. Frank J. Tipler, 21–37. New York: Academic Press.
- . 1986. Cosmological Limits on Computation. *International Journal of Theoretical Physics* 25: 617–661.
- . 1988. The Omega Point Theory: A Model of an Evolving God. In *Physics, Philosophy, and Theology: A Common Quest for Understanding*, ed. Robert Russell, William Stoeger, and George Coyne, 313–331. Notre Dame: University of Notre Dame Press.
- Wheeler, John A. 1988. World as System Self-Synthesized by Quantum Networking. *IBM Journal of Research* 32: 4–15.
- Williams, Christopher J. F. 1981. *What Is Existence?* Oxford: Oxford University Press.