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Teilhard de Chardin and Transhumanism

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Abstract

Pierre Teilhard de Chardin was among the first to give serious consideration to the future of human evolution. His work advocates both biotechnologies (e.g., genetic engineering) and intelligence technologies. He discusses the emergence of a global computation-communication system (and is said by some to have been the first to have envisioned the Internet). He advocates the development of a global society. Teilhard is almost surely the first to discuss the acceleration of technological progress to a Singularity in which human intelligence will become super-intelligence. He discusses the spread of human intelligence into the universe and its amplification into a cosmic intelligence. More recently, his work has been taken up by Barrow and Tipler; Tipler; Moravec; and Kurzweil. Of course, Teilhard's Omega Point Theory is deeply Christian, which may be difficult for secular transhumanists. But transhumanism cannot avoid a fateful engagement with Christianity. Christian institutions may support or oppose transhumanism. Since Christianity is an extremely powerful cultural force in the West, it is imperative for transhumanism to engage it carefully. A serious study of Teilhard can help that engagement and will thus be rewarding to both communities.

1. Introduction

Pierre Teilhard de Chardin (1881-1955) was a Jesuit paleontologist.[1] He combined his scientific study of the fossil record with his Christian faith to produce a general theory of evolution. Teilhard's body of work has much to offer transhumanists, who advocate the use of technology to enhance human capacities and see current human beings as in transition to posthuman forms. There are several specific reasons for transhumanists to study Teilhard's work.

The first reason is that Teilhard was one of the first to articulate transhumanist themes. Transhumanists advocate the ethical use of technology for human enhancement. Teilhard's writing likewise argues for the ethical application of technology in order to advance humanity beyond the limitations of natural biology. Teilhard explicitly argues for the use of both bio-technologies (e.g., genetic engineering) and intelligence technologies, and develops several other themes often found in transhumanist writings. He discusses the emergence of a global computation-communication system, and is said by some to have been the first to have envisioned the Internet (Kreisberg, 1995). He advocates the development of an egalitarian global society. He was almost certainly the first to discuss the acceleration of technological progress to a kind of Singularity in which human intelligence will become super-intelligence. He discusses the spread of human intelligence into the universe and its amplification into a cosmic-intelligence.

The second reason for transhumanists to study Teilhard is that his thought has influenced transhumanism itself. In particular, Teilhard develops an *Omega Point Theory*. An Omega Point Theory (OPT) claims that the universe is evolving towards a godlike final state. Teilhard's OPT was later refined and developed by Barrow and Tipler (1986) and by Tipler alone (1988; 1995). Ideas from the Barrow-Tipler OPT were, in turn, taken up by many transhumanists (see, for example, Moravec (1988; 2000) and Dewdney (1998)). Kurzweil also articulates a somewhat weaker OPT. He says: "evolution moves inexorably toward our conception of God, albeit never reaching this ideal" (2005: 476; see also 375, 389-390). Many transhumanists work within the conceptual architecture of Teilhard's OPT without being aware of its origins. Indeed, Teilhard is mostly ignored in the histories of transhumanism; e.g., he is mentioned once and only in passing in Bostrom's (2005) detailed history of the transhumanist movement.

The third reason for transhumanists to study Teilhard is that he develops his transhumanist ideas within a Christian context. Teilhard shows how one might develop a *Christian transhumanism*. Although some secular transhumanists may be inclined to react negatively to any mention of Christianity, such hostility may prove politically costly. Transhumanism and Christianity are not essentially enemies. They share some common themes (Hopkins, 2005). Of course, it is understandable that many transhumanists reject the superstitious aspects of Christian doctrine and the authoritarian aspects of Christian institutions. Likewise, Teilhard wants to abandon those aspects of Christianity. He argues that Christ is at work in evolution, that Christ is at work in technology, and that the work of Christ ultimately aims at the perfection of human biology. Christianity is a complex network of doctrines and institutions. A study of Teilhard can help transhumanists to locate and carefully cultivate friends in that network and to locate, and carefully defend against, opponents.

The fourth reason for transhumanists to study Teilhard is that they are likely to need to defend themselves against conservative forms of Christianity. The dominant forms of Christianity today (at least in the USA) are conservative. As the cultural visibility of transhumanism grows, conservative Christians will increasingly pay it their attention. They may feel increasingly threatened by transhumanism and come to see it as a heresy (Bainbridge, 2005). Various conservative Christians have already opposed transhumanism (Wiker, 2003; Hook, 2004; Daly, 2004; Hart, 2005). Since Christianity is an extremely powerful cultural force in the West, it is imperative for transhumanism to engage it carefully. Conservative Christian forces have already opposed various biotechnologies (such as embryonic stem cell research and cloning) and may oppose all the enhancement techniques that transhumanists advocate. Conservative Christianity currently has the political power to effectively shut transhumanism down in the West. Teilhard was attacked by conservative Catholics, and transhumanists may have to fight similar battles over similar issues. And yet Teilhard gained a surprisingly large following both within and beyond the church.[2] A study of his work can help transhumanists develop nuanced strategies for defending against attacks from conservative Christians.

The fifth reason for transhumanists to study Teilhard is that they may want to build bridges to liberal and progressive forms of Christianity. Teilhard believed that science and technology have positive roles to

play in building the City of God in this world. A study of Teilhard's work may help transhumanists to explore the ways that transhumanism can obtain support from Christian millenarianism (see Bozeman, 1997; Noble, 1999); from Irenaean and neo-Irenaean theodicies (see Hick, 1977; Walker, Undated);[3] from liberal Protestantism (see Arnow, 1950); and from process theology (see Cobb and Griffin, 1976). Teilhard believed that everyone has a right to enter the kingdom of heaven – it isn't reserved for any special sexual, racial, or economic elite. A study of Teilhard's writings can help transhumanism embrace a deep conception of social justice and expand its conception of social concern (see Garner, 2005). A study of Teilhard can help transhumanists make beneficial conceptual, and even political, connections to progressive Christian institutions.

My goal in this paper is to present the thought of Teilhard de Chardin in a way that is defensible and accessible to transhumanists. Teilhard was working in the early twentieth century, at a time when biology was primitive and computer science non-existent. Many of his ideas are presented in a nineteenth-century vocabulary that is now conceptually obsolete. My method is to present these ideas in a charitable way using a contemporary conceptual vocabulary, and to show how they have been refined by transhumanists such as Tipler, Moravec, and Kurzweil. One might say this paper offers a transhumanist reading of Teilhard or even a Teilhardian transhumanism. Since I make extensive use of computational ideas, I am offering a computational model of Teilhard's thought. I thereby hope to make his ideas accessible and to encourage further study of Teilhard among transhumanists. Teilhard produced an extensive body of work that may be of interest to them;[4] there is also an enormous secondary literature on Teilhard, much of which may be of great interest to transhumanists.[5]

2. Teilhard and computation

2.1 Complexity and logical depth

Physical things can be compared in terms of their size, mass, and so on. But they can also be compared in terms of their complexity. Complexity is an objective physical property and the scale of complexities is an objective physical scale. Teilhard says:

> the complexity of a thing . . . [is] the quality the thing possesses of being composed (a) of a larger number of elements, which are (b) more tightly organized among themselves. . . . [Complexity depends] not only on the number and diversity of the elements included in each case, but at least as much on the number and correlative variety of the links formed between these elements. (Teilhard, 1959, *The Future of Man*, page 98; henceforth abbreviated FUT.)

A first refinement of Teilhard's thought requires that we update his definition of complexity. We can define the complexity of an object as the amount of computational work it takes to simulate the object. It takes a more powerful computer to simulate a more complex object. Bennett (1990) makes this idea more precise by defining complexity as *logical depth*. He says:

> Logical depth = Execution time required to generate the object in question by a near-incompressible universal computer program, i.e., one not itself computable as output of a significantly more concise program. . . . Logically deep objects . . . contain internal evidence of having been the result of a long computation or slow-to-simulate dynamical process. (Bennett, 1990: 142.)

Teilhard observes that increasingly complex systems are emerging in our universe over time. We can plot this emergence on a graph with two axes: a time axis and a complexity axis (Teilhard, 1973, "My fundamental vision", page 166; henceforth abbreviated MFV). Teilhard refers to the emergence of

increasingly complex systems as *complexification*. Today we are more likely to talk about *self-organization*. But the idea is the same. According to Bennett, we should expect more complex objects to appear later in any evolutionary process. Teilhard would agree.

2.2 The Law of Complexity – Computation

Teilhard correctly observes that the evolution of increasingly complex living things on Earth goes hand in hand with the evolution of increasing mental powers. He uses the term *consciousness* to designate any kind of mental activity. He thus infers from the history of life on Earth that degrees of complexity correspond to degrees of consciousness. This is Teilhard's *Law of Complexity – Consciousness*: "Whatever instance we may think of, we may be sure that everytime a richer and better organized structure will correspond to the more developed consciousness" (Teilhard, 1955, *The Phenomenon of Man*, pages 60-61, 301; henceforth abbreviated PHEN).

At the time Teilhard was writing, many thinkers believed that all material things had some degree of mentality. The doctrine that all material things have some mental activity is *panpsychism*. Teilhard accepted the panpsychism of his day. For Teilhard, the scale of complexity runs from atoms to humans and beyond. So the scale of consciousness must also run from atoms to humans and beyond. However, nineteenth-century panpsychism is clearly obsolete. Once again, we can refine Teilhard's vision by replacing his vague nineteenth-century notion of consciousness with the more precise notion of computation.

As matter self-organizes, systems with the capacity for computation emerge. And since it takes a more powerful computer to simulate a less powerful computer, more powerful computers are more complex than less powerful ones. We can thus obtain the *Law of Complexity – Computation*: the emergence of increasingly complex systems goes hand in hand with the emergence of increasingly powerful computers. At this point, we need a precise definition of computational power. The power of a computer is its capacity to simulate other computers. One computer X *is more powerful than* computer Y if and only if X can simulate Y but Y cannot simulate X. For Teilhard, *noogenesis* is the emergence of more and more powerful minds. If we analyze mentality in computational terms, noogenesis can be understood as the emergence of increasingly powerful computers.

Teilhard's writings outline a series of epochs of complexity. These closely resemble the six epochs of complexity described by Kurzweil (2005: 7-33). In order to show how Teilhard's vision is taken up by such transhumanist thinkers as Kurzweil, I'll divide Teilhard's epochs of complexity into the six outlined by Kurzweil (2005: 15). These are (1) the epoch of physics and chemistry; (2) the epoch of biology; (3) the epoch of brains; (4) the epoch of technology; (5) the epoch of the merger of biology and technology; and (6) the epoch in which the universe wakes up.

3. First epoch: information in atomic systems

At the beginning of the first epoch, the Big Bang produces a vast explosion of radiation. The radiation cools and condenses into the simplest material things: subatomic particles such as electrons and quarks. The plasma of quarks, in turn, cools and condenses to form a gas of protons and neutrons. Continued condensation produces hydrogen atoms. Gravity now pulls hydrogen into stars.

Stars fuse hydrogen into helium and then fuse lighter elements into heavier elements: "In the stars . . . the degree of complexity rises rapidly . . . the stars are essentially laboratories in which Nature, starting with primordial hydrogen, manufactures atoms" (FUT: 102). As time goes by, the elements become more

complex: "arranged according to our scale of complexity, the elements succeed one another *in the historical order of their birth*" (FUT: 100-101). Stellar nucleosynthesis fills out the periodic table of elements. Atoms of all kinds are now available for the formation of planets and organic life.

Teilhard's panpsychism leads him to posit the existence of a primitive kind of mentality (pre-consciousness or proto-consciousness) in particles: "we are logically forced to assume the existence in rudimentary form . . . of some sort of psyche in every corpuscle, even in those (the mega-molecules and below) whose complexity is of such low or modest order as to render it (the psyche) imperceptible" (PHEN: 301-302). However, this attribution of mentality to sub-atomic particles is hard to defend. And even if we replace consciousness with computation, it seems wrong to attribute any degree of computation to particles or atoms. We may, however, say that the emergence of the atoms in the periodic table is the emergence of a system of combinatorial possibilities. These permit the evolution of computation. Chemistry is computation-friendly.

4. Second epoch: information in biological systems

As planets condense out of the rings of debris around stars, self-organization begins to take place on them: "the stars cannot carry the evolution of matter much beyond the atomic series: it is only on the very humble planets, on them alone, that the mysterious ascent of the world into the sphere of high complexity has a chance to take place" (FUT: 102-3).

We know that organic chemistry has appeared on Earth. Although biochemistry was primitive in Teilhard's day, he knew about polymers and proteins. He knew about the appearance of organic chemistry on Earth (PHEN: 70-74). Today we have a better idea of how the evolution of life proceeds. We may posit the emergence of auto-catalytic networks (Kaufmann, 1990). These are networks of polymers. They were probably initially networks of RNAs and proteins. DNA is then incorporated into such networks, which become encapsulated in membranes to form the first living cells.

Teilhard assigns a low degree of consciousness to polymers. Of course, Teilhard is wrong to say that polymers are conscious. But it is correct to say that computation first emerges in auto-catalytic networks of polymers. Polymers (proteins and nucleic acids) have the ability to store information. They have the ability to act as switches and logic circuits. Auto-catalytic networks are networks in which *self-reference* first appears. These networks contain feedback loops. A polymer X regulates the production of polymer Y; polymer Y, in turn, regulates the production of polymer X. Self-reference is what Teilhard calls *involution* (something turns inwards towards itself).

At some point, cells appear that are capable of self-replication. Self-replication is the next step in involution. Teilhard assigns a low degree of consciousness to cells (PHEN: 87-88). Of course, Teilhard is wrong to talk about the consciousness of a cell. But, again, we can talk about the computational powers of cells. With DNA, cells are the first things to store internal *self-descriptions*. The storage of an internal self-description is significant for two reasons. First, it is a further step in involution. Second, it is the initial appearance of what Teilhard refers to as *interiority*. The cell stores information about itself inside of itself. Storage of a self-description is the basis for the evolution of self-awareness.

Teilhard is also aware of the increasing complexity of many-celled organisms: "The simplest form of protoplasm is already a substance of unheard of complexity. This complexity increases in geometrical progression as we pass from the protozoon higher and higher up the scale of the metazoa" (PHEN: 60). As the complexity of living systems increases, so too does their consciousness: "the higher the degree of complexity in a living creature, the higher its consciousness, and vice versa" (FUT: 105). Once again, it is wrong to attribute consciousness to things like sponges and fungi. But it is right to argue that increasing

biological complexity is increasing computational power. With the emergence of multi-cellular organisms, we see the emergence of the first computer networks. We see the emergence of the first networks of *social self-regulation*.

5. Third epoch: information in brains

Teilhard correctly describes evolution by natural selection as filling out a Tree of Life. The various random mutations drive the formation of different types of living things. These types evolve along different pathways, but always towards greater complexity and more powerful computation. They develop towards greater self-relation.

The next step in the evolution of greater computational power (noogenesis) is the emergence of cellular systems specialized for computation. These are nervous systems (and immune systems). Teilhard says: "we have every reason to think that in animals too a certain inwardness exists, approximately proportional to the development of their brains" (PHEN: 144). He argues that there are two main lines of neural development. These are the insects and the mammals (PHEN: 153). We know today that he should have added the birds. Birds are among the most intelligent animals on the planet (perhaps just shy of the intelligence of the higher primates). So there are three lines in which intelligence is emerging with the greatest strength: the insects; the birds; and the mammals. Within the insects, intelligence emerges most powerfully in the social insects (ants, bees, termites). Within the birds, it emerges most powerfully in the corvids (crows, ravens) and parrots. Within the mammals, it emerges most powerfully in the primates.

The emergence of intelligence goes hand in hand with three other features: (1) the emergence of social networks (computer networks); (2) the emergence of signaling systems; and (3) the emergence of exosomatic organs (technologies). These three features are found in the social insects, in intelligent birds, and in the primates. They are consequences of the increasing power of computers bound into networks. The emergence of these three features corresponds to the separation of software from hardware (the separation of the program from the computer) and the emergence of computational universality. Intelligent swarms are more and more like universal computers.

As brains develop, they store increasingly complex self-representations. While the genome of an organism stores a static self-description of that organism, its nervous system stores a dynamic self-description. Nervous systems can learn. We must add that immune systems can also learn (they store memories in modifiable DNA). Still, brains are more powerful computers than immune systems; so we'll focus on brains. Brains store self-representations of the organism. Self-consciousness evolves in organisms with increasingly complex brains. Self-consciousness is the next step in involution. It is a deepening and intensification of interiority. Self-consciousness does not first emerge with humans. It emerges earlier. But in humans it becomes most intense.

As organisms become self-conscious, they become able to consciously modify their own representations (both of themselves and their environments). With the emergence of self-consciousness, intelligence becomes self-directing. Social networks, languages, and technologies all become self-directing. If we think of the mental content of an organism as software, we can say that a self-conscious system is able to modify its own software. A self-conscious system is a self-programming computer. For such systems, the software is able to evolve on its own. Insofar as the evolution is independent of the hardware, we can say that software has separated itself from the hardware. Evolution can thus continue in software (e.g., in the evolution of the knowledge of a society). As organisms and societies (computer networks) become self-aware and self-directing, parts of the universe become aware of the whole universe and their relations to it. The software can contain representations of the universe as a whole (e.g., scientific theories). Hence the universe can be said to "wake up" wherever software begins to evolve on its own.

We are aware of one place in the universe in which software has become separated from hardware: the emergence of humans. Humans thus have a special place in noogenesis (the evolution of increasingly powerful computers). Hence: "Man is not the center of the universe as once we thought in our simplicity, but something much more wonderful – the arrow pointing the way to the final unification of the world in terms of life. Man alone constitutes the last-born, the freshest, the most complicated, the most subtle of all the successive layers of life" (PHEN: 224). Of course, we must bear in mind that there are other lines in the tree of earthly life that are leading to this self-awareness. And it is entirely possible that life on other planets has also led to self-awareness.

6. Fourth epoch: information in exosomatic organs

Many writers have thought of technology in biological terms. Tools extend the functional powers of natural organs (e.g., clothes extend the protective powers of the skin). Tools can be regarded as artificial organs (e.g., cameras are artificial eyes; computers are artificial brains). Tools are organs outside of the body (Turner, 2000). They are *exosomatic organs*. The global system of exosomatic organs is like an organism. We can refer to the global system of technology as the *technosphere*. Teilhard thinks of technology in biological terms. The technosphere is "like some great body which is being born – with its limbs, its nervous system, its perceptive organs, its memory" (PHEN: 245-46).

Evolution continues in technology (PHEN 223; see also Dyson, 1997). Several technologies are often said to be essential to the future evolution of humanity (Garreau, 2005; Kurzweil, 2005). These are (1) *genetic* technologies; (2) *robotics* technologies; (3) artificial *intelligence* technologies; and (4) *nano-technologies*. Although he does not talk about robotics or nano-technologies, we can infer that Teilhard would welcome them. But Teilhard does discuss genetic and information-processing technologies.

First, Teilhard talks about information-processing technologies. He writes briefly but positively about computers and the "young science of cybernetics" (1966: 110). Some have argued that Teilhard foresaw the Internet (Kreisberg, 1995). He describes "a generalized nervous system, emanating from certain defined centers and covering the entire surface of the globe" (FUT: 125; PHEN: 244). More precisely, Teilhard writes:

> how can we fail to see the machine as playing a constructive part in the creation of a truly collective consciousness? . . . I am thinking, of course, in the first place of the extraordinary network of radio and television communications which . . . already link us all in a sort of "etherized" universal consciousness. But I am also thinking of . . . those astonishing electronic computers which, pulsating with signals at the rate of hundreds of thousands a second, not only relieve our brains of tedious and exhausting work but, because they enhance the essential (and too little noticed) "speed of thought," are also paving the way for a revolution in the sphere of research. . . . all these material instruments . . . are finally nothing less than the manifestation of a kind of super-Brain, capable of attaining mastery over some supersphere in the universe. (FUT: 161-62.)

This generalized nervous system (this "super-Brain") is an exosomatic nervous system. It is the totality of all computing and communications technologies. At present (2006), this exosomatic nervous system spans the whole Earth and extends into the solar system (via satellites, space-probes, Martian rovers, etc.). The evolution of the intelligence of the whole human species is continuing in the exosomatic nervous system.

Teilhard also talks about genetic and biotechnologies. He refers to genetic engineering "we appear to be on the eve of having a hand in the development of our bodies and even of our brains. With the discovery of genes it appears that we shall soon be able to control the mechanism of organic heredity" (PHEN: 250; MFV: 181). He argues, further, that human intelligence should guide human evolution via genetic engineering. He is thus arguing for an ethically appropriate form of eugenics:

> So far we have certainly allowed our race to develop at random, and we have given too little thought to the question of what medical and moral factors must replace the crude forces of natural selection should we suppress them. In the course of the coming centuries it is indispensable that a nobly human form of eugenics, on a standard worthy of our personalities, should be discovered and developed. Eugenics applied to individuals leads to eugenics applied to society. (PHEN: 282.)

He envisions the synthesis of entirely new forms of life: "we may well one day be capable of producing what the Earth, left to itself, seems no longer able to produce: a new wave of organisms, an artificially provoked neo-life" (PHEN: 250).

When human intelligence guides both human evolution and the evolution of novel forms of life, then evolution on Earth will have become self-directing. Evolution has so far been blind; but when it is guided by human thought, it becomes reflective and thus self-directed. Biotechnology is thus a further step in the rise of evolution to self-consciousness.

A historical survey of technological progress justifies the conclusion that technological evolution is accelerating (see Kurzweil, 2005). Teilhard argues that information technology is accelerating according to a "geometrical progression" (PHEN: 245). One might see here a primitive version of Moore's Law. Teilhard refers to the intensity of information-processing on Earth as the "psychic temperature" of the Earth. He says "there is at the moment a rapid rise in the psychic temperature on Earth, caused by the activity of an economico-technological network which is being tightened at a continually accelerated speed" (Teilhard, 1973; "Two principles": 148). The convergence of genetic and information technologies aims at the perfection of human intelligence: "Thought might artificially perfect the thinking instrument itself" (PHEN: 250).

7. Beyond the fourth epoch

Teilhard correctly observes four epochs of self-organization: (1) the emergence of stars and stellar nucleosynthesis; (2) the emergence of planets; (3) the emergence of living things and biological evolution; (4) the emergence of intelligence (in nervous systems). Each form of self-organization gives rise to the next. Evolution is thus hierarchical.

From these facts, he infers that evolution has a direction (PHEN: 146, 290). It is directed towards the production of increasingly complex systems (which we might interpret as the production of increasingly powerful natural and artificial computing systems). Teilhard argues further that there is a force (radial energy) that drives self-organization (FUT: 70). There is a universal force of *extropy* that opposes entropy. Noogenesis happens everywhere: "wherever there are life bearing planets in the Universe, they too will become encompassed, like the Earth, with some form of planetized spirit" (FUT: 109).

On the evidence of the four epochs of evolution, Teilhard posits further epochs. He posits the emergence of super-intelligent super-humans (FUT: 114; PHEN: 231-34). He says "there is for us, in the future, under some form or another, at least collectively, not only survival but also *super-life*" (PHEN: 234). Although the Earth is threatened by many disasters, Teilhard argues that they will not happen:

> When the end of the world is mentioned, the idea that leaps into our minds is always one of catastrophe. Generally we think of a sidereal cataclysm. . . Since physics has discovered that all energy runs down, we seem to feel the world getting a shade chillier every day. . . . Onslaughts of microbes, organic counter-evolutions, sterility, war, revolution – there are so many ways of coming to an end. We are well aware of these different eventualities. . . . And yet, on the strength of all we learn from past evolution, I feel entitled to say that we have nothing whatever to fear from these manifold disasters *in so far as* they imply the idea of premature accident or failure. However possible they may be in theory, we have higher reasons for being sure *that they will not happen*. (PHEN: 274-75.)

Teilhard's reasoning about the future is an early example of what Tipler (1995) calls *physical eschatology*. Physical eschatology is closely connected to various *anthropic principles* (Barrow and Tipler, 1986). We can identify three anthropic principles in order of increasing strength. First is the Weak Anthropic Principle (WAP): any cosmology must be consistent with the emergence and existence of creatures (like us) who are able to state that cosmology (Barrow and Tipler, 1986: 16). The WAP is not controversial. But the Strong Anthropic Principle (SAP) certainly is. It says: "The Universe must have those properties which allow life to develop within it at some stage in its history" (Barrow and Tipler, 1986: 21). The Final Anthropic Principle (FAP) is even more controversial. It says: "Intelligent information-processing must come into existence in the Universe, and, once it comes into existence, it will never die out" (Barrow and Tipler, 1986: 23).

Teilhard clearly subscribes to the Final Anthropic Principle. But his version of the FAP explicitly includes the perfection of humanity. He says: "We have seen and admitted that evolution is an ascent towards consciousness. . . . Therefore it should culminate forwards in some sort of supreme consciousness. But must not that consciousness, if it is to be supreme, contain in the highest degree what is the perfection of our consciousness?" (PHEN: 258). He further says that "The only universe capable of containing the human person is an irreversibly 'personalizing' universe" (PHEN: 290).

It is difficult to defend any version of the FAP. And therefore it is difficult to defend any Omega Point Theory. Tipler makes an argument from beauty: (1) the FAP is a beautiful principle; and (2) "We physicists know that a beautiful postulate is more likely to be correct than an ugly one" (Tipler, 1988: 32; see also Tipler, 1995: 11); therefore (3) the FAP is more likely to be true than false. But this argument is very weak. Of course, for Teilhard the anthropocentric version of the FAP is a matter of religious faith.[6]

Transhumanists like to marshal evidence that humanity is developing into a super-intelligence. They project current technological trends into the far future. And that is all fine. But we cannot infer with any certainty or inevitability that humanity will reach the fifth or sixth epochs of complexity. At most we can argue for some degree of probability that we will reach the fifth or sixth epochs. Or we can argue for some degree of probability that some civilization somewhere will reach them. Since including the whole universe includes more opportunities, the probability that some civilization will reach the fifth or sixth epochs is perhaps higher. Nevertheless, since we are following Teilhard's vision, I will proceed as if Teilhard's version of the FAP is true. In what follows, I will assume that human civilization will make progress into the fifth and sixth epochs.

8. Fifth epoch: the merger of humanity and technology

8.1 Kurzweil's Singularity

As already mentioned, Teilhard recognizes that the pace of technological advance is accelerating. He argues that this acceleration will lead to the emergence of a global super-machine: "all the machines on Earth, taken together, tend to form a single, vast organized mechanism" (FUT: 160). These machines begin to operate on themselves "thus accelerating and multiplying their own growth and forming a single gigantic network girdling the Earth" (FUT: 160). This self-direction of technological evolution is the next type of involution (after self-replication and self-consciousness).

The emergence of a global super-machine that directs its own evolution seems to correspond closely to the idea of the Singularity developed by Ray Kurzweil, who defines it as "a future period during which the pace of technological change will be so rapid, its impact so deep, that human life will be irreversibly transformed" (Kurzweil, 2005, *The Singularity is Near*, page 7; henceforth abbreviated SING). Kurzweil says the Singularity will transform humans into super-humans:

> Our version 1.0 biological bodies are likewise frail and subject to a myriad of failure modes . . . The Singularity will allow us to transcend these limitations of our biological bodies and brains. . . . We will be able to live as long as we want . . . The Singularity will represent the culmination of the merger of our biological thinking and existence with our technology, resulting in a world that is still human but that transcends our biological roots. There will be no distinction, post-Singularity, between human and machine or between physical and virtual reality. (SING: 9.)

Teilhard affirms that there will be a period of rapid technological change that will fuse humanity with technology. But he does not identify this period with the Singularity. For Teilhard, the Singularity comes later. The fusion of humanity with technology is the birth of the noosphere and the emergence of the spirit of the Earth.

8.2 The emergence of the spirit of the Earth

At this point of his discussion, Teilhard has already argued for the emergence of a technosphere. He has argued for the emergence of "a generalized nervous system, emanating from certain defined centers and covering the entire surface of the globe" (FUT: 125). We may take this to be a system of interconnected computing machines. The Internet is an early version of this nervous system. Teilhard argues that individual humans will eventually fuse into a single super-mind (PHEN: 278). A universal computational medium will cover the Earth. A human super-consciousness will emerge within this computational medium:

> We are faced with a harmonized collectivity of consciousnesses equivalent to a sort of super-consciousness. The idea is that of the Earth not only becoming covered by myriads of grains of thought, but becoming enclosed in a single thinking envelope so as to form, functionally, no more than a single vast grain of thought on the sidereal scale, the plurality of individual reflections grouping themselves together and reinforcing one another in the act of a single unanimous reflection. (PHEN: 252.)

In what follows, I will sketch a technically plausible way for this planetary computation to emerge. We can easily imagine that human brains and bodies will become increasingly merged with artificial computers (Teilhard already hints at this in 1966: 111). Some human brains already (in 2006) are directly plugged into computing machines. It is perfectly reasonable to think that brain-computer interfaces will become more common and more complex. Moravec (1988: ch. 4) has argued that human brains and bodies can be scanned and their programs abstracted. These human body-programs can then be run on artificial super-computers. Living thinking things will merge with the Internet.

The Internet is presently limited in several ways. Its first limit is that it consists of separate computing machines linked in thin ways (by wires or radio channels). It can overcome this limit by the fusion of all computers into a single computational medium. This computational medium could be a layer of silicon covering much of the Earth; or it could be a layer of carbon nano-tubes and nano-switches; or it could be a layer containing both silicon and carbon. This computational medium will be like a gigantic rhizome or network that covers the planet's entire landmass. The second limit is that the Internet depends on external power sources. It can overcome this limit by becoming solar powered.

We thus posit an Earth covered by a layer of pure *computronium*. This computronium is composed of self-constructing and self-repairing nano-machines (nanobots). It is like Bill Joy's grey goo, but it is not life-destroying. Rather, this layer of nanobots is a single living thinking substance. It is a layer of living and thinking material. It is solar-powered. All living systems are eventually scanned and their body-programs are uploaded into the layer of computronium. They live in a virtual reality simulation of their past ecosystems. But this virtual reality is not unreal. It is made of real mass-energy.

The evolution of computation on Earth leads to the conversion of the whole Earth into a planetary super-computer. Teilhard says we aim at "an interior totalization of the world upon itself, in the unanimous construction of a *spirit of the Earth*" (PHEN: 253). The spirit of the Earth is the totality of (human and non-human) software processes running on the planetary super-computer:

> the collectivization of the human race, at present accelerated, is nothing other than a higher form adopted by the process of moleculization on the surface of our planet. The first phase was the formation of proteins up to the stage of the cell. In the second phase individual cellular complexes were formed, up to and including Man. We are now at the beginning of the third phase, the formation of an organicosocial supercomplex, which . . . can only occur in the case of reflective, personalized elements. First the vitalization of matter, associated with the grouping of molecules; then the hominization of Life, associated with a supergrouping of cells; and finally the planetization of Mankind, associated with a closed grouping of people: Mankind, born on this planet and spread over its entire surface, coming gradually to form around its earthly matrix a single, major organic unity, enclosed upon itself; a single, hypercomplex, hypercentered, hyperconscious arch-molecule, coextensive with the heavenly body on which it was born. Is not this what is happening at the present time – the closing of this spherical thinking circuit? (FUT: 108-9.)

The technosphere will become the *noosphere*. History points to "the progressive genesis of what I have called a 'noosphere' – the pan-terrestrial organism in which, by compression and arrangement of the thinking particles, a resurgence of evolution (itself now become reflective) is striving to carry the stuff of the universe towards the higher conditions of a planetary super-reflection" (MFV: 180). Teilhard says "The noosphere, in short, is a stupendous thinking machine" (FUT: 168). We can think of this as the conversion of the entire Earth into a planetary super-computer (see SING: 350).

8.3 Material expansion into the universe

The noosphere is a living thinking machine with enormous physical powers. Teilhard writes that "in becoming planetized humanity is aquiring new physical powers which will enable it to superorganize matter" (FUT: 171). One possible future for the noosphere is that it will superorganize larger and larger arrangements of matter. It will expand materially into the solar system and universe. Teilhard considers this option: "We may perhaps move to Venus – perhaps even further afield" (FUT: 115). Elsewhere, he says

> we may begin by asking seriously whether life will not perhaps one day succeed in ingeniously forcing the bars of its earthly prison, either by finding the means to invade other planets or . . . by getting into psychical touch with other focal points of consciousness across the abysses of space. The meeting and mutual fecundation of two noospheres is a supposition which . . . is merely extending to psychical phenomena a scope no one would think of denying to material phenomena. Consciousness would thus finally construct itself by a synthesis of planetary units. Why not, in a universe whose astral unit is the galaxy? (PHEN: 286.)

The material expansion of the noosphere into the universe has several stages. The first is the conversion of the solar system into a computer. The solar system can be converted into a computer first by building increasingly large Dyson Spheres around the sun (Kurzweil, 2005: 350). The second stage is the expansion outwards from the solar system. It is the colonization of the galaxy. One way to colonize the galaxy is to use robotic space-probes (often called von Neumann probes). According to this strategy, our solar system will send out enormously large flocks of enormously small robots. These robots will flock to other planetary systems and convert them into super-computers.

The material expansion of the noosphere takes us into the very far future. Barrow and Tipler write that life will expand outwards from the Earth until it encompasses half of the universe (1986: 675). Around that time, they argue, the universe will start to converge to a Big Crunch. According to Barrow and Tipler, this Big Crunch is a good thing for life, since it means that energy will always be available for computation. As the universe converges, the available energy will be used more and more efficiently. So the computational power of the universe goes up without bound as time goes on. The universe at the moment of the Big Crunch is an infinitely powerful computer. It is the Barrow-Tipler Omega Point. This infinity will be the end of time – a total and endless presence of all possible finite computational processes (Barrow and Tipler, 1986: 675-77). Recent observations have, however, raised objections to the Barrow-Tipler eschatology. It seems that our universe is not converging to a Big Crunch. On the contrary, its expansion is accelerating. Accordingly, the Barrow-Tipler Omega Point Theory appears to be refuted by empirical evidence.

Kurzweil sketches an eschatology that does not depend on the Big Crunch. As civilization fills the universe, it will be able to program matter at the most basic physical level. We will discover ways to turn "dumb matter" into "smart matter." We will be able to convert any material structure into a substrate for universal computation (into computronium). Kurzweil describes our expansion into the universe in the following passages:

> In the aftermath of the Singularity, intelligence, derived from its biological origins in human brains and its technological origins in human ingenuity, will begin to saturate the matter and energy in its midst. It will achieve this by reorganizing matter and energy to provide an optimal level of computation . . . to spread out from the Earth. . . . [T]he "dumb" matter and mechanisms of the universe will be transformed into exquisitely sublime forms of intelligence, which will constitute the sixth epoch in the evolution of patterns of information. (SING: 21.)

> As intelligence saturates the matter and energy available to it, it turns dumb matter into smart matter. Although smart matter still nominally follows the laws of physics, it is so extraordinarily intelligent that it can harness the most subtle aspects of the laws to manipulate matter and energy to its will. (SING: 364.)

Kurzweil recognizes that the evolution of intelligence in our universe faces certain material limits. Kurzweil considers various highly speculative ways to get around these limits (2005: 359-66). But he also suggests more deeply (and more speculatively) that these material limits might be irrelevant to the evolution of intelligence, that the evolution of intelligence may not be constrained by material forces:

> My conjecture is that intelligence will ultimately prove more powerful than these big impersonal forces. . . . Intelligence does not exactly repeal the laws of physics, but it is sufficiently clever and resourceful to manipulate the forces in its midst to bend [them] to its will. . . . Ultimately, intelligence will be a force to reckon with, even for these big celestial forces (so watch out!). The laws of physics are not repealed by intelligence, but they effectively evaporate in its presence. So will the Universe end in a big crunch, or in an infinite expansion of dead stars, or in some other manner? In my view, the primary issue is not the mass of the Universe, or the possible existence of antigravity, or of Einstein's so-called cosmological constant. Rather, the fate of the Universe is a decision yet to be made, one which we will intelligently consider when the time is right. (1999: 258-60.)

9. Sixth epoch: the universe wakes up

9.1 Teilhard's Singularity

Although Teilhard considers the possibility that the noosphere will expand materially into the universe, he regards this possibility as a dead end (PHEN: 286-87; FUT: 302). The computational capacity of the material universe is finite. An expanding intelligence will eventually encounter the computational limits of matter (see Kurzweil, 2005: 364-66, 485-87). We will hit a wall. Teilhard suggests that when intelligence hits the computational limits of matter, it must change course. It must strive for a different kind of realization. So Teilhard is not interested in leaving the Earth (or solar system) materially.

Teilhard often speaks of a *critical point* in the evolution of human intelligence: "In our time Mankind seems to be approaching its critical point of social organization" (FUT: 31, 47). He refers to the critical point as "the entry into the super-human" (PHEN: 244-45). He says that intelligence will reach a critical point of intensity which "represents our passage, by translation or dematerialization, to another sphere of the Universe: not an ending of the Ultra-Human but its accession to some sort of Trans-Human at the ultimate heart of things" (FUT: 298). Teilhard's "Ultra-Human" is what we would call the transhuman and his "Trans-Human" is what we would call the posthuman.

Teilhard identifies the critical point with the Christian notion of the *parousia:* "the parousiac spark can, of physical and organic necessity, only be kindled between Heaven and a Mankind which has biologically reached a certain critical evolutionary point of collective maturity" (FUT: 267). The parousia is the fulfillment of the mission of Christ. It is crudely portrayed in popular religion as the "second coming" of Christ or the "rapture". For Teilhard, it is a radical biological change. He writes that when future human intelligence passes through the critical point it "will penetrate for the first time into the environment which is biologically requisite for the wholeness of its task" (FUT: 51). The critical point (identified with the parousia) is the Teilhardian Singularity.

9.2 Informational expansion into the universe

As we consider the evolution of intelligence in the sixth epoch, we must deal more and more with the explicitly religious and speculative aspects of Teilhard's thought. Teilhard has little interest in the material expansion of the noosphere into space. He writes that future human intelligence will "break through the material framework of Time and Space" (FUT: 175). He repeatedly says that future human intelligence will leave the Earth *spiritually* (PHEN: 272, 273, 287; FUT: 116, 175, 303-304). We obviously need to clarify Teilhard's notion of leaving the Earth spiritually. At first glance, it looks like old-fashioned supernaturalism. But Teilhard consistently says that his orientation is scientific.

For Teilhard, to leave the Earth spiritually is to enter the *pleroma* (Teilhard, 1974: 64-75).[7] This is the medium in which individual human persons become ultimately perfected and harmonized. Teilhard denies the materiality of the pleroma, but he affirms (and stresses) the pleroma's physicality (1974: 67-72). He says that those who enter the pleroma will be "*physically* incorporated" into it (1974: 70; the italics are Teilhard's). He says the pleroma is spatially "extended to the galaxies" (174: 236). Hence for a person to escape the Earth spiritually is for that person to break free from his or her material realization, while remaining physically in space-time. As we leave the Earth spiritually, we do not vanish from the universe. Teilhard writes that at the critical point we pass "by translation or dematerialization, to another sphere of the Universe" (FUT: 298). I understand this to mean that at the critical point future human intelligence will no longer be realized by any network of material particles and forces. We will cease to be realized by matter. This does not contradict the naturalistic thesis that we are entirely physical. It simply implies that not every physical thing is a material thing – physics has deeper levels. The pleroma is physical, but its physicality is deeper than material.

Many writers at the intersection of basic physics and computer science have argued that the material world is not the deepest level of our physical universe. They argue that the deepest level of physical reality is computational (Fredkin, Landauer, and Toffoli, 1982; Fredkin, 1991; Zeilinger, 1999). Early work on the computational foundations of physics tended to treat the universe as a cellular automaton like the game of life (see Poundstone, 1985). Each spatial point is a computer. The states of these computers form various physical fields (e.g., the electro-magnetic and gravitational fields). Material particles are self-perpetuating disturbances in these fields (like gliders in the game of life). But the states of these computers are purely informational, and they can do more than just realize material fields. We can think of these computers as running the sorts of informational processes that go on in human or super-human bodies and brains. And we can go beyond the finitism of cellular automata theory. We can think of these computers as infinitely complex. They might be accelerating universal Turing machines (Copeland, 1998). Every spatial point is an infinitely powerful physical computing machine interacting with an infinity of other points. On this hypothesis, the deepest level of physical reality is an infinitely complex network of infinitely powerful computers (call it the *Network*). I suggest that the most precise way to think of Teilhard's pleroma is to think of it as the Network. The Network is physical but not material. For Teilhard, spirit looks very much like energetic information. Spirit is software in action. As humanity becomes super-intelligent, it will cease to be material and will become purely informational. Future intelligence will cease to be materially realized. Evolution will pass into the pleroma.

The hypothesis that evolution continues in the pleroma enables us to make sense both of Teilhard's claim that we will leave the Earth spiritually and of Kurzweil's conjecture that intelligence will ultimately be more powerful than the big impersonal forces of the cosmos. A human person is a living thinking informational process. At present we are informational processes realized by carbon chemistry. We are realized by flesh. Our future super-human descendants may be realized by other kinds of materials (e.g., silicon). But the materials in which human or super-human computations are realized are not essential to those computations. We can be realized by purely informational processes in the pleroma. If we (or our super-human descendants) learn to program the pleroma, then we can program ourselves into it. We will live, move, and have our being in the pleroma. We will become living thinking software patterns. We will spread informationally to fill the entirety of an infinitely rich future cosmos. If there are other intelligent species, we will merge our computations with theirs. If all this happens, then we won't need to worry about the future material evolution of the universe. Material structures will no longer be of much interest to intelligent life. Future intelligence may choose to work with matter (perhaps for artistic expression) or it may ignore matter. Intelligence will no longer be material and will have become purely informational. It will have become spiritual.

9.3 The resurrection of the body

For Teilhard, faith in Christ is the conviction that the cosmic process is tending to a final state in which all persons are saved. Salvation is the recovery and perfection of what is most personal in every human (PHEN: 260-64; FUT: 175). Teilhard often writes about this salvation in psychological terms (e.g., in terms of consciousness). But he also talks in biological terms about the passage through the critical point (FUT: 51). He writes: "Is the Kingdom of God a big family? Yes, in a sense it is. But in another sense it is a prodigious biological operation – that of the Redeeming Incarnation" (PHEN: 293). On this view, there is no reason to oppose the psychological to the biological. Human cognition is a biological computation running in every cell in the body at the molecular level. The psychology of an individual human body is recovered and perfected when the biological program that was running on that body is recovered and perfected. The recovery and perfection of an individual body-program is the resurrection of the body. The resurrection of the body is obviously not the revival of a corpse. It is the translation of the body-program into a new medium.

The resurrection of the body has long been associated with the disembodiment and re-embodiment of the soul. A long tradition identifies the soul with the form of the body (see Aristotle, *De Anima*, 412a5-412b21; Aquinas, *Summa Theologica*, Part 1, Q 78-84). We may follow this tradition: the form of the body is the form of the biological computation running in every cell in that body at the molecular level. The soul may be identified with the body-program, as several important Christian thinkers have done (Hick, 1976: ch. 15; Reichenbach, 1978; Polkinghorne, 1985: 180-81; Mackay, 1997). Barrow and Tipler explicitly identify the soul with the body-program:

> an intelligent being – or more generally, any living creature – is fundamentally a type of computer . . . the really important part of a computer is not the particular hardware, but the program; we may even say that a human being is a program designed to run on particular hardware called a human body, coding its data in very special types of data storage devices called DNA molecules and nerve cells. The essence of a human being is not the body but the program which controls the body . . . defining the soul to be a type of program has much in common with Aristotle and Aquinas' definition of the soul as "the form of activity of the body". A living human being is a representation of a definite program rather than the program itself. In principle, the program corresponding to a human being could be stored in many different forms. (Barrow and Tipler, 1986: 659.)

For Barrow and Tipler (and especially for Tipler), a particular human individual is resurrected when its body-program begins to run on the material super-computer formed during the Big Crunch. Tipler refers to an exact simulation as an *emulation*. He says: "the physical mechanism of individual resurrection is the emulation of each and every long-dead person – and their worlds – in the computers of the far future" (1995: 14, 220). Of course, our emulations in the computers of the far future need not suffer and die as we do on Earth. They can be improved. They can live indefinitely. Their lives can be guided into super-human forms and then into forms of ever higher complexity. They can become infinitely complex (Barrow and Tipler, 1986: 659-61). Since the end of the universe in a Big Crunch does not seem likely, however, the Barrow-Tipler theory of resurrection does not seem likely either. And even if a Big Crunch were likely, Teilhard would not agree that we will be resurrected by emulation on any future *material* machines. All material machines have limits. For Teilhard, the future of intelligence lies beyond the material.

According to my computational interpretation of Teilhard, a particular human individual is resurrected when its body-program begins to be realized by some network of machines in the pleroma. The realization of a body-program by some network of machines in the pleroma is the resurrection body. If this is right, then our resurrection bodies are purely informational. They are spiritual bodies. They are the

soma pneumatikon of St. Paul (1 Corinthians 15). Although they are not material, they are still physical. These bodies are likely to evolve into posthuman forms. For example, they may evolve into forms like Moravec's bush robots (1988: 102-108; 2000: 150-54). Moravec observes that a human body has a recursive sticks-on-sticks pattern. The body has a level 0 stick (the chest). At each free end, the level 0 stick sprouts two sticks at level 1 (arms and legs). At each free end, the level 1 sticks sprout five sticks at level 2 (fingers and toes). This pattern can be regularized and extended. A bush robot starts with a level 0 stick. At each free end, each level n stick sprouts 2^(n+1) sticks at level n+1. Just as our fingers are shorter and thinner than our arms, so the sticks at each level are shorter and thinner.

9.4 The universality of the resurrection

Teilhard believed that human life and intelligence would break free from the constraints of material realization and become spiritual. On this account, our descendants here on Earth will evolve to the cosmic level (the sixth epoch). One might object that such a future does not look very likely for humanity. Humanity is one species on one planet orbiting one star. The odds are that humanity will fail before translating itself into the pleroma. And even if our descendants become spiritual bodies, we and our ancestors are likely to be dead. We need an argument that we will be resurrected no matter what happens to the Earth.

Teilhard often affirms the existence of many extra-terrestrial civilizations (PHEN: 286; FUT: 90-117; Teilhard 1974: 36-44). We can argue that if *any* civilization becomes cosmic (if it enters the pleroma), then every human will be saved. The argument goes like this: (1) the emergence of some cosmic civilization is probable in the future of our universe; (2) a cosmic civilization will be able to simulate all civilizations with lesser intelligence; (3) a cosmic civilization is obligated both by ethics and its desire for omniscience to simulate all lesser civilizations (see Tipler, 1988: 44; Tipler, 1995: 245-50); (4) a cosmic civilization is sensitive to its ethical and epistemic obligations; (5) therefore, a cosmic civilization will simulate all less complex civilizations and will also guide their evolution to the cosmic level. If human civilization is less complex, it follows that (6) a cosmic civilization will simulate human civilization and will guide its evolution to the cosmic level. This is one of the scenarios contemplated in Bostrom's well-known *simulation argument* (2003). If our future descendants (or the members of some other cosmic civilization) break through into the pleroma, they will be able to recover every past intelligent living thing by the brute force simulation of all programs (see Moravec, 1988: 122-24; Tipler, 1995: 220). Hence they will run our body-programs again and resurrect our bodies.

10. The Omega Point

10.1 The Omega Point as a universal Turing machine

Teilhard argues that the universe is convergent (PHEN: 259). World-history converges to a final state. He refers to this state as the Omega Point. According to Teilhard, the souls of humans somehow meet in the far future at the Omega Point (PHEN: 272). Barrow and Tipler offer a computational interpretation of Teilhard's idea. They say the soul is the body-program and that the Omega Point is a super-computer formed in the Big Crunch at the end of time. Tipler (1995: 249-50) is explicit: "the Omega Point in Its transcendence is in essence a self-programming universal Turing machine, with a literal infinity of memory." To say that all souls meet at the Omega Point is just to say that the Omega Point runs all possible human body-programs. I agree with Barrow and Tipler that the Omega Point is a super-computer that runs all possible human body-programs. But I do not believe the Omega Point is formed in some Big Crunch at the end of time. Rather, I think of the Omega Point as the final or goal state of the pleroma.

Teilhard interprets the Omega Point in both Christian and pantheistic terms. At the Omega Point "as St. Paul tells us, God shall be all in all. This is indeed a superior form of 'pantheism' . . . the expectation of a perfect unity, steeped in which each element will reach its consummation at the same time as the universe" (PHEN: 294). Teilhard defends himself against the charge that such pantheism is non-Christian:

> to put an end once and for all to the fears of "pantheism", constantly raised by certain upholders of traditional spirituality as regards evolution, how can we fail to see that, in the case of a *converging universe* such as I have delineated, far from being born from the fusion and confusion of the elemental centers it assembles, the universal center of unification (precisely to fulfill its motive, collective and stabilizing function) must be conceived as pre-existing and transcendent. A very real "pantheism" if you like . . . but an absolutely legitimate pantheism – for if, in the last resort, the reflective centers of the world are effectively "one with God", this state is obtained not by identification (God becoming all) but by the differentiating and communicating action of love (God *all in everyone*). And that is essentially orthodox and Christian. (PHEN: 309-310.)

Teilhard's synthesis of Christianity and pantheism has a remarkably clear and elegant computational interpretation. The pleroma is a network of infinitely complex computers. I have suggested that each computer is an accelerating universal Turing machine with infinite memory (an AUTM). Just as an infinite set contains infinitely many infinite subsets, so an AUTM can exactly simulate infinitely many other AUTMs. It exactly simulates them by running them as sub-programs. Each of these sub-programs is a *virtual machine*. I have said that each resurrection body has the power of an AUTM. Accordingly, while running its own body-program, each resurrection body can also exactly simulate every other resurrection body by running it as a sub-program (as a virtual body). We might say that every resurrection body runs all the others in its imagination (see Moravec, 1988: 178-79). Each resurrection body is conscious of itself as itself while it is conscious of the others as others. A community of AUTMs in which each exactly simulates every other is one in which all persons formally interpenetrate. Each person is in every other person as a living image (a virtual machine). Each person is a mirror in which every other person is perfectly reflected. But all these persons are distinct programs.

10.2 The Omega Point as a self-representative system

Teilhard has argued for an increase in self-reference (involution) and self-representation (interiority) at every stage of evolution. Thus, we can interpret the Omega Point as the maximum of self-representation. It is a perfectly self-representative system. Such a perfectly *self-representative system* was described by Josiah Royce, who referred to it as the *Absolute Self*. If this is right, then Teilhard's Omega Point is Royce's Absolute Self.

To motivate his theory of the Absolute Self, Royce uses the notion of a perfect map of England, located within England (1899: 502-507). Suppose there is a perfect map of England inscribed on the surface of England. Since this map is located at a place P in England, there must be a place P* on the map that represents P. The map must contain a representation of itself. There is a part of the map that is a perfect copy of the whole map. And of course, since this copy is perfect, there is a part of the copy that is a perfect copy of itself. The map contains an endlessly nested series of self-copies. It is infinitely complex. The infinite self-nesting of copies is analogous to a perfect self-consciousness. For a perfectly self-conscious mind contains an exact internal representation of its own self; and that exact internal representation contains a further exact internal representation of its own self; and so on endlessly. So the Absolute Self is a self-representative system.

A self-representative system can contain more than one self-map. For instance, there can be many perfect maps of England on the surface of England. Each one maps England from a different perspective. Each

contains a copy of itself, but it also contains a copy of every other map. Thus each different perspective perfectly mirrors every other perspective. And there is only one maximal whole (namely, England itself) that contains all these maps. The Absolute Self is analogous to an England that contains many perfect self-maps. Each different self-map is a different lesser self within the Absolute Self (Royce, 1899: 546). Each lesser self has a perspective on every other lesser self. There is exactly one maximal Self that contains every lesser self. We can link Royce with my computational interpretation of Teilhard by equating Royce's perfect self-representative system with the Omega Point. The final state of the pleroma, in which every body perfectly simulates every other body, has the structure of the Roycean Absolute Self. Each resurrection body is a perspective on the whole. Hence Royce's Absolute Self is a model for Teilhard's notion that at the Omega Point (1) God is all in all and (2) God is all in everyone.

11. Transhumanism and Christianity

At the beginning of this paper, I offered five reasons for transhumanists to study Teilhard: (1) Teilhard is one of the first to articulate transhumanist themes; (2) Teilhard's thought has influenced transhumanism, and several important transhumanists have developed Omega Point Theories; (3) Teilhard works out his transhumanist ideas in a Christian context; (4) transhumanism is likely to need to defend itself against conservative forms of Christianity; and (5) the future success of transhumanism may well depend on its ability to build bridges to liberal and progressive forms of Christianity. Transhumanism and Christianity share common themes and are likely to meet soon in a fateful way. Conservative Christians stand ready to condemn transhumanism as a heretical sect and to politically suppress the use of technology for human enhancement. A study of Teilhard can help in this defense. At the same time, a study of Teilhard can help transhumanists find potential allies among liberal and progressive Christians.

The last two reasons for studying Teilhard have a certain urgency. As the cultural profile of transhumanism rises, conservative Christian groups are beginning to notice it. There are two ways this encounter can go. On the one hand, the encounter can involve mutual hostility. The transhumanists and conservative Christians will denounce one another as enemies. Each side will attack a cartoon version of the other. Such hostility could be fatal for transhumanism in the West. On the other hand, the encounter can be more diplomatic. If transhumanists learn more about the similarities between Christianity and transhumanism, they can respond carefully and successfully to attacks. Since Teilhard is clearly in favor of the use of technology for human enhancement, and since his arguments for human enhancement are developed within a Christian framework, a study of Teilhard can help transhumanists defend against religious conservatives.

Transhumanists should also study other forms of liberal Christianity with which they have much in common (such as process theology). A dialogue with liberal Christian thought offers benefits. One benefit is that transhumanists can gain access to a greater audience. Another benefit is that transhumanists may be able to use liberal Christian ideas to further develop their own theories of social justice. A dialogue with liberal Christianity also offers dangers. One is that exposure to liberal Christianity will lead some transhumanists to rely more on faith and less on the hard practical work needed to sustain technical progress. However, I believe this danger can be met successfully if both groups stay focused on their common belief that human brains and hands must help build the future. By studying Teilhard, transhumanists can begin to argue that they are continuing what is best and brightest in the Christian tradition. It's my hope the dialogue between liberal Christians and transhumanists can enrich and strengthen transhumanism.

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[1] King (1996) provides an excellent intellectual biography of Teilhard. The *Teilhard de Chardin Album* (Mortier & Auboux, 1966) is an impressive photographic record of Teilhard's life, including his many research expeditions.

[2] There are many international organizations devoted to the study of Teilhard's thoughts and the realization of his ideals. Among them are the American Teilhard Association, which has a website at <http://www.teilharddechardin.org/association.html>.
he British Teilhard Association maintains a site at
<http://www.teilhard.org.uk/>.

[3] A very brief sketch of the Irenaean theodicy is as follows. The history of humanity is analogous to the development of an individual human from childhood to maturity. Just as a child is born into the world in an immature condition, so humanity first emerges on Earth in an immature condition. And, much like children, we are initially fragile creatures in a dangerous world. When we meet these dangers, we are often hurt by them. The dangers in this world should not be thought of as evil, however, but as challenges we must overcome in our individual and collective development. Overcoming these challenges is a character-building or soul-making process. As we successfully overcome them, we become more and more like God. Similarly a transhumanist might argue that the ethical development of technology is part of our collective process of maturation. It is our most natural way to meet and overcome the challenges we face. A deeper or more detailed discussion of Irenaean theodicy is beyond the scope of this article. For more information, see Hick (1977) or Walker (undated).

[4] If you have time to read only one short essay by Teilhard, read "The formation of the noosphere" in *The Future of Man* (1959). If you have time for only a few more short essays, read "Life and the planets" and "From the pre-human to the ultra-human: The phases of a living planet" also in *The Future of Man*. If you have time to read a whole book, try *The Phenomenon of Man* (1955). Then finish the essays in *The Future of Man*. After that, you will be well-prepared to venture into the rest of Teilhard's work.

[5] Transhumanists are likely to be particularly interested in several items published by the journal *Teilhard Studies*. These items are short and accessible. Norris (1995) discusses Teilhard's work in relation to anthropic cosmological principles, and particularly how Teilhard's thought was taken up by Barrow and Tipler. Dupuy (2000) discusses technology and millenarian thought in Bacon and Teilhard. Salmon (1986) and Duffy (2001) examine Teilhard's evolutionary cosmology in light of recent developments in the sciences of self-organization and complexity. Issues of *Teilhard Studies* may be ordered from the American Teilhard Association: see < http://www.teilharddechardin.org/studies.html>. Salmon (1995) is an edited volume devoted to more recent assessments of Teilhard's thought. It contains an extensive biography of work on Teilhard from 1980 to 1995.

[6] Teilhard hints at, but does not develop, an intriguing argument from the principle of plenitude to the purposiveness of evolution. His sketch goes like this: "spirit is a constantly increasing physical magnitude; there is, indeed, no discernible limit to the depths to which knowledge and love can be carried. But if spirit *can* grow greater without any check, surely that is an indication that it *will* in fact *do so* in a universe whose fundamental law would appear to be 'if a thing is possible, it will be realized'"(1974: 109; italics are Teilhard's). This argument has interesting links to the classical arguments from degrees of perfection to the existence of God (Anselm, *Monologion*, ch. 4; Aquinas, *Summa Theologica*, Part 1, Q. 2, Art. 3). I cannot, however, further pursue those links here.

[7] Since I am not presently concerned with Teilhard's theology, I cannot enter into a full discussion of his conception of the pleroma. I can only point out that Teilhard stresses the physicality of the pleroma (in 1974: 67–72). He equates it with the consummated Christ and insists that those who are saved will be "*physically* incorporated in the organic and 'natural' whole of the consummated Christ"(1974: 70; italics are Teilhard's). Teilhard also says that Christ has "a cosmic nature, enabling him to center all the lives which constitute a pleroma extended to the galaxies" (1974: 236).