

Use the Force, Luke!

What presents a greater threat to our future? If we listen to sci-fi writers Vernor Vinge, Ray Kurzweil, Hans Moravec, Marvin Minsky, and their ilk, transcendent AIs threaten the very foundations of our world. But if we listen to Eric Drexler

and Neal Stephenson (among others), we should worry more, or perhaps less, about threats from nanotechnology—in other words, death by gray goo. Are we living in denial? Vinge's basic argument for singularity is compelling, give or take any real understanding of what a transcendent AI's software might look like. Nanotech is similarly compelling, although the gray-goo thesis is less likely than some alarmists would have us believe—autonomous nanofactories that can “live off the land” won't happen any time soon or by accident.

In this final installment of Biblio Tech, we'll examine some of the various views of life and intelligence that have thrived in sci-fi over the years. We'll see how these views, coupled with a belief in or desire for human exceptionalism, contribute to our tendency to look away from threats, real or imagined, like those envisioned by the possibly fevered minds of the futurists, prognosticators, and sci-fi writers.

Vitalism

In the early days of the science of chemistry—from the 17th century through the early part of the 19th century—chemists divided their subjects of study into two classes: organic and inorganic compounds.

Rough treatment could transform organic substances (wood, oil, cloth) into inorganic ones (carbon, hydrogen, oxygen), but only living things could produce organic ones. This asymmetry was the basis for a philosophical principle called *vitalism*, which held that organisms are imbued with a life force that transcends known or knowable natural laws.

Over the course of the 19th century, progress in chemical synthesis—notably, the German chemist

Adolph Wilhelm Hermann Kolbe's synthesis of acetic acid from its essential chemical constituents in 1845—chipped away at vitalism to the point where it had essentially vanished from chemistry by 1900. However, several recent sci-fi works and a range of current events show how that concept still survives.

In George Lucas's *Star Wars* films, for example, Jedi knights rely on their training in the ways of a mystical energy source they call the Force. As Yoda says in *Episode V: The Empire Strikes Back*, “Its energy surrounds us, and binds us.” Later, in *Episode I: The Phantom Menace*, Lucas introduces midi-chlorians, symbiotic life forms that inhabit human cells to enable communication with the Force. Jedi master Qui-Gon Jinn says to the young Anakin Skywalker, “Without the midi-

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Table 1. Influential works.

TITLE	AUTHOR	ORIGINAL PUBLICATION
<i>A Production of Amino Acids Under Possible Primitive Earth Conditions</i>	Stanley L. Miller	1953
<i>When Harlie Was One</i>	David Gerrold	1969, 1972
<i>Star Wars IV: A New Hope</i>	George Lucas	1977
<i>Star Wars V: The Empire Strikes Back</i>	George Lucas	1980
<i>Engines of Creation</i>	K. Eric Drexler	1986
<i>Snowcrash</i>	Neal Stephenson	1991
<i>The Golden Compass</i>	Philip Pullman	1996
<i>The Subtle Knife</i>	Philip Pullman	1997
<i>Star Wars I: The Phantom Menace</i>	George Lucas	1999
<i>The Amber Spyglass</i>	Philip Pullman	2000

chlorians, life could not exist, and we would have no knowledge of the Force.” The Force is more than just the Jedi knights’ magical power; it’s what the vitalists conceived of back in the 16th and 17th centuries, a life force that distinguishes living from nonliving things.

It’s alive

We’re left with two possibilities for the future of transcendent AIs: that Vinge et al.’s predictions will come to pass, or that some limitation will prevent such an AI from being constructed. What might this limitation be? For one, the complexity required for duplicating or exceeding the human brain’s capabilities might be significantly larger than Vinge assumes. However, even a 100-fold or 1,000-fold increase in complexity doesn’t buy much time when confronted with the exponential growth in technological capability that Moore’s law continues to provide. The only remaining possibility is that duplicating the brain’s function and performance is simply impossible without an extra ingredient, one that we can’t engineer but that comes from somewhere else. Can such a thing, if it exists, even be added to a construct, or does it have some sort of limitation restricting it to living brains? Some recent sci-fi explores explicit or implicit assumptions of this sort.

This missing ingredient, which

we could call the mind if we want to be neutral or the soul if we want to take a quasi-religious stand, has been controversial for a long time. If a soul is created to inhabit a future person, when is it created and when does it first inhabit the person’s physical manifestation? There’s no widely accepted answer to this question, or else there wouldn’t be a controversy over when an embryo becomes a person or whether to allow stem-cell research. But the creation of an unambiguously human-equivalent AI, like the synthesis of acetic acid in 1845, would spell the beginning of the end for the last important refuge of vitalism.

When David Gerrold’s 1972 novel *When Harlie Was One* debuted, it was one of very few early sci-fi novels after Isaac Asimov’s robot stories to explore the ramifications of a human-equivalent AI. This otherwise flawed book also provides an extensive discussion of some interesting ethical problems we have yet to address—for instance, whether shutting down such a machine could be construed as murder. The author considers some of the chilling implications of a massively connected extremely intelligent machine, considering its ability to invade privacy and manipulate people. Gerrold thankfully avoids a sophomoric exploration of whether Harlie has a soul; he does, however, spend many pages on whether an AI can love someone

or something. He makes the standard error of arguing that the machine is so smart that to behave benevolently toward humans is the only option, an error made by the early atom bomb scientists in their efforts to grapple with the implications of their achievement. Heinlein makes the same assumption in *The Moon Is a Harsh Mistress*, but at least he can be forgiven because he doesn’t make the error explicit (he also writes a good yarn). Interestingly, Gerrold’s greatest claim to immortality in *Harlie* is probably his introduction of the notion of a computer virus, articulating software virus behavior quite accurately and even giving us the name “virus.” Neal Stephenson gave us a much more lyrical conception of a computer virus in his 1991 novel *Snowcrash* in which he explored the notion of viruses that could migrate between cyberspace and meatspace, a rather sobering concept.

It’s my creation

In Philip Pullman’s *His Dark Materials* novels, we get yet another (albeit better put together) exploration of vitalism. Pullman, like J.K. Rowling, has mastered the art of writing novels ostensibly for children and young adults but that also pull in adult readers. This work doesn’t really qualify as SF, but it nonetheless qualifies for inclusion here because of his impressive recruitment of recent cosmolog-

ical research into an otherwise plain vanilla parallel-universe fantasy. Of course, the fact that he writes well doesn't hurt either. Pullman sets his stories, or at least their anchor points, in Oxford, England, in several parallel universes. The vital fluid in Pullman's universe is the dark matter that cosmologists have been scratching their heads about for the past several years. Studies of the dynamics of galactic cluster behavior suggest that somewhere between 88 and 95 percent of the universe's mass is dark matter (that is, not stars). According to cosmologists, only a tiny fraction of this matter could be planets and interstellar dust and gas; the vast bulk must either be neutrinos or something more exotic.

Pullman starts with this and weaves a fantasy based on a simple observation: there's so much of this material and it interacts with normal matter so weakly, it can take on an extra job. In the *His Dark Materials* universe, the dark matter, referred to as dust, is the vital essence of sentient life.

What exactly is vitalism's appeal? Why has this concept, defeated scientifically again and again, continued to survive, providing sustenance to otherwise unsupportable theories? I think it's simple: vitalism

supports the notion that the human consciousness is unique and special. Although we know the Earth is not the center of the physical universe, we're still less than eager to give up the notion that we occupy the center of the intellectual universe. What if we create an AI with an IQ of a billion? Or we encounter alien intellects on the same scale? How would you feel if, relative to most advanced intellects in the universe, you were no more intelligent than an amoeba?

Although it's pure speculation on my part, this is the same impulse that

moved the contemporary establishment to react so negatively to the Copernican heresy that the Earth revolves around the Sun. Copernicus, Galileo, and others who advocated the heliocentric theory provoked with simple truths a reaction so violent that even today we call any radical proposal "revolutionary." □

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A fond farewell

Two years ago, this department launched along with *IEEE Security & Privacy*. In that time, we've explored a broad range of issues at the boundary between technology and society as expressed in science fiction. Our goal was to provoke thought and discussion within the engineering community, whose members contribute so much to the technology that changes our world but who generally hold back from the most vigorous debates about the larger impacts of technology on society.

The reception for Biblio Tech has been warm, as some readers have expressed to numerous members of the editorial board, and it has been a pleasure to write for and edit this department. However, after this issue, we will be removing Biblio Tech from the regular lineup of departments (although it might return from time to time on an irregular basis). Creating something like this had been a dream of mine for many years, and doing it has been extremely fulfilling. In the 10 articles I've personally written, I've explored the bulk of themes that were on my mind when originally proposing the department. Rather than have Biblio Tech degenerate into a "what's new in sci-fi this month," we decided to dial it down. Thank you all for your generous attention and kind messages.

—Marc Donner

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