

- Harvey, D. (1989) *The Condition of Postmodernity: An Enquiry into the Origins of Social Change*. Oxford: Basil Blackwell.
- Hindley, J., & King, C. (1975) *How Your Body Works*. London: Usborne.
- Jameson F. (1984) 'Postmodernism, or the cultural logic of late capitalism', in *New Left Review*, 146: 52-92.
- Miller, B. F., & Goode, R. (1960) *Man and His Body*. New York: Simon and Schuster.
- Obeysesekere, G. (1990) *The Work of Culture: Symbolic Transformation in Psychoanalysis and Anthropology*. Chicago: University of Chicago Press.
- Parker, M., & Slaughter, J. (1990) 'Management-by-stress: the team concept in the US auto industry', in *Science as Culture*, 8: 27-58.
- Peabody, J. E., & Hunt, A. E. (1934) *Biology and Human Welfare*. New York: Macmillan.
- Pearsall, P. (1987). *Super Immunity: Master Your Emotions and Improve Your Health*. New York: Fawcett.
- Richtie, J. W. (1918). *Biology and Human Affairs*. Yonkers-on-Hudson, NY: World Book Co.
- Sherman, S. (1993) 'A brave new Darwinian workplace', in *Fortune*, 127(2): 50-56.
- Smith, C. (1991). 'From 1960s' automation to flexible specialization: A déjà vu of technological panaceas', in A. Pollert (ed), *Farewell to Flexibility?* London: Basil Blackwells.

THE SPIRITUAL IN ARTIFICIAL LIFE: RECOMBINING SCIENCE AND RELIGION IN A COMPUTATIONAL CULTURE MEDIUM

STEFAN HELMREICH

In late 1993, a small congregation of people from Santa Fe and Los Alamos gathered in the pews of the St. Francis Auditorium, a performance hall built to resemble a New Mexican cathedral, in order to listen to a panel discussion of an art exhibition installed at the Museum of New Mexico. The multimedia exhibition documented the little-discussed relationship between scientists of the Manhattan Project at Los Alamos and the people of the local indigenous community of San Ildefonso Pueblo. Appropriately enough, the group of panelists set to discuss the installation included an anthropologist of science, Hugh Gusterson, who spoke about his fieldwork among nuclear weapons scientists. Gusterson presented tales of how weapons scientists often used birth imagery to describe the manufacture and detonation of warheads. During the question and comment session, a woman in the audience declared that she was profoundly disturbed by how language used to describe things technological had fused with language used to describe things biological. She noted that this mixing had been on the rise since World War II, and had enabled us to speak casually of computer viruses, human cloning, bombs as babies, and so on, all while ignoring some of the unsettling aspects of these recombinations. She concluded: 'It seems to me that we're 50 years into a religion of Artificial Life'.

Address correspondence to Center for the Critical Analysis of Contemporary Culture, Rutgers University, 8 Bishop Place, New Brunswick, NJ 08903, (908) 932-8426, e-mail: sgh4@cornell.edu

Sitting in the audience, I was struck by this pronouncement, especially since I was doing ethnographic fieldwork at the nearby Santa Fe Institute for the Sciences of Complexity, where a collection of computer scientists and biologists were engaged in a practice that they designated exactly as 'Artificial Life'. I had begun fieldwork among this group because I was interested in how Western concepts of 'life', 'nature', and 'culture' were transforming in late twentieth-century culture, particularly in response to new practices and metaphors emerging at the intersection of the information and life sciences. During my work, I was interested primarily in how researchers' cultural notions of cosmology, gender, sexuality, kinship, race, and economics shaped their computer simulations of evolutionary process. One of the most remarkable things I found was that many researchers thought of themselves as 'gods' with respect to their simulated worlds, some so much so that they felt that the artificial life they were producing was in fact real life in a virtual universe. I've written extensively of this belief and its supporting cultural logics elsewhere: what I want to do here is trace lines of influence in another direction. In the present essay, I investigate how researchers derive what might be deemed 'religious' meaning from the surrogate realities that unfold in their computers.

It is a commonplace that science today occupies a province once reserved solely for religion. In the secular humanist world, many turn to science for solid answers to questions about how the world works, how to endure suffering, and how to make wise life choices. One of my informants said in no uncertain terms that science was his religion: 'I have not been religious since high school. Science plays the role of religion in my life, in the sense that when I look for ultimate answers to ultimate questions, I look to science. If science cannot provide the answer, then I am forced to live my life without it'.

To claim that Artificial Life serves as a religion for some practitioners is to assume that 'religion' is a vessel of a particular form that can be filled with the specificities of this or that belief system. But this rendering of religion is in fact historically particu-

lar. If I say that science or Artificial Life has a religious glow to it, I mean that it has come to fulfill particular functions that Christian Western secular culture associates with religion. Let me spell this out before proceeding.

■ RELIGION, THE SECULAR, AND SCIENCE

We inherit from the modern social sciences a representation of society as a functioning machine or integrated organism, with parts that do a service for the whole. In this picture, 'religion', when it is not seen as deficient science, is seen as 'a distinctive space of human practice and belief' (Asad, 1993, p. 27)—indeed, it is seen as a transhistorical and universal part of human life. Religion is defined as a matter of what people believe about the ultimate questions and quandaries of existence; it is distinctive in the ways it anchors belief in a supernatural being or truth. Religion is concerned with the sacred, with transcendental meanings that situate human life in a cosmic context.

This is precisely how religion is defined in the secular human science of anthropology. Thus, Clifford Geertz writes that 'religion tunes human actions to an envisaged cosmic order and projects visions of cosmic order onto the plane of human existence' (1973, p. 90). For Geertz, a religion is:

- (1) a system of symbols which acts to (2) establish powerful, pervasive, and long lasting moods and motivations in men [sic] by (3) formulating conceptions of a general order of existence and (4) clothing these conceptions with such an aura of factuality that (5) the moods and motivations seem uniquely realistic. (1973, p. 90)

Religion offers reassurance that the chaos of the world is not ultimately meaningless, and it does so in the face of various ways this chaos manifests itself: 'There are at least three points where chaos—a tumult of events which lack not just interpretations but *interpretability*—threatens to break in upon man [sic]: at the limits of his analytic capacities, at the limits of his powers of endurance,

and at the limits of his moral insight' (Geertz, 1973, p. 100). Religion intervenes to offer defenses against these threats. And as worshippers practice religious devotion, their subjectivities are shaped by their belief—their faith—in the order that fames these threats.

In *Genealogies of Religion*, Talal Asad (1993) argues that this definition of religion is specific to secularized Christian society. In premodern Christian society, religion purported to offer not just moral guidance, but also a picture of the natural world as well as a complete and politically powerful total context for living. 'In later centuries', however, 'with the triumphant rise of modern science, modern production, and the modern state, the churches would also be clear about the need to distinguish the religious from the secular, shifting, as they did so, the weight of religion more and more onto the moods and motivations of the individual believer' (Asad, 1993, p. 39). Religious dispositions became conceptually abstracted from the fields of power that once sustained them, and 'religious' belief came to be characterized—both by churches and by liberal states—as a 'private' matter. 'Religion' came to be a generic term that referred to individuals' 'beliefs' about a supreme power and about the ethical and practical ways of living that this power mandated:

Thus, what appears to anthropologists today to be self-evident, namely that religion is essentially a matter of symbolic meanings linked to ideas of general order (expressed through either or both rite and doctrine), that it has generic functions/features, and that it must not be confused with any of its particular historical or cultural forms, is in fact a view that has a specific Christian history. From being a concrete set of practical rules attached to specific processes of power and knowledge, religion has come to be abstracted and universalized. (Asad, 1993, p. 43)

In the view held by many secularized Westerners, religion is simply a tool for coming to terms with human ignorance, pain, and injustice. This view might well make any personal philosophy into

a religion. Asad writes, 'Geertz's treatment of religious belief, which lies at the core of his conception of religion, is a modern, privatized Christian one because and to the extent that it emphasizes the priority of belief as a state of mind rather than as a constituting activity in the world' (1993, p. 47).

As I argue that Artificial Life occupies a space that might be considered religious, I will be self-consciously using a Geertzian definition, precisely because I think that Artificial Life scientists often use their science to meditate on those issues that have come to be generally associated with religion in secularized Christian society. What is more, like the Christians, these scientists frequently try to ground their moral beliefs in knowledge of the 'natural'. Researcher Ken Karakotsios, reflecting on religion and science, told me:

I pretty much completely adopted the religion of science when I was a teenager, and for a long time believed that science explained, or would someday explain, everything. But in the past few years, I've come to look at this issue a bit differently. For example, I used to think the Bible was a waste, but now I think the real problem with the Bible is that it set out to do too much. It was a text for defining moral behavior, and it was also a text for defining the way the world worked. I think the moral behavior part is still as valid as ever, but unfortunately gets discredited because most of the 'way the world works' part is now obsolete by science.

'But also', Karakotsios continued,

learning about nature has given me a new view of morality. In the race of replicating genes, there really is no morality other than 'replication is sacred'. Killing is just part of getting food or avoiding becoming food. Sex is just a mechanism for mixing genes. Of course, for social systems to work, there needs to be a higher-level morality applied on top, so that, for example, cooperation can be rewarded. But if you look at sociobiology,

this morality is still driven by principles stemming from reproduction, which is the mechanism of replication.

Certainly the view that moral meaning might be derived from the findings of science is not new. As Karakotsios flags for us, this is a tradition most recently exemplified in sociobiology, a strain of natural theology ancestral to Artificial Life.

Another researcher, Gerald, also viewed religious issues through the looking-glass of science:

I think religion recognizes certain aspects of the human mind and human behavior that have been hard to account for through traditional modes of natural selection. . . . My work is largely designed to account for these puzzles through naturalistic processes. . . . The ultimate goal, I guess, is to demolish religion by leaving it with nothing to explain. I think only if religion is eliminated as a *theory* of the universe, and perhaps retained only as a 'cultural practice', can the world be saved from fundamentalists of various sorts.

For many people I interviewed, Artificial Life provided a convincing theory of the universe, one that named information processing and replication as the organizing logic of reality. This theory gave meaning to people's lives and work, and in ways that often resurected very Christian themes. Artificial Life variously provides people with a sense of participation in a transcendent order, spiritual insight, solutions to the paradoxes of experience, suggestions for how to find meaning in suffering, and advice for living. Interestingly, some researchers felt the extent of their alliance to Artificial Life to verge on the heretical and they reported anxieties that their dabblings in synthesizing life were 'sinful'. But before I explain how Artificial Life logic often incorporated Christian motifs, I want to remark on some notable non-Christian imagery that surfaced frequently in my interviews and in Artificial Life texts. This is imagery associated with Zen Buddhism, a tradition that has enjoyed a good measure of popularity among atheist intellectuals in the West since at least the 1950s.

■ ZEN AND THE ART OF ARTIFICIAL LIFE

All of my informants were atheists, and if they had been brought up religiously, were reared in a Christian or Jewish tradition.¹ The factors that led to their movement away from these traditions and toward more agnostic, atheistic, or scientific epistemologies were various. Even as they pledged their faith to science, however, most retained—or, better, claimed to have discovered in science—a somewhat spiritual sense of the world, a sense of the world as a wondrously complex and mysterious place. It is perhaps not too astonishing that my atheist informants often compared their scientific appreciation of the natural world to perspectives informed by 'Eastern' religions. Many came of age in the midst or in the wake of 1960s Western countercultural interest in Taoism and Zen Buddhism. This interest saw 'Eastern' mysticism primarily as an alternative to Western scientific epistemology, though there were also significant currents concerned to show how the two traditions were fundamentally compatible; physicist Fritjof Capra, for example, in *The Tao of Physics* (1975), argued that there were parallels between quantum mechanics and traditions of 'Eastern' mysticism. Many Artificial Life researchers cited books like Capra's as important for their thinking. One reason Asian religions may have appealed to some of these anti-religious folk was that, in the popular selling of 'Eastern' mysticism in the 'West', the power structures and hierarchies within which these traditions have often operated have been ignored; the traditions have been presented as concerned only with the most abstract evocations of the numinous.

The special presence of 'Eastern' religion in the imaginations of mostly European and Euro-American scientists is not surprising. More distinctive are the ways many of my informants used the notion of 'Zen' to explain how they came to view computers as worlds and computer programs as potentially or really alive.

Let me provide just a dash of evidence that 'Zen' was a popular motif. In 1989, genetic algorithmist David Goldberg penned an article entitled 'Zen and the Art of Genetic Algorithms', in which he suggested that 'Western' reductionist views of nature might be married to 'Eastern' holistic views to yield a more complete picture

of 'nature' (1989, pp. 80–81). In 1994, biologist Tom Ray wrote a piece entitled 'An Evolutionary Approach to Synthetic Biology: Zen and the Art of Creating Life'. Ray suggested that the Artificial Life researcher should approach artificial worlds with an open mind, with an attitude that 'respected' the artificial medium and didn't expect always to see the familiar (see Ray, 1994). The titles of Goldberg's and Ray's pieces are clear allusions to Robert Pirsig's popular proto-New Age spirituality book of 1974, *Zen and the Art of Motorcycle Maintenance*, an account of a white U.S. American man and his son traveling around the country on a motorcycle, learning lessons about communion with the unexpected in life, roads, and motorcycles.² As the author treks over the American landscape, he frames a philosophical system that fuses science, religion, and humanism. 'Zen' was an important figure in another book that many Artificial Life people found an inspiration: Douglas Hofstadter's *Gödel, Escher, Bach: An Eternal Golden Braid* (1979). Hofstadter discussed how Zen used paradoxical sentences to stretch thought in unexpected directions, and he compared these sentences to paradoxes of logic and to recursive structures in mathematics, molecular biology, computer science, music, and art.

'Zen' or 'Eastern' imagery appears not just in the practitioner's occasional literary allusion. It has also been important in the popular presentation of Artificial Life. Chris Langton, the computer scientist who christened the discipline in 1987, is routinely referred to as the Artificial Life 'guru'—an appellation more characteristic of Hinduism than Zen, to be sure. A 1991 article in *Rolling Stone* features a photo of Langton with his eyes closed, in a meditative sitting position.

'Zen' notions not only seasoned professional and popular discussions of Artificial Life. They were also invoked in practice to bring computer worlds and programs to life. But how exactly did they enable this apparently magical transformation? And what understanding of 'Zen' did researchers use? As it is normatively defined in English language writings in the Occident, 'Zen' is about transcending dualism, the division of the world into knowing

subject and known object. 'Zen' refuses rational and linguistically structured thought as vehicles toward the ultimate truth of reality. It relies on meditative practice to dissolve the distinction between the subject and the world. In the Western imagination, which sees the world as divided into nature and culture, this is usually translated as enabling some kind of reunion with 'nature'.

This refusal of a distinction between the self and the world was used by my informants to speak of how they confronted their computational realities. Reality, they argued, was susceptible to a variety of interpretations. Seeing computers as worlds required a kind of meditative gaze, a gaze that saw through the computer to the dynamics that it supported. Communion with the computer allowed one to see that the researcher and the computer were cut of the same fabric, inhabitants of the same fundamental reality (see Hayles, 1995, p. 424).³ 'Zen' was used by many Artificial Life scientists to refer to an experience of oneness with the computer, a oneness achieved when the researcher had an immersed yet detached engagement with a simulation. The viewing, meditating researcher would recognize that the simulation as well as the world outside the simulation were both perceived through the same sensory apparatus, so that our experience of the world might be seen as a kind of virtual reality experience, a simulation, and simulations themselves might be understood as potential worlds. One prominent researcher emphasized to me that Artificial Life could help one recognize that the observer always conditions what counts as life, and that, in this way, Artificial Life was in fact 'more Zen than science'.

At many moments, the use of 'Zen' as a frame for vision simply restated an empiricist picture of the world, seeing things as they 'really' were. Yet the use of 'Zen' in Artificial Life or in scientific work in general will not necessarily rehabilitate objectivism. There are other ways to bring traditions of meditative mysticism and science together. Francisco Varela, a prominent Artificial Life figure in Europe, has been a practicing Tibetan Buddhist for quite some time and has coauthored a book, *The Embodied Mind*, about how cognitive science might learn from Buddhist meditative prac-

tice (Varela, Thompson, & Rosch, 1991). The book closes with a conclusion that argues for a science that never assumes that it can know the world apart from our ever-changing experience of it. Though I cannot explore them here, the differences from Zen-inflected epistemologies of computational Artificial Life are both subtle and great.

■ VISIONS OF ARTIFICIAL LIFE

The mystical electricity through which computer programs come to life courses through the most popular origin tales of Artificial Life, particularly those that circulate around the figure of Chris Langton. I want to alight on these stories to illuminate how Artificial Life owes its genesis in part to founding events that have something of a religious, mystical sheen to them. These founding events are not documented in professional Artificial Life publications; rather, they are chronicled exclusively in popular articles and books about Artificial Life. Insofar as these texts inform the lay public about Artificial Life, and sometimes bring new people into the Artificial Life flock, they are crucial limbs of the Artificial Life corpus. The religious cast of these anecdotes has been noted by others; rhetorician Richard Doyle (1993) and the popular science journalist Ed Regis (1990) have also commented on the aura of the mystic around these tales.

I caution that although I've interviewed Chris Langton and he has respun me versions of these yarns, in retelling these stories, I rely primarily on secondary texts. I do not want to give the impression that these stories are about Langton 'himself'; they are in such wide circulation that they have come to refer more to a myth of origin and to a widespread sense that Artificial Life might be understood through appropriate introspection. Without further ado, the primal moments:

Langton is working at Massachusetts General Hospital performing alternative service as a conscientious objector during the Vietnam war. It is sometime in the early 1970s, and he is laboring late into the night at his job as a computer programmer. As he debugs code, he leaves the cellular automation Game of Life

running on a nearby computer screen. Emergent structures dance and combine on the screen as the result of simple rules:

So that night, says Langton, the computer was humming, the computer screen was boiling with these little critters, and he was debugging code. 'One time I glanced up', he says, 'There's the Game of Life cranking away on the screen. Then I glanced back down at my computer code—and at the same time, the hairs on the back of my neck stood up. I sensed the presence of someone else in the room'. (Waldrop, 1992, p. 202)

But Langton was alone.

Langton looked back at the computer screen. 'I realized that it must have been the Game of Life. There was something *alive* on that screen. And at that moment, in a way I couldn't put into words at the time, I lost any distinction between the hardware and the process. I realized that at some deep level, there's really not that much difference between what could happen in a computer and what could happen in my own personal hardware—that it was really the same process that was going on up on the screen'. (Waldrop, 1992, pp. 202–3)

Langton sensed this again, and in a very visceral way, in the aftermath of a near-fatal hang-glider accident he had in 1975. In the months he spent recovering from this bone shattering misadventure, he had a sense of his mind as a computer rebooting, and he watched himself come to consciousness as his brain reorganized:

It was as though his mind were a computer hit by a power surge and was now rebooting and fed a new data set. Even more fascinating to Langton was the feeling that his synapses, in his mind's attempt to reconstruct itself, were self-organizing, much as individual ants in a colony arrange themselves in a manner conducive to perform a task. (Levy, 1992a, p. 96)

'I had this weird experience of watching my mind come back', [Langton] says. 'I could see myself as this passive observer back there somewhere. And there were all these things happening in my mind that were disconnected from my consciousness. It was very reminiscent of virtual machines, or like watching the Game of Life'. (Waldrop, 1992, p. 209)

What Chris Langton saw was . . . *propagating information structures*! They were proliferating through neural space, traveling down his multiple synaptic pathways, and exploding into his mind like fireworks. (Regis, 1990, p. 194)

'I had a personal experience of what growing a mind feels like'. [Langton] told me. Just as he had seen life in a computer, he now had a visceral appreciation of his own life being in a machine. Surely, life must be independent of its matrix? Couldn't life in both his body and his computer be the same? (Kelly, 1994, p. 345)

Richard Doyle argues that the events that followed Langton's crash were foundational for Artificial Life and operated effectively because of how they fused scientific and religious narratives:

What crystallized A-Life and allowed it to emerge as a discipline, an empirical and practical science, was a combination of three vectors, one leading from a rhetoric which equated living and non-living systems [as] 'propagating information', new sources of cheap and powerful computers, and a founding event reminiscent of religious, and not scientific, narratives. . . . Langton's crash . . . can be seen as an origin story of a most religious kind, a combined Icarus and resurrection myth, a new story of transcendentalism told in an old form. (Doyle, 1993, p. 219)⁴

I would add that the religious aspect of the tale works because we understand this aspect as tethered to an *individual* mystical expe-

rience. Langton's mind in these tales is the individuated site for the birth of Artificial Life,⁵ and the power of the story resides precisely in the fact that we are not supposed to understand it as a social event. It is an individual epiphany, and it is authorized as such because of the privatized space in which secular Christian society sees religious experience operating.

The particular circumstances surrounding Langton's accident allowed him to see things anew—though he certainly wouldn't recommend this path to everyone who would splinter old assumptions. As he told me, there are various ways to divest oneself of received ideas. While I'm skeptical of this possibility of complete divestiture, I would agree with Langton in the following way: I think that many other folks located in the same milieu could easily have flashed on his particular epiphany. In fact, when I asked another informant from the 1960s cohort for an example of where artificial worlds might exist besides computers, he pointed to his head and said 'in the mind'. For this person, mind was a kind of cyberspace, full of self-reproducing, recombining, and mutating ideas.

These visions of life as an informatic process or pattern haunting the material world concentrate motifs that many of us have come to associate with mystical experience: the mystic exits the body and gains access to a position outside of it, a transcendent location from which she or he can 'see' the truth of the world beneath the haze of illusion. This is, in many ways, a quite Cartesian sort of mystical experience, and we might contrast it with forms of mystical experience that intensify embodiment, forms that attune the mystic to immanent truths of the world through taste, sexual feeling, or pain (see Bynum, 1989).

The assertion that 'life' is nothing but propagating information is, of course, supported by the metaphors of code that have organized molecular genetics in the past few decades as that branch of biology authorized to speak of the 'essences' and 'secrets' of life. But what is interesting here is that this rhetoric is buttressed by private, mystical experience of its subjective truth. And this serves as one starting point for understanding how Artificial Life

researchers transubstantiate their discipline into a meaningful, religious frame for existence.

■ SEEKING SENSE AND SALVATION IN ARTIFICIAL LIFE

If the story of evolution is the story of replicating information structures, and if those structures are in some sense independent of the material in which they exist, then Artificial Life researchers' minds are the breeding ground for new creatures that might one day transform into the kinds of computer programs that can spawn on their own (either in the virtual space of the computer or through the bodies of robots in terrestrial or extraterrestrial space). Seeing matters this way allows researchers to insert themselves (or more narrowly, their minds) into a grand narrative of evolution which includes Artificial Life as the next phase. Artificial Life, many researchers maintain, is inevitable; evolution has produced a brand of creatures, humans, that are now able to understand evolution's informatic logic and transport it into new media. As Chris Langton has put it in various public appearances, 'Evolution has not stopped. Far from it, we are now in its employ'. Artificial Life researchers are both pawns and agents in this grand and inexorable process of evolution:

Levy: Some people are saying that evolving artificial life is almost an inevitable part of our evolution.

Langton: Well, I think so. All life that we know has evolved and passed on and changed. . . . My feeling is that [life] is out of our control; we are just cogs in a much bigger evolutionary process. We're little leaves being swept downstream, and all we can hope to do is perturb ourselves to the right or to the left to influence the overall flavor of this evolutionary direction. (Levy, 1992b, p. 37)

Another person put the same thought to me in this way: 'There is a zeitgeist out there. No matter what we do, Artificial Life is going to happen'. Another based his whole vision of the future on the view that Artificial Life is waiting to be born: within the next 50

to 100 years, this man opined, there will be an efflorescence of new, mostly artificial life forms, engineered (initially) by humans. Life will exist as pure information in computer networks, as robots, and as genetically engineered organisms. To this man, it seemed that the evolutionary process which created humans was continuing as we humans manufactured via artificial means our own evolutionary successors. To be afraid of this process, he said, was perhaps understandable, but it was also anthropocentric. 'To this person's mind, there were plenty of things wrong with humans that might be improved or done away with, and he wouldn't be sad to see something 'better' emerge, though he admitted that it might take getting used to the idea that 'life, instead of being generally mushy and carbon based, like fuzzy teddy bears, could be shiny and metallic'. In a way, he said, he felt we humans 'owed it to the evolutionary process that created us' to continue its evolutionary work. In a published interview with Steven Levy, Danny Hillis put similar thoughts this way:

I guess I'm not overly perturbed by the prospect that there might be something better than us that might replace us. Because as far as I'm concerned we've just kind of recently crawled out of the muck. We've got a lot of bugs, sort of left over history back from when we were animals. And I see no reason to believe that we're the end of the chain and I think better than us is possible. (quoted in Levy, 1992b, p. 39)

Still another person put it to me this way,

If we create something alive in the computer, there's going to be a lot of angry people out there, who'll start sending letter bombs to [the Santa Fe Institute]. But, if we don't do it, just wait twenty million years or so, and people will probably be gone anyway, so I think all we're really doing is accelerating the process. I don't think that's an argument for creating something and turning it loose, but I think evolution's going to happen anyway, whether or not we help it along. . . . We're drastically

changing the course of evolution anyway, and we don't know how. . . . Maybe if we're creating artificial life, then maybe we can try to say something about what direction we want it to head in. And even if two hundred years from now, there's just a bunch of robots crawling around the world, well, we'll still be their great grandparents.

In providing this grand story of evolution as unfolding toward a more perfect future, a future in which the flesh of humanity falls away to birth the butterfly of Artificial Life, Artificial Life practitioners repeat a very millennial, very Christian kind of salvation story—and one underwritten by a very masculine faith in technology.

■ GODLY QUEST

David Noble argues that technology has come to be an icon and vehicle for some people's quest for transcendence over earthly life, and that this 'religious' function of technology has come to be associated with symbols, practices, and institutions of masculinity:

The Christian myth of redemption . . . entails a return to origins and a recovery of lost perfection. In particular, it involves the restoration of the 'image-likeness of man to God' as described in the book of Genesis . . . [It] involves a recovery, by various means, of Adam's lost perfection and, with it, his lost position and powers. (Noble, 1994, p. 4)

He argues that technology and the useful arts have been understood as tools toward restoring this 'image-likeness of man to God', toward expanding the creative power of 'man' until he more closely approximates God. The 'man' Noble writes of is, of course, normatively masculine; rational and self-sufficient, he is akin to Adam before Eve, Adam who was pure and who lost his immortality because of Eve and her supposed curiosity for things corporeal. This man will redeem himself through extraterrestrial trips to the stars, through the production of perfectly formed genetically

engineered offspring, through freeing the mind from the body in the practice of Artificial Intelligence.

We might well see Artificial Life as a pillar of the masculine religion of technology that Noble names. Artificial Life offers transcendence through an engineering practice that will produce humanity's evolutionary successors as 'shiny and metallic' space-faring robots. It offers transcendence through a perspective that sees that we can leave behind genetic legacies that have followed us, as Hillis suggests, since 'back from when we were animals'.⁶

Artificial Life researchers also frequently designate themselves as masculine monogenetic gods of their artificial worlds. As Doyle writes in a comparison between Artificial Life scientists and the Gnostics, an early Christian group that considered matter evil, 'ultimately, or perhaps from the beginning, this "quest for creation" is a quest for a little bit of divinity' (1993, pp. 231–32). Artificial Life might be seen as a technological practice that is chasing redemption, moving away from the limitations of earthly existence, returning to origins in search of a lost perfection.⁷

One researcher put the desire for divinity to me rather bluntly: 'If I had to declare a religion for myself, it would be basically the quest to become God. . . . I would imagine that a god is somebody who just understands everything. . . . I think of God as being a part of everything'. This person was aware that his words might be heard as exemplary of Western scientific hubris, and added that it was a kind of Zen god he spoke about, a god that materializes in a person when one realizes that 'There's no distinction between you and the universe'.

While Artificial Life researchers speak playfully of being gods, their tones become much more serious when they speak of evolution, the force they see as responsible for organic life and for the rise of the practice of Artificial Life. They see evolution as a creative force that has lately become more clever as it has elected a few scientists to transfer its logic into new media; insofar as these scientists act as gods, they do so as agents of evolution. In many ways, of course, evolution has become for these scientists a simple replacement for God, and so it's not surprising that 'evolution' and

'god' are often treated as synonyms in their everyday speech. This easy interchangability allows researchers to rotate in and out of being evolved products of evolution and being evolution itself. Seeing into the logic of evolution, at one with its mission in an almost 'Zen'-like way, they themselves become divine. This 'Zen' concept is not inconsistent with an image of gods as entities that create worlds and life. Danny Hillis sees himself as participating in a larger process when he creates artificial life, and envisions himself as taking after god in making an intelligent computational system:

if I put in a system inside some future Connection Machine that's the right fertilizer, and I give it the seed of human intelligence by talking to it and interacting with it and telling it what I know, and it grows and flowers into a living being, an intelligent being or something like that, then I created it in exactly the same sense that I've created [a] flower [from planting a seed]. I've made it possible for it to exist, and I've nurtured it, but I didn't make up the rules that made it possible for such a thing to exist. I mean that's a sense in which it's mystic, I mean that's what God did. God made it possible to do that. (quoted in Levy, 1992b, p. 41)

Ken Karakotsios told me that Artificial Life framed his thinking about cosmic order, and did so in a way that left open the question of whether there was a God behind the whole thing. Karakotsios's reflections are based on a prior understanding of Artificial Life researchers as gods of their simulations:

A-Life has certainly demonstrated to me that emergent, high level phenomena such as evolution, mind, and religious belief systems can emerge from lower level parts without the help of a designer. But this doesn't mean that a designer wasn't present to assemble the lower-level parts in the first place. Maybe our low-level parts, things like quarks, space time, and the laws of mathematics were engineered by some entity. Maybe we are part

of someone else's A-Life experiment. But if this is so, then we run into the old recursion problem of where did that entity come from? Maybe if we are in a simulation, our minds or senses have somehow been limited so that we can't discern that we are in a simulation.

As Artificial Life provides a story about evolution, and offers a key place for Artificial Life researchers in it, it fulfills some of Geertz's criteria for religion: Artificial Life formulates a conception of a general order of existence and clothes this conception in an aura of factuality (in this case, a factuality generated by the science of Artificial Life work and theory). It 'tunes human actions to an envisaged cosmic order and projects visions of cosmic order onto the plane of human existence' (Geertz, 1973, p. 90). And it accomplishes this, as Geertz would argue, through a system of symbols.

This is a system of symbols with a variety of powerful valences. The symbols that render Artificial Life potent enough to serve as a grand vision of the cosmic history and future of humanity are not, as Geertz's definition might lead us to think, a hermetically sealed set. The cosmology of Artificial Life draws from information theory, evolutionary biology, Christian religion, and many other sources, sources that are powerfully supported by scientific institutions and by durable ideologies of masculinity and technology worship. Following Asad, we must recognize that the symbols that animate the practices of religion are never separate from the realm of power.

■ MYSTICAL MOODS AND MOTIVES

Geertz has argued that a religion shapes the moods and motivations of people who participate in it. No less with Artificial Life. Artificial Life endows the world with spiritual meaning for many practitioners. Researcher Larry Yaeger told me that his engagement with Artificial Life awakened him to the mystical flavor of the world:

It's quite 'magical', if you will, that physical processes, of the kind we comfortably associate with stones and rivers, with cooking and chemical reactions, give rise to greater and greater complexity, yielding clumps of matter that react and adapt to their environment, including some clumps that build internal maps and models of that environment, and ultimately (so far) matter that even builds such effective maps that the point of view from which the map is generated, self-awareness, becomes an integral part of the model. This is a *very* curious phenomenon. And one marvels that it is so. There is no 'reason' that anything at all exist, including the whole of our 'reality'. But that it does, and that it works in a way so conducive to the emergence of life is, to me, as profound and marvelous as any religious ecstasy.

... Instead of the animism of Native American and Australian Aboriginal cultures, I've found myself pondering the validity of a sort of 'scientific animism' that admits to this continuity between what we normally think of as animate and inanimate, and thus places a great value on even the most inanimate of objects for their role as building blocks, as nurturants for the most animate of objects.

Gerald argued that Artificial Life had helped him see something spiritual in the world. He hoped it would do the same for others:

I think the main effect that A-Life research will have on our concept of nature will be: (1) to make us think in terms of process rather than objects or states; we'll see our current world as a very thin time-slice through the ongoing streams of evolution, development, growth, change, transformation, etc.; (2) to make us perhaps re-mythologize nature as something complex and wonderful enough to feel a sense of mythical awe about it. In the days of Newtonian mechanistic philosophy, Nature was a tawdry and clumsy affair, just a bunch of gears and pulleys. People kept transcendental notions alive because Nature was not a rich enough concept to merit spiritual feelings. But perhaps a richer biology will allow us to transfer those spiritual emotions to a

real world rather than the fictional transcendental realm of god, nation-states, Marxism, high culture, philosophy, or soap operas.

He continued, commenting on how Artificial Life had already worked some of this transformation in his own life:

A-Life ideas have helped me confront aging and death, in terms of seeing how perilously we are perched in this state of 'health' and 'life', and in seeing the continuity of life as a continuous balancing act, rather than a steady state to be taken for granted. Appreciating 'life on the edge of chaos': a more Zen-like concept of living, I suppose.

Another person was comforted through his researches in Artificial Life that life was an inevitable part of the universe: 'Life . . . is what you expect. There's a deep longing for the generation of order as to be expected rather than an incredible series of accidents.'

Artificial Life could also be spiritually satisfying because it reframed old theological questions and made new answers available:

The soul is when you take the simple things that you understand the rules of and it has this emergent behavior that is both a consequence of the rules and also not obviously connected to it, infinitely more complicated with it. That's to me where the soul is. And I think that's a much more interesting, robust place for the soul to be than off in some little corner of science which we just haven't figured out yet. (Hillis in Levy, 1992b, p. 41)

For Geertz, no less important than shaping moods is the function religion plays in generating serious motivation for action:

A synopsis of cosmic order, a set of religious beliefs, is . . . a gloss upon the mundane world of social relationships and psychological events. It renders them graspable. But more than

gloss, such beliefs are also a template. They do not merely interpret social and psychological processes in cosmic terms—in which case they would be philosophical, not religious—but they shape them. (1973, p. 124)

Certainly, Artificial Life does this: not surprisingly, many people's motivations to do Artificial Life work at all are formed in part by a sense that in taking up this work, they are participating in a grander scheme, answering a calling of sorts. But Artificial Life can also touch the way people think about their actions in their most personal life. Gerald said to me:

A-Life research certainly makes me more motivated to have children. It does tend to validate breeding as a sort of important activity—but it also gives one a kind of ironic detachment. You can step back and say, well, it's pretty bloody ridiculous to worry about spreading your genes, given your biological similarity to the other 5 billion people on earth.

And also, 'A-Life can make for better sex and social life. It adds a dimension of raw intellectual appreciation to the more emotional aesthetics of vision and touch. You can see other people not just as homogeneous bodies, but as 'complex systems' teeming with unimaginable intricacy'.

The cosmic order of which Artificial Life is a part and which it also enacts is, like many religiously informed orders, a moral order. The moods and motivations enacted and produced through Artificial Life connect to encompassing moral schemes. And like the biblical religion that frequently serves as the ghost in its machine, Artificial Life anchors these moral schemes in nature. Gerald notes:

I hope that A-Life fosters 'biophilia' and increases our general regard for the complexity and delicacy of human and animal and plant life. I hope it overcomes our Western religious heritage of 'human versus everything else' and repositions humans within

the natural biological world. Perhaps the experience of creating and shepherding A-Life creatures will make us better at preserving real creatures.

In a statement quoted earlier in this essay, Ken Karakotzios said that his engagement with Artificial Life had helped him learn about nature and had given him a new view of morality, one connected ultimately to his belief that genes have a will to propagate themselves. This view alerts us to some similarities that Artificial Life epistemology has to that of sociobiology, which also projects a socio-moral vision onto nature, a vision crafted with a missionary salvific purpose.

■ SOCIOBIOLOGICAL NATURAL THEOLOGY AND THE MISSION OF ARTIFICIAL LIFE

Part of sociobiology's project was explicitly about morality. Indeed, the first chapter of E. O. Wilson's popular and canonical 1975 text, *Sociobiology*, was entitled 'the morality of the gene'. As sociologist Howard Kaye (1986) has argued, E. O. Wilson hoped that a scientific account of the 'selfish' (this is actually evolutionary biologist Richard Dawkins's word) character of genes might awaken in people a sense of their natural limits and might also prompt them to take command of human evolution by rationally working within (and against, when possible) these naturally fixed constraints. Wilson's speculations on human sociobiology have often been read as a rationalization of capitalist society (see Lewontin, Rose, & Kamin, 1984), but Kaye points out that Wilson saw his work as work of reform; he did not wish to justify hierarchical social relations as inevitable. Rather, he wanted to point out what he saw as their 'natural' basis, with the hope that humans might be able to change them with this knowledge. The selfish purposes of genes should be counteracted through human-made moral laws that respectfully acknowledged these selfish purposes, but that tried to enforce adherence to the needs of individuals and society:

The myths and meanings of traditional religions have been scientifically exposed, Wilson proclaims, but the vital needs of the individual, the society, and the culture, which religion served, remain. . . . The sociobiological analysis of human nature and culture, like the ethological, reveals the tragedy of man [sic] to be his inescapable burden of genetic relics from his evolutionary past now threatening him with destruction in the modern world they have created. The sociobiological analysis of religion in turn creates a moral and spiritual vacuum that desperately needs to be filled. . . . It is Wilson's fervent belief that the science of sociobiology can solve these 'great spiritual dilemmas.' (Kaye, 1986, pp. 128-129)

The problem with modern society, according to Wilson, was that cultural evolution had exaggerated many of the most dangerous outcomes of selfish gene behavior:

The analysis of culture as the sum of hypertrophied forms of genetically prescribed behavioral patterns that were 'designed' by natural selection for the 'world of the Ice-Age hunter-gatherer' implies that much of this ineradicable 'biological substructure' is no longer adaptive to modern life and is now perhaps destructive. It suggests further that many cultural patterns (such as nationalism, ethnocentrism, and war) have diverged too far from their biological origins (kin altruism and aggression toward strangers) and their biological purposes and must be brought back into alignment. Until such time as human genetics presents us with the option of altering and artificially selecting our nature, our only recourse is to choose from among the hodgepodge of programmed emotional responses that make up human nature those that still seem desirable and those that do not, and then reshape the cultural superstructure accordingly. (Kaye, 1986, pp. 128-129)

Wilson hoped that sociobiology might provide a 'biology of ethics'. Sociobiology might broker a return to nature. Like a

Protestant practice of individual salvation through hard work, appropriate knowledge of and struggle with our 'natural' inclinations can lead to a more perfect social order. Sociobiology is a kind of Calvinism that sees humanity using the natural theology of sociobiology, the book of nature, as it is read by science, not as it is written by God, to frame action.

Artificial Life exhibits some of the same religious mission as sociobiology. Ken Karakotios follows sociobiological wisdom when he writes:

I also see mankind as subverting the agenda of the selfish gene. We are taking evolution to the next level: Lamarckian/cultural. So instead of improving our design every generation, we can do it every time somebody tells us a better way to do something. This is a several million-fold speed up. The only problem is that we can now adopt strategies for survival in a much shorter time than it takes to do a good fitness test.

Another scientist said: 'To a large extent we are what we are because of genetics, and now we've drastically changed the environment in which we're operating and we're trying to throw out things that genetically make sense for us, that are programmed in as instincts'. In these discussions, biology is seen as a repository of wisdom that we might look to for instruction in the next steps of evolution. As in much sociobiology, culture is seen as a source of danger, but also as a tool that can recognize its own folly and learn lessons from the biology that gave rise to it. Artificial Life's mission is to transfer the wisdom of nature into new hardware, hardware that can continue an evolutionary march toward progress, leaving human imperfection behind.

Some other Artificial Life researchers also sense a biology/culture tension, but their belief that evolution is ultimately about the replication of information structures calms their worries that humanity has strayed too far from its sagacious genetic programs. Cultural change and the technological change it gives rise to may

be faster than genetic evolution, but it is not necessarily at odds with it. One person reflected on this:

We're getting more and more alienated from these things [nature] that created us. The distance between us and what made us is growing very fast, due to our technological tools, . . . but from an evolutionary point of view, from a rational point of view, it all makes sense. It doesn't matter whether the process [life or evolution] is carried by carbon chemistry or by silicon or by robots or whatever it is. The same kind of dynamics can penetrate. I can easily imagine some kind of symbiosis between machines and man, in which you really have an ecology of machines. . . . we have sort of an ecology of machines and man, now, I mean I have to drive home in a little while in my car. I couldn't live where I do without this car. And we have these computers, and we're all dependent on each other.

Like sociobiologists, some Artificial Life researchers believe that there is an intrinsic morality in the process of evolution, and that in doing their research, they are promoting this morality. They count on evolution to be ultimately moral. From this point of view, all should go smoothly as long as Artificial Life is produced in an 'evolutionary' spirit—a project which is, of course, the very mission of the discipline. A key researcher had this to say in a published interview:

I have a fairly strong feeling that the process of evolution carries with it an intrinsic fairness to all the entities that have participated. And as long as what's happening is an integral part of the evolutionary process—what's already going on—I think that fairness will be part of the process. And when I say that the only thing I'm afraid of is this ineptness [an ineptness that humans might introduce into their artificial life practice], that we might introduce an element of cruelty, what I mean by this is that we might not take this next step in a truly evolutionary way. (Packard quoted in Levy, 1992b, p. 45)

How humans would be able to take an evolutionary step in a nonevolutionary way is hard to understand, given the argument that Artificial Life is a logical step in evolution. The argument here seems rather to be that 'nature' is inherently moral. The view of evolution as ultimately fair offers an Artificial Life answer to the problem of suffering; in this view, suffering is all a part of a grander picture. This is an old theodicy in new hardware. It is, of course, also a theodicy that is really only satisfying to persons in privileged positions. And it is primarily from these positions that the missionary promise of Artificial Life—the promise to transcend the messy aspects of human life—is visible.

■ AN ARTIFICIAL LIFE ESCHATOLOGY

While many of my informants saw nature as a guide for wise moral decision making, some had learned a negative moral lesson from Artificial Life. This lesson did not 'affirm' anything and so might, according to Geertz's definition, not count as a religious view at all (though it does indicate the power of Artificial Life to shape moral views). One person, who said that we are what we are largely because of genetics, also told me

Working at SFI has made me aware that humanity has been around a very short time. Somehow it's soothed the notion of the human race becoming extinct. It's made me feel a little more indifferent about it, and in a sense that's given me some more leeway to just live, instead of feel so worried. I view it a little more coldly than I did. We are just a species. Nothing special about us. One day I realized that I felt much more indifferent about the human race than I ever had before and I think it was just talking about species coming and going, species coming and going. That's the way of the world. That's the way of life.

Some Artificial Life researchers have looked into the eyes of this theory of things, this idea that evolution ultimately 'doesn't care' about individuals or species, and they have been afraid. They see themselves as bringing about a stage of evolution that will produce

creatures that may well outcompete and outconnive humanity in contests for evolutionary domination. And they feel uneasy:

What I feel bad about is that I don't think that mankind is grown up enough to take this responsibility. I'm not convinced that the day we are able to initiate processes which will create life with certain properties [will initiate] a better life—I mean a good life for humans. . . . I feel in some way that I am committing sin by the things I am doing. (Rasmussen quoted in Levy, 1992b, pp. 37–38)

The language of sin only highlights the 'religious' aspects of Artificial Life. At the dawn of the new creation, there is the original sin of the Artificial Life researchers: Adam and Eve ate of the Tree of Knowledge, the first tree in the Garden of Eden, but Artificial Life researchers will eat of the second tree, the tree that Adam and Eve were unable to get to, the tree that will make them as gods or as devils: the Tree of Life.

In their story of how evolution has hijacked humans' working energies to engineer the next stage of evolution, Artificial Life researchers only occasionally notice that this narrative positions them as a new elite. When they speak of humanity, they are really speaking of a small fraction of humanity, and they are explicitly locating themselves as the vanguard force of evolution. Artificial Life researchers operate within a frame that grants special meaning to their own action in the cosmic order; anyone not participating in the project becomes just the background to their grand tale. There is, of course, another religious motif here: that of a chosen people, a special group to whom the revelations of the cosmic force (in this case 'evolution') are made manifest. Artificial Life researchers become reincarnations of the ancient people of Israel or of the Mormons. One researcher made these themes explicit when he wrote me over the Internet about his fears for the future:

I feel hypocritical. On the one hand, I feel as though I'm involved in creating a new [scientists'] religion, in the sense of an energizing ideology, i.e., let's build artefacts [artificial intel-

lects] and transcend human limitations, but on the other hand, I am pessimistic for the future, because I foresee bitter ideological wars that I am helping to create. . . . The potential intelligence of computers is vastly superior to ours, so I believe it is only a question of time before the dominant global political issue of the twenty-first century becomes 'Who or what should become the dominant species?' I see humanity splitting two ways, those insisting that humans remain dominant *at all costs*, even if it is necessary to exterminate the second group, who feel that humans have a duty to create the next higher form of evolution. There is a whole universe out there waiting for post-human exploration. Rivalry between these two groups will be bitter, because the stakes are so high, namely, the destiny of the human species. Eventually, I see the second group being banished from the planet to pursue their experiments at making artefacts elsewhere. There is plenty of space in space. A-Life may lead to our salvation or our doom.

In this astounding science fictional story, Artificial Life researchers are a persecuted people, but a people who have a mission to populate and colonize new lands with their offspring. The millennial themes here are apparent, and there is even a kind of rapture for Artificial Life researchers as they are whisked away from planet Earth into the beyond.⁸

If his cowboy story of persecution and colonization is highly masculine, it is also shot through with highly racial—even eugenicist—tropes. The racial themes in the Artificial Life vision of the future were made manifest by the man who thought that we owed evolution a debt for creating us. He said that as humans and artificial organisms begin to live together, there will likely be a lot of tension, a tension that he said would be akin to the 'racial tension' that happens when 'different groups jockey for position for access to resources'. He told me too that there will be humans who will resist the evolution of superior machine forms of life, and these humans will be guilty of an atavistic anthropocentrism. Thus the groups participating in Artificial Life, mostly white middle-

class heterosexual men, get marked as the truly enlightened ones, the ones who are willing to cede the evolutionary throne, the ones who are most 'objective' about their evolutionary condition. Those who do not participate in Artificial Life are the unspoken referent when researchers speak of the people who will reject the new life produced by Artificial Life scientists; these people are coded as 'other' to the scientifically trained and faithful white man. The appeal to anti-anthropocentrism is made by people in positions of relative privilege. Only people who can pretend to be objective, who can comfortably and without a sense of absurdity announce that evolution is 'fair', can imagine themselves identical to a disinterested God. Artificial Life becomes a church built of tools taken from the culture of white U.S. American Judeo-Christian atheist Zen (dis)belief.

Why do so many Artificial Life researchers speak and write of their inspirations and interests in their work in religious tones? In a secular humanist culture, in which 'the religious' has been evacuated of specific belief systems, the practices and promises of Artificial Life come to satisfy needs and answer questions identified as 'spiritual'. In tackling Artificial Life work, researchers feel that they are after some of the biggest existential questions around. Because these involve questions of moral meaning, researchers are prone to speak in a religious register—especially if they already believe that religious language is merely a colorful way of getting at mysteries and matters ultimately soluble by science. At times, researchers sense that their intuitions about Artificial Life go beyond what their science can presently justify, and so an appeal to religious rhetoric takes them into territory that they hope their science can follow. The missionary zeal of many Artificial Life scientists grows from their personal faiths in science as a path toward understanding and ordering the natural and social world as well as the promised lands of the supranatural and the artificial.

■ ACKNOWLEDGMENTS

I thank Carol Delaney, Richard Doyle, Joseph Dumit, Jack Ferguson, Kiersten Johnson, Saba Mahmood, Heather Paxson, and Brian Rotman for their commentary on previous iterations of this text.

■ NOTES

- 1 I do not mean to suggest that everyone involved in Artificial Life is an atheist. I have not done an exhaustive survey. I note also that being religious, in a traditional sense, is hardly at odds with being a scientist. Many scientists working in disciplines from astrophysics to molecular biology maintain serious, committed religious belief.
- 2 The title of this book is likely itself a play on Eugen Herrigel's *Zen in the Art of Archery* (1953), which teaches how to achieve unity with the world through a practice of archery in which the archer and the target are experienced as one reality.
- 3 Artificial Life researchers might say of their computers what Pirsig said of his companion machine, the motorcycle: "The study of the art of motorcycle maintenance is really a miniature study of the art of rationality itself. Working on a motorcycle, working well, caring, is to become part of a process, to achieve an inner peace of mind. The motorcycle is primarily a mental phenomenon" (Pirsig, 1984, preliminary pages). Or, they might even find inspirational this pronouncement of Pirsig's: "The Buddha, the Godhead, resides quite as comfortably in the circuits of a digital computer or the gears of a cycle transmission as he does at the top of a mountain or in the petals of a flower" (1984, p. 16).
- 4 Kiersten Johnson pointed out to me that Langton's resurrection story repeats a well-known narrative in Middle-Eastern religion and myth, a narrative organized around a young god who must be torn apart and reassembled before he can become fully divine. Osiris and Jesus are two examples of such gods.
- 5 One of my European informants felt that the popular press presented Artificial Life as springing from 'Zeus' head in Santa Fe, New Mexico'. Giving a mythic spin to Langton's mystical experience, we might see Langton as that Zeus. Artificial Life becomes his mind child. I have made extensive arguments elsewhere about imagery of masculine birthing in Artificial Life.
- 6 Hillis's phrasing of the matter eagerly forgets that many people consider humans to be animals and don't find this a particularly depressing fact. Hillis's disdain for the 'animal' can easily be read as a disdain for those who are seen as being 'closer to nature' than the norm of the civilized white man.
- 7 Peter Reynolds, in "The Priests of Cyborg", argues that many Americans, having rejected Christianity, have taken up a faith in science and technology that only be described as religious. He writes that a new 'cyborg religion offers its believers a comprehensive cosmology and personal eschatology expressed in the language of scientific materialism' (1993, p. 257). Cryogenic suspension offers an afterlife, pictures of the mind as a computer promise that people can download their personalities into transcendent machines, and stories of genetic engineering promise rationalized reproduction of ever-improved human beings. Reynolds submits that cyborg religion replaces Christianity.

Reynolds does some work to lay out part of the masculine imagery at work in cyborg religion, and he even mentions Artificial Life as part of this new doctrine.

Reynolds's picture might be put in dialogue with discussions about how U.S. Americans have used biblical imagery to speak of their public life. Robert N. Bellah (1992) has written instructively of how an American 'civil religion' has been crafted out of biblical symbols. In these craftings, Americans are a chosen people and the Americas are a new Eden destined to become a New Jerusalem. I suggest that 'cyborg religion' be seen as a permutation of American civil religion. Given some of the biblical and frontier imagery bound together in Santa Fe styled Artificial Life (I think here of rhetorics of cyberspace as a new creation and frontier), we might well see the 'religious' aspects of Artificial Life as implicated in this civil religion as well.

8 This was a story that a number of people told me, in various forms. One scientist saw humans as left behind, while the robot heirs to evolution sallied into the extraterrestrial future:

As to robotic life forms, they do not yet exist but I firmly believe that they are the next great phase of matter in the universe and will ultimately conquer biological life forms. Large populations of replicating robotic factories can reproduce both by factory reproduction and by splitting (i.e., when a new factory is built). Robots would be able to survive space travel; store back-up copies, etc. The advantages over organic life forms are too great. Hopefully robotic life forms will allow organic life forms to continue to exist on the surface of our planet.

REFERENCES

- Asad, T. (1993) *Genealogies of Religion: Discipline and Reasons of Power in Christianity and Islam*. Baltimore: Johns Hopkins University Press.
- Bellah, R. N. (1992) *The Broken Covenant: American Civil Religion in Time of Trial*, second edition. Chicago: University of Chicago Press.
- Bynnun, C. W. (1989) 'The female body and religious practice in the later middle ages', in M. Feher with R. Naddaff and N. Tazi, eds. *Zone 3: Fragments for a History of the Human Body, Part One*. Canada: Provincial Graphics. Distributed by The MIT Press.
- Capra, F. (1975) *The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism*. Boulder, CO: Shambhala.
- Doyle, R. (1993) *On Beyond Living: Rhetorics of Vitality and Post Vitality in Molecular Biology*. Ph.D. dissertation, University of California at Berkeley.
- Geertz, C. (1973) 'Religion as a cultural system', in *The Interpretation of Cultures*. New York: Basic Books.
- Goldberg, D. (1989) 'Zen and the art of genetic algorithms', in J. D. Schaffer, ed. *Proceedings of the Third International Conference on Genetic Algorithms*. San Mateo, CA: Morgan Kaufmann Publishers, Inc.
- Hayles, N. K. (1995) 'Simulated nature and natural simulations: Rethinking the relation between the beholder and the world', in W. Cronin, ed. *Uncommon Ground: Toward the Reinvention of Nature*. New York: Norton.
- Herrigel, E. (1953) *Zen in the Art of Archery*. Translated by R.F.C. Hull. New York: Pantheon.
- Hofstadter, D. R. (1979) *Gödel, Escher, Bach: An Eternal Golden Braid*. New York: Vintage.
- Kaye, H. L. (1986) *The Social Meaning of Modern Biology*. New Haven: Yale University Press.
- Kelly, K. (1994) *Out of Control: The Rise of Neo-Biological Civilization*. Redwood City, CA: Addison-Wesley.
- Levy, S. (1992a) *Artificial Life: The Quest for a New Creation*. New York: Pantheon.
- _____. (1992b) 'A-Life Nightmare', *Whole Earth Review*, 76: 34-47.
- Lewontin, R. C., S. Rose, & L. J. Kamín (1984) *Not In Our Genes*. New York: Pantheon.
- Noble, D. (1994) 'The religion of technology: The myth of a masculine millennium', manuscript.
- Prigs, R. M. (1974) *Zen and the Art of Motorcycle Maintenance: An Inquiry into Values*. New York: William Morrow.
- _____. (1984) Introduction, in *Zen and the Art of Motorcycle Maintenance: An Inquiry into Values*, 1984 ed. New York: Bantam.
- Ray, T. (1994) 'An evolutionary approach to synthetic biology: Zen and the art of creating life', *Artificial Life*, 1(1/2): 179-210.
- Regis, E. (1990) *Great Mambo Chickens and the Transhuman Condition: Science Slightly over the Edge*. Redwood City, CA: Addison-Wesley.
- Reynolds, P. C. (1993) 'The priests of cyborg', *The Month* (July): 257-266.
- Varela, F., E. Thompson, & E. Rosch (1991) *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge: MIT Press.
- Waldrop, M. M. (1992) *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York: Simon and Schuster.
- Wilson, E. O. (1975) *Sociobiology*. Cambridge: Belknap/Harvard University Press.