The Double Helix: Why Science Needs Science Fiction

by Athena Andreadis

Excellence in the Academy Awards

The first book that I clearly remember reading is the unexpurgated version of Jules Verne's *20,000 Leagues under the Sea*. Had I been superstitious, I would have taken it for an omen, since the book contains just about everything that has shaped my life and personality since then. For me, the major wonder of the book was that Captain Nemo was both a scientist and an adventurer, a swashbuckler in a lab coat, a profile I imagined myself fulfilling one day. As it was, my first departure from the Continent was to pursue adventures in science, on the wings of a scholarship to Harvard/Radcliffe in 1973. I'd have liked to take the Nautilus, but I had to settle for a Boeing 747 instead, my first trip ever on an airplane.

From the moment that I could articulate my thoughts, it never occurred to me that I would become anything but a scientist. The only question was which science to choose: astrophysics or biochemistry? The notorious ambivalence toward math and science that is supposed to descend upon teenage girls totally passed me by. Maybe that was because

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***Athena Andreadis**, Ph.D. is associate professor in cell biology at the University of Massachusetts Medical School and associate director of research and head of the neurobiology division at the Eunice Kennedy Shriver Center, a University of Massachusetts affiliate. Her fantasy and science fiction stories have appeared in* After Hours, *and she was a regular book critic for the* Harvard Review. *Her first book,* To Seek Out New Life: The Biology of Star Trek, *appeared in the spring of 1998 and she is now at work on her second.*

at that time, Greek high schools were sex-segregated, so we didn't need to worry about appearing desirable to boys by playing down our abilities, or maybe because my father, coming from a family of five boys and no girls, nurtured his daughter's spirit extravagantly—a rare attitude for a Greek man of that era.

I envisioned scientists as paladins—warrior wizards, consumed by the flame of the quest, cutting through obstacles to discover the hidden kernel regardless of personal sacrifices. Though I devoured all printed matter, my romance novels were the chronicles of scientific discoveries—Eratosthenes measuring the circumference of the earth by extrapolation, Schliemann unearthing the Trojan and Mycenaean golden troves, Pasteur inventing the rabies vaccine, Kekulé dreaming the structure of benzene—as well as biographies of scientists, especially women: Maria Sklodowska-Curie studying in an unheated Paris garret and subsisting on cherries; Caroline Herschel, whose careful observations led her brother to discover Uranus, expanding the list of known planets for the first time in two thousand years.

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But my deep, guilty secret, which I didn't confess even to my devoted parents, was that from the moment that my English could support the habit I had become an avid reader of science fiction. If science was my romance literature, science fiction was my hidden stash of bodice rippers.

Why this cloak and dagger? Well, science fiction was not written in Greece at the time, and those who read it were considered to border on the socially unacceptable. The Greek language, sinuous but over-inflected, is not conducive to science fiction writing. In form, it doesn't have room for technical word constructions or for new genders, and in content it carries so much mythological baggage that it can hardly find a myth that is not already in the canon.

English, with its percussive staccato rhythm, monosyllabic Saxon words and ambiguous word endings, is superbly fitted for the genre. And the concepts—time travel, alternative planetary physics, speculative biologies and societies—were, in my eyes at least, as valid as Einstein's *gedanken* experiments. In both, you started with "what if?" and followed the logical extensions of your premises. In both, entire new universes could spin off from your vision, like the Milky Way from Hera's breast.

With this background, I arrived at Harvard, the eager novice.

Overnight, I found myself in the midst of hitherto unimagined riches. I came at the crest of the science fiction new wave—LeGuin, Tiptree, Russ, Ellison, Zelazny. These writers had taken the genre out of its ghetto of thick techno-jargon and thin characters, and turned it into a force to be reckoned with both as literature and as social commentary. Too, during my junior year, the brand-new science of molecular biology emerged from biochemistry, like Athena from the forehead of Zeus. This miracle birth made me choose my present path, a few courses shy of graduating as a physicist.

Now that I'm a scientist, with a lab of my own, how does reality compare to those edifying stories that I read as a misty-eyed adolescent? Some of the visions presented were amply fulfilled—the single-minded pursuit of knowledge, the fluttering of the heart that accompanies even the smallest discovery, the overwhelming sense of epiphany when something clicks in your brain and you know, without the shadow of a doubt, that disparate pieces of a puzzle suddenly fit. I remember, as if it were today, Alan Sokal—who is famous now but back then was a young teaching fellow in my quantum mechanics course—coming to class carrying a graph with a clear spike from the particle accelerator. That spike announced the existence of the "gypsy" particle, the first one with the quantum property of strangeness, opening the door for the eventual discovery of quarks and gluons.

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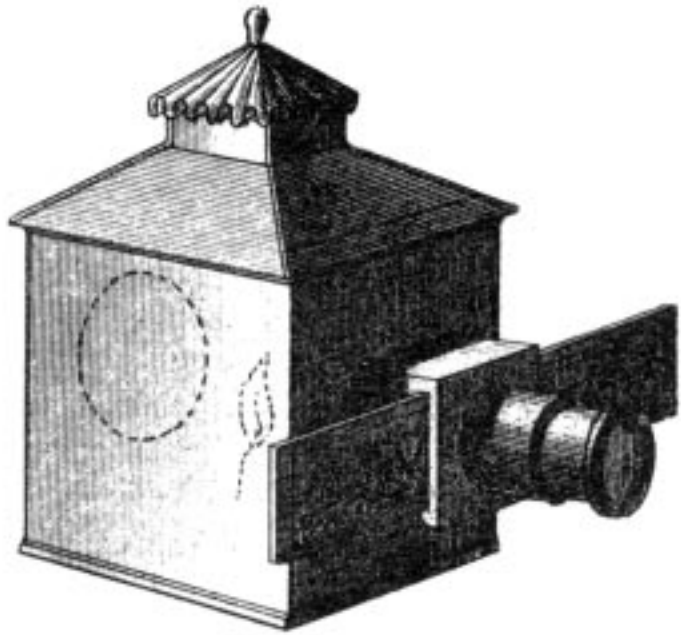
However, there were also major disappointments. The books didn't mention the vicious departmental politics. They also glossed over the fact that academic science was—and still is—feudal, even in this supposedly egalitarian nation: Lab heads literally have a death grip on the careers of the members of their labs. One lukewarm letter of recommendation, and you can kiss your future as a scientist good-bye.

Still, I could take all this in stride, at least in theory—after all, I kept reminding myself, this is the real world, not Shangri-La. If credit and recognition often don't go to those who deserve it—well, scientists are as fallible as other human beings, with egos and mortgages that need feeding. But there was one unexpected shortcoming of science to which I couldn't reconcile myself: For want of a better term, I call it spiritual poverty, an odd combination of scholasticism and parochialism. When I signed up to be a scientist, I assumed that the work would be the equivalent of an architect building new structures. Instead, I discovered that I

was expected to be a bricklayer—essentially a data collector. The discipline demands an almost deadening concentration on analysis, at the expense of synthesis. Swashbuckling and bold strides are forbidden—or apportioned meagerly and reluctantly only to famous elderly scientists, who generally have very little buckle left to swash.

This has reached pathological proportions in the biological sciences, in which even the mildest speculation is greeted with skepticism at best, and more often with hostility. I suspect that this is essentially a sign of insecurity, an attempt on the part of biologists to show those in the sciences higher up in the totem pole—physicists, for example—that they're macho enough to be members of the club. Equally stultifying is the approved style of writing scientific results for peer-reviewed journals, which achieves the considerable feat of being simultaneously convoluted and vapid.

What makes great science is the willingness and ability to go outside narrow frameworks. Any composer who simply sits at the keyboard hitting C-sharp all day will write sterile and mediocre stuff. Ditto with science. Science is all about taking down divisions and reaching a larger understanding. And yet, science today is all about jealously guarded divisions that have resulted in fiefdoms. Scientists who try to reach across these boundaries are derided by their colleagues as fools or charlatans. Worse yet, these divisions have given rise to such mountains of jargon and nitpicking that laypeople can no longer easily comprehend



science—hence both the reluctance to fund basic research and the ambivalence with which non-scientists regard the enterprise.

Broadly defined, science is the understanding of the physical world. However, our imagination is an integral part of that comprehension, of the ability to transform mere observations into real knowledge, instead of "least publishable units." Contrary to popular usage, which juxtaposes the words scientific and creative as antonyms, the best science comes from leaps of intuition. Each bridge of this kind leads to others, starting a productive feedback loop that should be appreciated and encouraged. And here is where science fiction comes in.

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The quality of science fiction may vary widely, but the underlying premise is always that if you postulate something, you must follow it through—and do so on a global scale. If you envision a planet circling a double sun system, you must work out its orbit and how the orbit affects the planet's geology and hence its ecosystems. If you show a life form with five sexes, you must present a coherent picture of their biological and social interactions. Science fiction may give its writers latitude to extrapolate wildly, but what makes it compelling is its capacity to make connections, to find larger relationships between domains that are kept in watertight compartments in the sciences.

My personal antidote to the institutionalized tunnel vision prevailing in academic science was to write a popular science book. The rapid progress of molecular biology and its possible applications—cloning, genetic engineering—have sparked wide interest among lay people. So I decided to visit biology in humanity's future—and chose as a peg a TV series legendary for its longevity and its determined accessibility: *Star Trek*. This, my first book, gave me the opportunity to run free and unruly, to play the whole keyboard, to defy the C-sharpification of science. I felt like Rachmanninoff might have felt if he'd sat in front of his first piano after being locked in a dungeon for decades with only a cow-bell and a broken chair leg. *Star Trek* gave me ground and room to discuss concepts in disparate disciplines using the language and experience of the show as speculative fodder. In short, I finally got to write a symphony—or, more accurately, given *Star Trek*'s structure and form, an opera.

The kernel of this book had been in my mind for a long time. Writing it was very satisfying because it brought all strands of my life together—

my love of astrophysics, which I had a hard time relinquishing in favor of molecular biology; my synthesis of universal Western myths and archetypes—and, of course, Captain Nemo, my eternal role model, now (alas!) diluted into the different facets of the *Star Trek* characters.

Writing the book let me roam through all the biological questions posed by *Star Trek*, some of which are relevant to contemporary science—if not directly, certainly as potential ethical dilemmas. Starting with the possibility of life based on elements other than carbon, I examined humanoid hybrids, shape-shifters, androids and cyborgs; investigated immortality, prostheses, suspended animation, engineered humanoids, parasitism and extrasensory perceptions; chuckled over the holodeck, the transporter and the universal translator; and finally cast a look over the societies shown in the series, as well as the ethics that guide the explorers of the Federation.

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Why choose *Star Trek*? After all, it often mangles scientific concepts and, ever mindful of its demographic base, beats a decidedly safe middle path. Nevertheless, the series has succeeded in embedding itself in culture as no other of its species before or since.

When I first arrived in the States, the original *Star Trek* was already in syndication. In the basement of my dorm there was a battered color TV. Dorm denizens invariably quarreled over which program to watch during all time slots—except the *Star Trek* slot. Its hour was sacrosanct.

But even more intriguing was what happened during commercial breaks. People would debate the feasibility and probability of what was portrayed in the series, like visionary scientists—or, more accurately, like visionary scientists should. This series, with all its conceptual shortcomings, with its clichés, moralizing, and easy conclusions, was nevertheless nurturing the spirit and firing the imagination of future scientists and engineers. *Star Trek* served as the forum for exchange of ideas, rather than the utilitarian course lectures, geared toward maximal standardization and a B+ average for anxious premeds.

So in choosing *Star Trek* as my point of departure, not only would I use a framework shared by a large group; I would also be building on ground receptive to science. The challenge for me was to convey concepts vividly and persuasively without resorting to the opaque vocabulary of the several disciplines that I ranged across.

When word got around that I was doing a book on *Star Trek*, my col-

leagues' reactions were interesting and revealing. Some immediately hastened to assure me that they had never polluted their mind by watching the series. Others told me in ominous tones that, once the book was out, I would be categorized as a "science popularizer" and my chances for tenure as well as my reputation as a serious scientist would suffer irreparable damage—putting me in the company of people such as Carl Sagan, Stephen Jay Gould and Stephen Hawking, a punishment I can handle.

These reactions by my colleagues brought home to me how conditioned today's scientists are to remain within narrowly defined boundaries. Yet they would stand to benefit enormously from presenting their work in accessible form: How else are nonscientists to appreciate and judge the scientists' efforts? And how else are the sciences to attract the next generation of apprentices? Sagan's *Cosmos* series, derided as it was for its "billyuns and billyuns" refrain, did more for scientific prestige than all the NIH reports to Congress for the last few decades.

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The most amusing and touching thing was that several of my peers, including some of those who disavowed knowledge of *Star Trek* or issued the dire warnings, would come furtively to discuss scientific aspects of the series—as enthusiastically and hungrily as the denizens of my undergrad dorm. Creative fires need nourishing even when we have forced ourselves to fit into the straitjackets of our disciplines, and *Star Trek* is as good a fuel as any.

The National Institutes of Health, the premier venue for federally funded biological research, is aware of the ossification danger stalking academic science. Belying its staid image, the agency promptly invited me to give a talk about the future of medicine on the basis of my book. Also, several colleges, grasping my implicit goal, are using the book as an auxiliary textbook and, to my pleasure, across disciplines. For example, Columbus State University is using the book for biology ("Life in Space") and Virginia Tech for literature ("Writing the Millennium"). Whenever I give a "shop talk" on my scientific projects, at least one member of the audience asks about astrobiology, with its wide potential connections and horizons.

Humans have many weaknesses, but realizing a vision is a paramount strength of our species. Borrowing from the "what ifs" of science fiction allows us to dream of possibilities and then embark on the quest of mak-

ing them real. So I launched an "Astrobiology and Space Medicine" course this year, to enthusiastic response. I shaped its arc as a journey of a long-generation starship to an earth-like extrasolar planet. I want this course to serve as a forum in which medical and graduate students can ask fundamental questions of scientific knowledge while keeping a larger context firmly in view—from the need to genetically engineer long-term planetary explorers to the complex equation of what constitutes intelligence; from the ability to establish efficient recycling systems to a cure for osteoporosis.

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Without a doubt, science is a cumulative, collective enterprise, like the building of the great cathedrals. It's also true that riches and fame figure in scientists' equations, as well as the desire to do something for the greater good. However, the deepest, most fundamental reason that makes people willing to become scientists, to put in endless amounts of energy and time into the effort at the expense of their health and relationships, is the license to dream, the hope of making a novel connection, no matter how small—of experiencing those moments of epiphany that make it all worthwhile.

The wish to experience moments of extraordinary comprehension is not confined to intellectual elites, but is recognized as a universal human prerogative—and not that high in the hierarchy of needs, either. When the textile workers rose up in protest and organized the historic strike of 1912 in Lawrence, Massachusetts, they demanded "bread and roses." They recognized that the right to dream was as vital as having food and shelter. The spirit can be starved just as easily as the body.

So now here we are, in the technologically advanced Western civilization of the early 21st century, with our obsession with tangibles and our stranglehold on imagination. Can we live only day to day, without a large future goal? Now that humanity has covered the face of the planet, where is the frontier? What will give us a unified vision, something larger than ourselves?

In the past, people built great edifices, sent out expeditions into the unknown, or experimented with novel social systems. Unless we have collective goals, we are doomed to the relatively sterile enterprise of "bettering ourselves" at the individual level—watching our navels among dwindling prospects and resources.

Quest for knowledge in general, but particularly the desire for space

exploration so extolled in *Star Trek*, is the large goal, the last goal, if only because it guarantees our long-term survival. Earth is beautiful, but it won't live forever, even if we husband its finite resources with infinite care. We humans may drown in our own refuse, or run through the finite lifespan vouchsafed to all species unless we speciate. We may get extinguished by an asteroid hit or the lethal radiation of a nova explosion. Even barring such statistically likely events, eventually our sun will exhaust its fuel, turn into a red giant and engulf the inner planets.

Before any of these outcomes happen, we'd better be able to take to the stars, whose fiery engines created the elements that comprise our bodies. From the stars we came, and to the stars we must return. And though science will build the starships, it's science fiction that will make us want to board them.