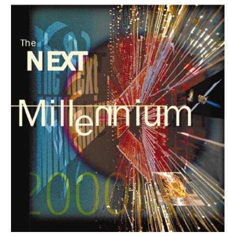
Writing the Future: Computers in Science Fiction



Although we cannot be certain that science fiction directly influenced the course that computing technology has taken over the past 50 years, the genre has—at the very least—anticipated the technologies we're using and developing.

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Speculation about our future relationship to computers—and to technology in general—has been the province of science fiction for at least a hundred years. But not all of that speculation has been as optimistic as those in the computing profession might assume.

For example, in Harlan Ellison's chilling "I Have No Mouth and I Must Scream,"[1] three political superpowers construct vast subterranean computer complexes for the purpose of waging global war. Instead of carrying out their commands, the computers housed in these complexes grow indignant at the flaws the humans have introduced into their systems. These self-repairing machines eventually rebel against their creators and unite to destroy the entire human race. Collectively calling itself AM—as in "I think therefore I am"—the spiteful system preserves the last five people on the planet and holds them prisoner so it can torment them endlessly.

While cautionary tales like this in science fiction are plentiful and varied, the genre is also filled with more optimistic speculation about computer technology that will help save time, improve health, and generally benefit life as we know it. If we take a look at some of this speculation—both optimistic and pessimistic—as if it were prediction, it turns out that many science fiction authors have envisioned the future as accurately as historians have chronicled the past.

Thirty years ago, for example, Fritz Lieber wrestled with the implications of a computer some day beating humans at chess. In "The 64-Square Madhouse,"[2] Lieber offers a fascinatingly detailed exposition of the first international grandmaster tournament in which an electronic computing machine plays chess. One of the most poignant elements of the story—particularly in light of Deep Blue's victory over Kasparov—is Lieber's allusion to the grandmaster Mikhail Botvinnik, Russian world champion for 13 years, who once said "Man is limited, man gets tired, man's program changes very slowly. Computer not tired, has great memory, is very fast."[3]

Of course fiction doesn't always come this close to getting it right. Or perhaps in some cases we aren't far enough along to tell. It remains to be seen, for example, whether certain golden-age science fiction novelists of the 1920s and 1930s did a poor job of predicting computer technology and its impact on our world. After all, many golden-age authors envisioned that in our time we would be flying personal helicopters built with vacuum-tube electronics. Of course we're not going to be basing a design these days on vacuum tubes, but it might be too early to judge whether we'll one day be flitting about in personal helicopters.

Prediction is difficult, goes the joke, especially when it comes to the future. Yet science fiction authors have taken their self-imposed charters seriously; they've tested countless technologies in the virtual environments of their fiction.

Perhaps in this sense science fiction isn't all that different from plain old product proposals and spec sheets that chart the effects of a new technology on our lives. The main difference—literary merits aside, of course—is the time it takes to move from product inception (the idea) to production and adoption.

OUTTHINKING THE SMALL

Generally speaking, science fiction has adhered to a kind of Moore's law of its own, with each successive generation of writers attempting to outthink earlier generations' technologies in terms of both form and function. Often, outdoing earlier fictions simply entailed imagining a device smaller or more portable or with greater functionality—exactly the kind of enhancements at the heart of competition in the computing marketplace today. It wasn't until the birth

Digital Angels

In modern philosophy from Descartes to the present, you'll often see medieval theologians mocked for their zealous interest in minutia; many wrote huge volumes dedicated to questions so speculative as to be rhetorical art rather than anything else. A prime example: How many angels can dance on the head of a pin?

Since the spiritual realm was to a medieval theologian what the atomic realm is to a twentieth-century scientist, it's not hard to suggest that these theologians were speculating about the same realm as today's scientists. What both perspectives amount to is a powerful urge to understand the world beyond human sight. After all, one of the richest traditions of speculative fiction is medieval theology.

The more we have seen in the microworld, the more we've been able to create smaller and smaller tools to help us look even further. When it comes to computers, it has taken us a while to catch up to some of the technologies that writers have been toying with in their fiction for a hundred years. In this sense, though, science fiction functions just like a microscope: It's an imaginative tool that helps focus scientists on all the interesting possibilities that miniaturization makes available. Without science fiction, we might never have gone from Eckert and Mauchly's 1946 ENIAC, a computer that filled a large room and weighed 50 tons, to much more powerful computers that have the distinct advantage of being able to fit into the palm of your hand.

And it is also highly likely that without science fiction—almost single-handedly responsible for putting geek and chic in the same sentence—we never would have been able to see the possibility of incorporating electronic tools into our attire. While wearable junkies (like MIT's Thad Starner and Josh Weaver) can network in at least two senses, seeing someone walk around with one eye only a few centimeters from a miniature computer screen still looks a little bizarre.

ENIAC. (AP/Wide World Photos)

of the space program, however, that real-world researchers began to feel the pressure to do likewise by making their electronics both smaller and lighter.

Fostered in part by the personal computing revolution, in part by the military, and in part by the advancements in related fields, computers have shrunk from multiton mainframe monsters of vacuum tubes and relays to ten-pound desktops and two-ounce handhelds. How long can this trend continue? Here is one forecast, the author of which may surprise you:

> Miniaturization breakthroughs—combined with the scaling benefits of the quantum transistor, the utility of voice recognition, and novel human/machine interface technologies—will make the concept of a computer the size of a lapel pin a reality in the early decades of the 21st century.

No, this isn't from the realm of speculative fiction; it's from Texas Instruments' Web site.

Nobel Laureate Richard Feynman wrote in 1959 that physics did not prevent devices, motors, and computers from being built, atom by atom, at the molecular level.[4] Feynman's basic idea was to build a microfactory that we would use to build an even smaller factory, which in turn would make one even smaller until we were able to access and manipulate the individual atom.

While we haven't yet realized Feynman's goal of an atomic-level machine, we've been steadily moving in that direction for at least 50 years. Perhaps signaling that move was John Mauchley and J. Presper Eckert's top secret BINAC, delivered to the Pentagon in 1949 as a prototype stellar navigation computer.[5] From the warhead of a missile, it could look at the stars and compute locations and trajectories.

BINAC signaled a general change in the spirit of design. Successful miniaturization efforts like BINAC fed back into science fiction to the extent that key authors began to explore, even to a greater degree than in the first half of the century, the implications of miniaturization.

In 1958, Isaac Asimov described a handheld programmable calculator—multicolored for civilians and blue-steel for the military.[6] In terms of hardware and software, Asimov's story flawlessly described the kind of calculators we use today. The calculator, you'll recall, made it to market about 20 years later. But why didn't Asimov make his calculator even smaller? Why didn't he embed it in a pen or in a necklace?

Computer scientist David H. Levy identifies the *ergonomic threshold* as the point at which we move from electronic-limited miniaturization to interface-limited miniaturization.[7] In other words, there will be a point in the future when we'll be able to pack just about any computing feature we want into a very small form factor, but when we reduce the dimensions of a device beyond a certain point, it becomes difficult to use.

After all, the dimensions of the human body require certain interfaces. Working around these requirements takes not only a great deal of imagination, but almost always a breakthrough in technology. Eliminating keyboard-based input from laptops, for example, It's more than likely, however, that it won't be long before fashion shows like the one depicted here become the norm rather than the exception. After all, each sleek new technology that has already been adopted as a kind of fashion statement—like small digital phones or featherweight MP3 players—has had to move gradually from bizarre to normal. This trend will likely continue, which means that wearables like those worn by Starner and Weaver will become as much a fashion norm as Levi's jeans. This trend will be aided and accelerated by technologies that not only make these small systems smaller still, but also work more effectively than the technology they're replacing.

One tool that does just that is this pair of glasses created by MIT and MicroOptical. These glasses house a tiny color video display that is generated in the glasses' temple piece and projected to a small mirror embedded in the lens. This mirror reflects the image directly into the eye. Unlike the first generation of bulky screens that completely covered one eye, this miniature display isn't obtrusive. Just as many houses built now are wired for high-speed data access, eyewear stores will soon be stocking video-ready frames.

Members of the MIT wearables group. (AP/Wide World Photos)

Katrina Barillova (center), cofounder of InfoCharms, a spin-off of the MIT Media Lab.

It seems that science fiction authors often visit the ideas entertained by medieval mystics—more often than coincidence alone would allow. Plenty of authors' characters break through to another reality that they describe only with the language of theology. Given this phenomenon, it shouldn't seem all that strange that we in the twentieth century have begun to explore the possibilities of technologies like quantum computing and neural networking. Might not these pursuits just be another way of asking how many angels can dance on the head of a pin?

Color QVGA ClipOn Display. (Courtesy of MicroOptical)

enabled an entire generation of PDAs that rely primarily on various kinds of handwriting recognition technology for entering and retrieving information. Reducing the size of this generation of PDAs will likely require reliable voice recognition and voice synthesis technology.

PORTABLE FUSION

Early science fiction maintained an erroneous but very popular idea about miniaturization that was based on a literal interpretation of the Bohr atom metaphor—where the atomic nucleus is actually a sun and the electrons circling it are the planets. Quite a few authors in the first half of the twentieth century toyed with the idea that if you could shrink yourself to a small enough size, you would find people on those planets whose atoms are themselves solar systems, and so on, ad infinitum.

We've come to understand, of course, that such a continuum isn't all that likely and that we might even eventually reach the limits of the kind of miniaturization described by Moore's law. After all, continuing to shrink active electronic components on computer chips is already running into quantum problems.

Quantum computing holds the key to computers that are exponentially faster than conventional computers for certain problems. A phenomenon known as *quantum parallelism* allows exponentially many such computations to take place simultaneously, thus vastly increasing the speed of computation. Unfortunately, the development of a practical quantum computer still seems far away.

Meanwhile, science fiction has taken on the quantum issue, with one story even suggesting a storage system based on "notched quanta." We don't know how to "notch" quanta, but since quantum computing is just now beginning to emerge, it might very well be shortsighted to believe that computer scientists 20 years from now won't scoff at our idea that we are approaching the limits of miniaturization and speed.

Consider that in 1959 Howard Fast described technologies that we're capable of producing today but that in the late 1950s sounded impossible (if not ludicrous) to most people. In his classic story "The Martian Shop,"[8] Fast described a calculator endowed with speech recognition capabilities. He also described a miniature music box with a vast repertoire of recorded music—not unlike a small CD or MP3 player—and a fusion-powered outboard motor. Forty years after publication, the first two of these three have become reality.

Using a fusion-powered outboard motor—or a nuclear-powered car for that matter—will require more than a revolutionary breakthrough, but it's still too early to tell whether or not it's at all possible.

COMIC-STRIP STRATEGIES

Robert A. Heinlein—science fiction author and inventor of the waterbed—worked in the 1940s on pressure suit technology for the US Navy; this work led almost directly to the development of space suits. But some 21 years before Armstrong and Aldrin even walked on the moon, Heinlein published a short story in which an astronaut experiences a problem with his oxygen; by looking at a small device attached to his belt, the astronaut confirms that the oxygen content in his blood has fallen.[9]

Such a device might not seem all that impressive to us today, particularly since, in the past 20 or 30 years, portable medical devices like this have become commonplace technologies in popular media like TV and film. Each generation of Star Trek doctors, for example, uses similar devices. But Heinlein was among the first writers to describe a device based on the idea of real-time biofeedback.

And now, wearable computers—including biofeedback devices nearly as sophisticated as Heinlein's—have clearly passed from technological speculation and science fiction into real-world use. Millions of people grew up with the comic-strip character Dick Tracy, who used a two-way wristwatch radio. Over the decades, he upgraded his wrist gadgetry to be

Future Transport

Although Richard Trevithick built the first practical steam locomotive in 1804, the railroad revolution had to wait 21 years—until the opening of the Stockton-Darlington railway—before it could begin its rapid expansion across Europe and the US. But by the end of the century, railroads were nearly everywhere and having a powerful effect on people's lives. Understandably, then, the speculative writers of the late nineteenth and early twentieth centuries should find the future of transportation one of their most inspiring themes.

The internal combustion engine and Henry Ford's 1909 Model-T fueled the imaginative fires of authors who envisioned a day when we'd all have our own automobiles; beyond ground transportation, writers from Jules Verne forward imagined personal air transportation machines so consistently and vividly that such vehicles moved from possibility to postulate. Philip K. Dick's 1968 near-future novel *Do Androids Dream of Electric Sheep?*—more commonly known in its movie form as "Blade Runner"—describes a city in which many residents travel in flying cars.

Although such vehicles might seem attractive but far-fetched even now, Moller International has developed one: the M400 Skycar. Cruising comfortably at 563 kilometers per hour and using regular automobile fuel, the M400 effortlessly avoids traffic, red lights, and speeding tickets. The skycar has three on-board computers and eight engines. According to the company, the M400 is so automated you don't need a pilot's license to fly it. Flight safety, always a prime concern, is ensured by the M400's eight engines, four of which are redundant.

The SoloTrek Exo-Skeletor Flying Vehicle. (Courtesy of Millennium Jet, http://www.solotrek.com)

Moller believes their skycar is but an interim step on the path to gravity independence; flying automobiles are the next step. Although the M400 costs around $1 million, Moller expects that the cost will drop to that of a standard luxury car once mass production begins.

Meanwhile, the Millennium Jet company has invented a new kind of personal transportation, which they call the SoloTrek Exo-Skeletor Flying Vehicle (XFV). You step into the machine, strap it on, and fly. Like a helicopter, the SoloTrek XFV can provide a bird's-eye view of the ground and lets you fly through a variety of terrain at up to 128 kph.

Less complex than a helicopter, the XFV is easier to maintain, and can launch and land at sites the size of a dining room table. Best of all, the XFV costs just 5 percent of the typical helicopter's $1 million price tag. Because it uses ordinary 87 octane automobile gasoline, not aviation fuel, you can refuel your XFV at the nearest service station.

Moller International's conception of an M400 Police Skycar.

The M400 Skycar. (Reprinted with permission of Moller International)

From Fiction to Fact: A Self-Fulfilling Prophecy

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Andrews Creative Enterprises

In 1984 I wrote "2020: The Chimera Engineer" for the *Electronic Design News* contest to predict a day in the life of the electronics engineer of the year 2020. It did not win and wasn't published until 1995, in conjunction with a talk I gave on predicting the future.[1]

In that story, my character used a solar-system-wide virtual reality computer-based system for real-time CAD to design a device in less than an hour for manufacturing in a Japanese orbiting factory. The story featured what is today called *agile manufacturing* or *concurrent engineering*, which is having all team members together for all crucial decisions and implementing all aspects of work concurrently. The story also featured real-time computer graphics, which I called "spatial animation" and which were done by sculpting in open space with fingertip transmitters.

Practically, that vision of "2020" made me realize that such a system could actually be invented. It inspired me to search for an appropriate VR system that could actually do what I had envisioned (even though the term hadn't been invented yet). In the early 1980s, computer graphics couldn't do the kind of real-time rendering of CAD drawings that I needed, and head-tracking wasn't mature. While in D.C. in the early 1990s, I witnessed the DoD's crude military VR animations and despaired of ever finding what I was looking for.

But in 1993, after returning from the White House to Sandia Labs, I found such a software system under development there, and in 1994 I founded a start-up company, Viga Technologies, to commercialize that system. In 1995, together with the inventors of the software system, I cofounded Viga's successor firm, Muse Technologies, which now markets Muse (multidimensional user-oriented synthetic environment). Muse is the VR system that NASA uses for conference calls among its centers, and the software system it uses to coordinate the real-time construction of the International Space Station.

My story is an example of science fiction providing a vision and a goal that results eventually in the founding of a real company to implement the dream. I left Muse Technologies in 1997, but the company continues to expand, and my science fiction vision of the early 1980s is now pretty much fulfilled.

Reference

1. A. Andrews, "2020: The Chimera Engineer," *Proc. Agile Manufacturing Conf.*, University of New Mexico Press, 1995.

capable of receiving a video signal. At the November 1999 Comdex, Hewlett-Packard's CEO Carly Fiorina announced to an enthusiastic Las Vegas audience that HP would be collaborating with Swatch to manufacture watches with wireless Internet connectivity.

It is of course difficult—if not impossible—to establish a causal relationship between science fiction and real-world technology, unless we consider the names we give our technology, which often come directly from science fiction. We've taken "cyberspace" from the work of William Gibson, "robot" from Karel Capek, "robotics" from Isaac Asimov, hacker-created "worm programs" from John Brunner, and a term from Star Trek, "borg," which is used by today's aficionados of wearable computing devices. But beyond names, it is fairly safe to suggest that just as early science fiction popularized the notion of space travel—and made it much easier to fund a very expensive space program—science fiction also made popular the idea that our most useful tools could be both portable and intelligent.

MECHANICAL COMPUTING

Before there were electronic computers, there were mechanical calculating devices: technologies (like the abacus) designed to save people time. One of the most elaborate of such devices was Charles Babbage's unfinished calculating machine, which he called the Difference Engine; this device is often credited as being the most important nineteenth-century ancestor of the computer.

Science fiction authors, particularly in the 1920s and 1930s, drew conclusions from Babbage's work and created in their fiction elaborately designed androids driven by mechanical brains. It wasn't until roughly the middle of the twentieth century that the Babbage computing model gave way to electronic computing, well after the development of huge mechanical integrators in the 1930s and 1940s, most notably built at MIT under Vannevar Bush. But what if Charles Babbage had finished his work? What if mechanical computers actually brought about the computer revolution a century early?

One of the provinces of science fiction—and in this case what some would instead call speculative fiction—is alternate history, an extended indulgence in what-if scenarios. So what if Babbage had actually finished his machine? One answer to this question is *The Difference Engine*, a novel by William Gibson and Bruce Sterling[10] in which the British empire by 1855 controls the entire world through cybersurveillance.

In addition to portraying an entire age driven by a science that never happened, Gibson and Sterling indulge in speculation about how this change might have affected twentieth-century ideas. For example, a punch-card program proves Kurt Godel's theory 80 years early—that every language complex enough to include arithmetic contains statements that are completely impossible to prove or disprove. And John Keats, unable to make a living from poetry, becomes the leading Royal Society kinetropist—essentially a director of computer-generated special effects.

Even though the mechanical computing model eventually gave way to electronic computing, Babbage's ideas—coupled, no doubt, with all the fiction written about androids with mechanical brains—inspired creations like the animatronic automata that amusement parks like Disneyland use for entertainment. Disney's first fully automated show was the tiki room, which opened in 1963 with more than 225 animatronic creatures. Of all the automata at Disneyland, though, perhaps most familiar is the mechanical Abraham Lincoln, which even inspired a Philip K. Dick novel.

The Feedback Effect: Artificial Life

Cybernetics is an interdisciplinary science that deals with communication and control systems in living organisms, machines, and organizations. Norbert Wiener first applied the term in 1948 to the theory of control mechanisms. Since then, cybernetics has developed into the investigation of how information can be transformed into performance.

Cybernetics considers the systems of communication and control in living organisms and in machines analogous. In the human body, the brain and nervous system function to coordinate information, which is then used to determine a future course of action. Control mechanisms for self-correction in machines serve a similar purpose: The principle, known as *feedback*, is a fundamental concept of automation.

If you accept that feedback capability measures technological sophistication, you'll see that the more capable our feedback technology, the more lifelike our artificial creatures. The same has held true for science fiction. It wasn't until well after industrialization—automated factories, mass production, and the birth of consumer culture—that fiction writers moved from imagining organic creations like the golem and Frankenstein's monster to those built with mechanical brains. The more sophisticated the science, it seems, the further the imagination can go. Fiction and science fuse with particular effect in the term "cyborg"—the epitome of cybernetics—as Chris Hables Gray explains in *The Cyborg Handbook*.[1]

By the late nineteenth century, science fiction writers had already begun to imagine mechanical people. As early as 1924—with the debut of Fritz Lang's film "Metropolis"—the image of intelligent artificial people began seeping into the popular imagination. In 1940, imagination became metal when Sparko and Elektro appeared at the World's Fair—connected to external power supplies but nonetheless capable of significant movement.

Today's artificial creatures seem more real than ever. Mitsubishi recently debuted an artificial fish that behaves so much like an organic one you can't tell the difference unless you look closely at the fish's eyes. Mitsubishi spent more than $1 million to develop the fully automatic mechanical fish, using technology they hope will one day power ships and submersibles. Plans for a consumer version remain uncertain because the fish requires a special tank with built-in sensors.

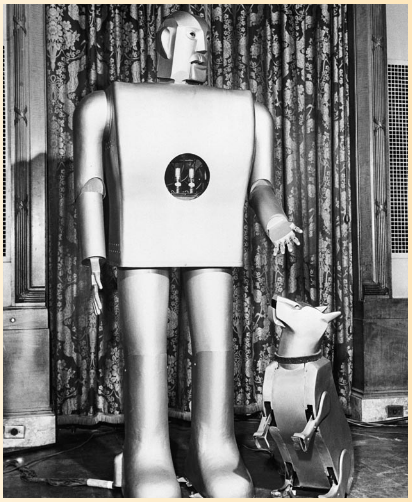
Sony's $2,500 artificial dog Aibo (pictured with ball) replaces remote control with a CPU and sensors powerful enough to perform complex actions. Further, Aibo's software gives it the semblance of emotions, instincts, and the ability to learn and mature. Speaking through musical tones and body language, Aibo stores its communication data and maturity level in its memory stick, which can be transferred to another Aibo.

Aibo's eye, a 180,000-pixel miniature color video camera, can recognize objects in the environment. Its head-mounted touch sensor—when given a short, forceful poke—lets Aibo know that it's being scolded. Pressing the sensor more gently for two or three seconds translates as praise.

Aibo. (Courtesy of Sony Electronics)

Mitsubishi's artificial fish. (Reuters)

Metropolis. (© Bettmann/Corbis)



Sparko and Elektro. (© Bettmann/Corbis)

Reference

1. C.H. Gray, ed., *The Cyborg Handbook*, Routledge, New York & London, 1995.

EXAGGERATED ERROR

While it is almost always easy to see the benefits of a new technology, it isn't always easy to foresee the dangers. We generally consider automotive transportation a necessity, for example, but we don't often consider that if there were no automobiles there would also be no automotive-related injuries. The same might also be said of the Space Shuttle program.

It would be fairly easy to counter these observations by suggesting that these technologies also *save* lives. On the surface, automotive technology enables ambulances and fire engines to bring aid much more quickly than

A Reflection of Values

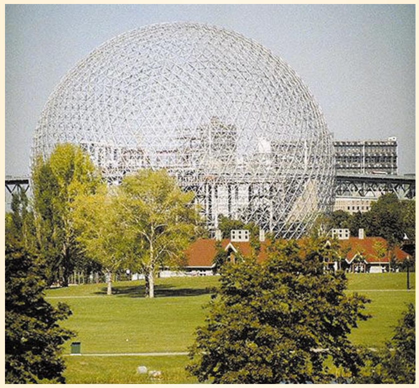
In 1948, Buckminster Fuller developed his synergetic-energetic system of geometry, which resulted in the geodesic dome. Such a dome comprises a network of interconnected tetrahedrons (four-sided pyramids of equilateral triangles) forming a three-way grid that distributes stress evenly to all members of an entire semi-spherical structure.

Fuller's work led to extended study of economical space-spanning structures. In 1953, the Ford Motor Company commissioned Fuller to design the Ford Rotunda Dome in Dearborn, Michigan. Thereafter, Fuller designed domes housing a variety of machinery like military radar antennas, in addition to the American pavilion dome at Expo 1967 in Montreal (shown here).

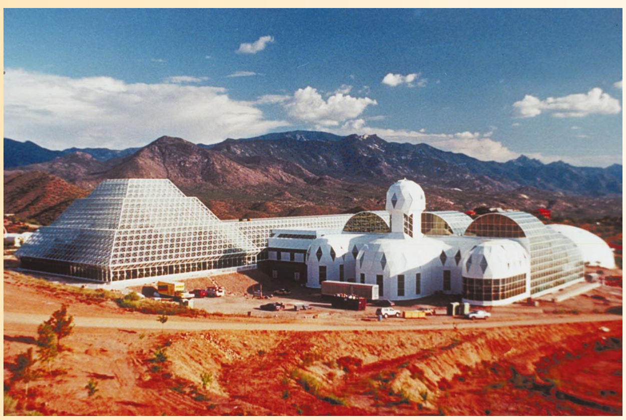
The Antarctic research dome, whose frozen interior is pictured, is roughly 20 meters high and 55 meters across. Trash recycling bins and cold-resistant emergency food supplies are stacked inside the dome near sleeping modules that can accommodate up to 33 people.

Creative building ideas like Fuller's led eventually to closed-system tests like Biosphere 2 and to inventive, automated living environments. The move toward high-tech housing continues to accelerate, and soon the computer will be as common to the home as the television or washing machine. While research shows that most people use their home computer primarily for entertainment, in the future it will likely become a central part of the home's structure. Software systems could be connected to external utilities like telephone and electricity and could be used to monitor usage and billing. This technology, already used in large commercial buildings, promises to make real the automated home science fiction writers have predicted for more than a century.

Perhaps in a few years, Microsoft will oust Martha Stewart as arbiter of taste in the home. After all, when we're shopping for towels in 2020, we'll likely want them to match our favorite desktop themes because our PCs will be everywhere, including our bathrooms. In addition to being just the right color, we'll also want Microsoft's towels because they'll be formulated to be particularly compatible with our Windows-run dryers.



Geodesic dome at the 1967 Montreal Expo. (© Lawrence A. Martin, www.GreatBuildings.com)



Biosphere 2. (AP/Wide World Photo)

Antarctic dome. (AP/Wide World Photo)

earlier technologies allowed; and the space shuttle program, it could easily be argued, generates a great deal of research that will no doubt eventually be used to enhance our quality of life. Science fiction authors as early as Mary Shelley have dealt with hard trade-offs like these in their fiction, often attempting to anticipate the dangers of a new technology before it is even invented.

Echoing Shelley's method in *Frankenstein*, twentieth-century science fiction authors dealing with the issue of technology running amok often exaggerate computer glitches to warn of the potentially unforeseen ills of computing technology. For instance, in Ambrose Bierce's "Moxon's Master," a chess-playing robot loses its temper upon being beaten at a game and murders Moxon, the robot's creator.[11] Frederic Brown's "Answer," a story so famous as to have passed into modern folklore, describes the birth of the first supercomputer.[12] When asked "Is there a God?" the computer answers "Yes, *now* there is," and kills his creator when he goes for the plug.

Frank Herbert's "Bu-Sab" stories[13] describe ways of keeping computers from making government *too* efficient. In Herbert's imagined future, computerization has accelerated the pace of government so that computers automatically pass and amend laws in a matter of minutes. The speed of government is so fast that no human can possibly understand or keep pace with the legal system. So government saboteurs deliberately introduce bugs to slow things down, even assassinating those who stand in their way.

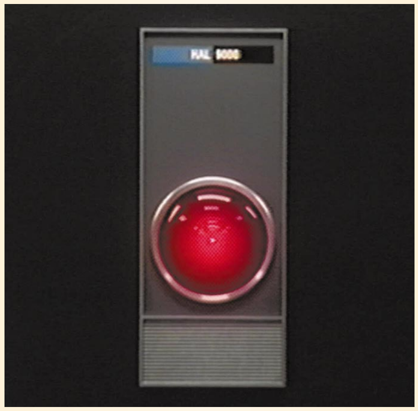
Finally, in Fritz Lieber's "A Bad Day for Sales,"[14] a vending robot named Robbie is baffled by the start of atomic war, signaled by an airburst above New York's Times Square. Robbie is incapable of dispensing water to the thirsty burn victims who can't slip coins into his coin slot. In this image of technology (not running

Dangers Born of Innovation

Innovation in technology tends to transform traditional cultural systems, frequently with unexpected social consequence. At the minimum, an innovation obsolesces a preexisting technology; at most, it may obsolesce a mode of inquiry or even a way of thinking. Thus, while many point to technology as being responsible for a host of positive developments like increased lifespans and greater educational opportunities, innovation can also be a destructive process.

World War I and the ensuing Depression forced a sobering reassessment of all the technological and industrial innovation percolating at the turn of the century. The development of submarines, machine guns, battleships, and chemical warfare made increasingly clear the destructive side of technology—which golden-age science fiction seemed to promote through its fascination with future weaponry and space warfare. Beneath the surface, however, even many popular science fiction pieces challenged some of science's most longstanding assumptions about progress.

Take, for example, James Whale's 1931 film "Frankenstein," which immediately became a hit despite emerging in an era in which the kind of industrialized science depicted in the film had recently produced a great deal of death and destruction. The subtitle of Mary Shelley's 1818 novel (to which all twentieth-century iterations of the Frankenstein story owe their inspiration) is "a modern Prometheus." Like Prometheus, who is punished by the gods for his hubris, Victor Frankenstein creates a monster incompatible with the world and dies in the end as a result.



HAL, from "2001: A Space Odyssey." (AP/Wide World Photo)

Disasters that parallel Frankenstein's—in real-world science and in fiction—aren't often the results of so-called mad scientists. Like Frankenstein's monster, Stanley Kubrick's HAL 9000, from the film "2001: A Space Odyssey," exemplifies the risks inherent in even the most seemingly benign technologies.

Loosely based on an early 1950s Arthur C. Clarke story, the movie poses questions about the best kind of tool humans are capable of creating: artificial intelligence. Ironically, HAL seems the most human of all the movie's characters, despite having no human features except an eye-like optical device that blankly stares at his interlocutors. More ironic still, one of the most human-like elements of his personality—his paranoia—leads him eventually to go insane and murder the crew.

These stories, and stories like them, focus on and anticipate what might otherwise have been difficult to imagine: grave disasters that stem directly from technological advancements. One needn't look too far to see evidence. Nobody anticipated, for example, that the seven members of the Challenger crew would die aboard that Space Shuttle in 1986.

Frankenstein. (© Lisette LeBon/SuperStock)

Space Shuttle Challenger, 1986. (AP/Wide World Photo)

amok so much as) missing the mark, Lieber anticipates a question regarding technology that nearly everyone ever frustrated by a computing device has asked: Why doesn't it work?

Computing technology seems to invite a different level of expectation than other technologies. The way we've defined computing—that it should be life-enhancing, time-saving, reliable, simple, and adaptable—doesn't make allowance for problems like system crashes or hardware malfunctions. Problems like this tend to annoy us, especially when we can at least imagine creating devices that either repair themselves or don't fail in the first place. From no other class of tool do we expect so much, which is likely why we feel anxiety at Robbie's plight. Had his creators anticipated an emergency situation like nuclear war, he might have been able to help.

There are almost countless examples like these that address some of the potential problems with the technology we're developing now and will be developing in the future. You needn't look very far to find science fiction in the first part of the century that anticipated problems like Y2K and computer viruses.

FAITH IN MACHINERY

"Faith in machinery," wrote Matthew Arnold in *Culture and Anarchy* in 1869,[15] "is our besetting danger." The first coherent vision of a world transformed into a future run entirely by computers—dramatically illustrating Arnold's argument—may have been E.M. Forster's "The Machine Stops," published in 1909,[16] in which people basically become hive creatures in a worldwide city run by a massive machine:

> No one confessed the Machine was out of hand. Year by year it was served with increased efficiency and decreased intelligence. The better a man knew his own duties upon it, the less he understood the duties of his neighbor, and in all the world there was not one who understood the monster as a whole. Those master brains had perished. They had left full directions, it is true, and their successors had each of them mastered a portion of those directions. But humanity, in its desire for comfort, had over-reached itself. It had explored the riches of nature too far. Quietly and complacently, it was sinking into decadence, and progress had come to mean the progress of the Machine.

Eventually, goes Forster's story, in this world where people are fed, clothed, and housed by the Machine, and never see each other face to face (but only through two-way video), the system collapses.

In Arthur C. Clarke's classic novel *The City and the Stars,*[17] published in the 1950s, we see a similar idea fleshed out. People live in an enclosed city run by a machine called the Central Computer. Unlike Forster's more primitive technology, the Central Computer materializes everything out of its memory banks, including consumer items, human inhabitants, and the physical form of the city itself.

Here, once again, technology has done too well, and a dependent humanity is trapped in a prison of its own construction, having developed a fear of the world outside the city. And here too they enjoy only virtual experiences—lifelike fantasies induced by the computer to create real-world illusions. Clarke names the city Diaspar, as if to suggest that when humanity surrenders its will to technology, and loses itself in an artificial world of its own creation, it is in a kind of Diaspora, a state of exile, from the world and from itself.

The quality of any prediction about the future—whether cautionary like Forster's and Clarke's or promotional like golden-age fiction's—depends on the agenda of the person making the prediction. As such, science fiction will likely never perfectly predict the future of technology. Attempting to do so, however, is only one of several goals science fiction authors typically admit to targeting. ❖

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