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Imagining Tomorrow: Why the Technological Future We Imagine Is Seldom the One We Get

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Abstract

We routinely try, as a society, to imagine the technological future, and we just as routinely get that future spectacularly wrong: confidently predicting wonders that never come to pass, and overlooking inventions that transform the world. We fail, moreover, in predictable ways: By assuming that tomorrow's problems will be the same as today's; by assuming that, once invented, new technology will invariably be used; and by envisioning technological change as uniformly linear and gradual. These failures are reflected in the depictions of the future of space travel that blossomed in American popular culture in the late 1940s and 1950s, which envisioned a Space Age with a far different scope and tempo than the one began with the launch of Sputnik *in 1957.*

Keywords: science fiction, literature, pop culture, future

Introduction

We try to peer into the future of technology because two centuries' worth of experience has taught us that technology has the power to change our lives. We try to imagine the world that technology will create, because two centuries' worth of experience has taught us that it will be different than the world in which we were born and raised. Two centuries of experience has not, however, made us very good at either process. We confidently predict things (like food pills and flying cars) that never come to pass, and utterly miss things (like oral contraceptives and cellular phones) that have transformed our world in the space of a generation. We routinely get the future wrong, and the further ahead we look, the more wrong we get it.

We fail to predict how technology can change our world not because our visions of the technological future are too expansive but because they're not expansive *enough*. We assume human needs are essentially static: that tomorrow's problems will be the same as today's. We assume that technological change is inevitable: that invention of a new technology leads to its use and its use leads to the transformation of the users' world. We assume that technological change is linear and gradual: that the technologies of yesterday, today, and tomorrow are part of a seamless continuum, and that the technology of the day after tomorrow will be a small step down the same road. As a result, when we look to the past for models of how a new technology might (re)shape the world we live in, we tend to focus on the wrong things, and draw the wrong conclusions from them. The reality of socio-technical interactions is more complex than we give it credit for, but also more interesting. Our needs are more fluid than we realize, innovation is wilder and more unruly than we realize, and our control over the course of technological change is greater than we realize.

The essay that follows is about the ways we (mis)imagine the future of technology. It begins with a tour of three misapprehensions about technological change that routinely derail our attempts to predict the technological future, and ends with a case study of them at work. In between, it outlines the case study itself: Efforts, in the decade-and-a-half after the Second World War, to imagine the shape of the Space Age that was, even then, clearly on the verge of being born. Others have asked, rhetorically, "Where's my jetpack?"(1). This essay explores why routine space travel, bases on the Moon, and manned missions to Mars are, likewise, still among the missing.

Misunderstanding technological change

Technology is our collective name for products of human ingenuity that extend human capabilities[i]. We create it in order to solve problems, and the first mistake we make in forecasting technology's future is assuming that we will want it to solve are constant: that today's problems will be tomorrow's as well. Basic human needs *are* constant, but their expression varies with time and place, and from group to group within a given time and place. Old cultural expectations fade, familiar social bonds weaken, and once-powerful groups find new voices expressing hitherto-unmet needs. Yesterday's tomorrows—to borrow Joseph J. Corn and Brian Horrigan's term for obsolete visions of the future (2)—are studded with glittering technological solutions to problems that evaporated before the technology could be made real.

Robot servants were envisioned, in the 1920s and 1930s, as a technological fix for what nineteenth century householders called "the servant problem:" that is, finding and keeping good ones (3). Substituting robots for humans would have solved it at a stroke. Robot servants don't talk back (Rosie, the robot housekeeper in television's *The Jetsons*, notwithstanding), don't take days off, don't steal the silverware, don't demand higher wages, and don't go work for somebody else if they get dissatisfied. A July 1928 article in the *San Antonio Light* even envisioned them as providing romantic "companionship" to "old maids" who had lost all hope of getting any from a flesh-and-blood man. Such "mechanical men" would, the article suggested, largely put European gigolos out of work—an outcome of which the author clearly approved (4).

Before a functional household robot could be built, however, the social expectations that lent them their appeal began to shift. New labor-saving appliances reduced, in theory, the burden of housekeeping, and a renewed "cult of domesticity" valorized what was left (5). The idea that a live-in servant—cook, housekeeper, nanny or combination—was an unremarkable presence in an upper-middle-class American home gradually fell by the wayside as the 1940s gave way to the 1950s (3). As it faded, it took the perceived need for robot servants with it. The future lay not in robots to iron your shirts, but shirts that—thanks to the wonders tumble drying and cotton-polyester blends—didn't need ironing in the first place.

Kitchen computers suffered a different version of the same fate. They were designed for a world in which cooking all-hands meals from on-hand ingredients was an expected cultural norm. Seen in that context, a single machine that took the place of a shelf full of cookbooks and a box (or two) full of recipe cards might have made conceptual sense (6). The technological breakthroughs that would have made it usable—color displays, user-friendly database programs, the worldwide web, wireless connectivity—all arrived, in time, but by the time they did the *need* for a dedicated recipe-database appliance has long since vanished: a casualty of changes in family structure and mealtime routines on the one hand and the availability of convenience foods on the other hand (7). The future of cooking lay not in having a dozen pot roast recipes at your fingertips, but in prepackaged pot roast that microwaves in under 10 minutes.

Our second mistake, when we try to predict the technological future, lies in assuming that technological change is linear and incremental: that tomorrow's technological solution to a given problem will be like today's solution, only better. This model works well for the year-in, year-out improvements that render decade-old cars less capable than new ones and decade-old computers obsolete, and so corresponds to the kinds of technological change that most of the public is most aware of. It breaks down, however, in two critical ways. It fails to account for the fact that there are limits to incremental improvement, and for the possibility that a new breakthrough (in scientific knowledge, in available materials, or in design) will open up new technological vistas overnight (8).

The airship—powered, steerable, lighter-than-air—seemed, at the beginning of the 20th century, to have far more promise that the airplane: safer, smoother-riding, more stable, and able to carry heavier loads. Rudyard Kipling's *With the Night Mail*, written in 1900 and subtitled "A Story of 2000 AD," chronicles a flight across the Atlantic through skies filled with airships of every description—all descendents of those built by Alberto Santos-Dumont and Count Ferdinand von Zeppelin around 1900 (9). Kipling's 2000 AD is, technologically speaking, his Edwardian present plus a hundred years' worth of incremental improvement. In fact, airship technology hit a plateau by the early 1930s. Helium could only lift so much, gasoline engines could only push so hard, and airship hulls could only be built so long. The most successful airships ever built—Britain's *R-100*, Germany's *Graf Zeppelin*—could carry less than a hundred passengers and reach speeds of less than a hundred miles per hour. By the late 1930s land planes could carry the same loads at three times the speed, flying boats could cross the Atlantic in half the time, and—hastened by a series of headline-grabbing accidents, including the fiery destruction of the Hindenburg—the day of the airship was over (10).

Unforeseen breakthroughs—the other fatal weakness of the slow-incremental model of technological change—undo even more imagined futures than unforeseen barriers. The transistor, invented in 1947, made microelectronics possible and led—by way of the integrated circuit and the microchip—to the world we take for granted (11). Through the 1940s and even the 1950s, however, even science-fiction writers who prided themselves on their technical savvy never saw it coming. Perhaps the biggest difference between pre- and post-1960 visions of the future is that the latter *begin* to take microelectronics for granted and their social ramifications seriously.

Robert Heinlein was, arguably, the most technically adept science-fiction writer of the era: a trained engineer, Naval Academy graduate, and holder of multiple patents. Even he, however, failed to see the revolution that microelectronics were creating (or even imagine that it was possible). His 1941 short story "Misfit," set in about 2100, stars a mathematical genius whose nickname, "Slipstick," is slang for "slide rule," which Heinlein assumed would still be the standard calculating tool of the twenty-second century (12). The titular vehicle in his 1947 novel *Rocket Ship Galileo* flies to the Moon using nuclear-thermal propulsion, but is steered by a mechanical autopilot who "consults a cam in his belly" to effect a course change (13). Heinlein's 1953 novel *Starman Jones* takes place in a world where starships' navigational computers have no data-storage capability and must be programmed, in real time, by technicians reading numerical values out of bound paper tables (that is, books) and inputting them using paper tape (14).

Our third, and perhaps most alarming, mistake in predicting the future lies in our assumption that technological change is beyond our control. If it *can* be built, the "technological imperative" implies, it *will* be built, and all that remains for us to decide is how to cope with the results (15). Even commentators who fear the corrosive effects of the imperative have tended to regard it as an inescapable presence in modern life (16), leading to the subjugation of humans by machines that they "may not know, until it is too late, when to turn off" (17). The official motto of the Century of Progress Exhibition, held in Chicago in 1933-34, sums up this sense of inevitability: "Science discovers, industry applies, man conforms" (18). The reality, however, is that humans can and do choose *not* to conform. The history of technology is strewn with examples of new machines—introduced with great fanfare—that, presented to societies that wanted no part of them, died of neglect in the marketplace or of cut-off funding and draconian regulation in the legislature (19).

Visions of the future from the 1950s and early 1960s featured every imaginable application of the atom. There would be nuclear merchant ships (like the graceful *N/S Savannah*), nuclear airplanes (like the giant X-6), and nuclear spacecraft. Ford even showed a concept car—the Nucleon—that would be powered by a compact, modular reactor replaceable every hundred thousand miles (20). Nuclear energy would burn tunnels through mountains, Walt Disney Studios promised in its 1958 documentary *Magic Highway USA*, and carefully-placed nuclear explosions would make possible massive construction projects, like harbors in the mountainous Alaska panhandle and a sea-level canal across the Isthmus of Panama (21). Growing skepticism toward nuclear energy and growing concern about the environment meant, however, that by 1970 none of those projects seemed even remotely attractive. *Savannah* was the first *and* last of her kind, the X-6 never left the drawing board, and Projects Orion (nuclear spacecraft) and Plowshare (nuclear earthmoving) slipped quietly into obscurity (20).

Technological revolutions that depend—literally and figuratively—on public "buy-in" die more quietly. Food pills, another staple of imagined futures in the 1950s, failed to materialize in part because the smell of steak, the texture of baked potatoes and the taste of blueberry pie mattered more to would-be consumers than did efficiency (22). Jumpsuits, another ubiquitous feature of imagined futures from mid-century, emerged from a similar desire to simplify and streamline everyday life . . . and died a similar death. They were a more efficient way of getting dressed, but too many people rated efficiency far below comfort, stylishness and self-expression. The all-plastic living room—"cleans up with a garden hose!" exulted a 1950 issue of *Popular Science*—never even got near reality until it resurfaced in the interior of the Honda Element: a car for which pure functionality *was* the aesthetic (23).

Imagining space travel

Space travel was, for most Americans in the 1930s and early 1940s, a fantasy: the stuff of boys' adventure stories. It was how, in comic strips and movie serials, Flash Gordon came face-to-face with the Lion Men of Mongo, and how pulp-magazine hero Richard Seaton chased after his nemesis Marc "Blackie" Duquesne. Few (outside of science fiction fans and members of organizations like the American Rocket Society) believed "that Buck Rogers stuff" would become reality, let alone that it would do so within a decade or two. Then, in 1944, evidence to the contrary—the V-2 guided missile developed by Wernher von Braun—began falling on London and Antwerp (24).

The success of Germany's wartime V-2 missile program led (by way of captured missiles and engineers) to the United States Army's postwar missile program. It also spurred broad public interest in the use of rockets for space exploration—a lifelong goal of von Braun and many of his colleagues (24). The government's interest in rockets remained narrowly military well into the mid-1950s, but public interest in space exploration steadily deepened. *Life* and *Colliers'* ran lavishly illustrated articles describing what space travel would be like, and *Bluebook* and *The Saturday Evening Post* (then leading outlets for mainstream short fiction) published stories about it by Robert Heinlein and others. Willy Ley, a German émigré science writer, expanded his 1944 treatise *Rockets* into *Rockets and Space Travel* in 1947. Two years later, he provided the text for *The Conquest of Space*, a large-format book with illustrations by artist Chesley Bonestell. George Pal's science fiction film *Destination Moon*, with background paintings by Bonestell and a story by Heinlein, reached theaters in 1950. It was followed in 1951 by Pal's production of *When Worlds Collide*, in which a "space ark" saves the human race from extinction when the Earth is destroyed, and in 1955 by *The Conquest of Space*, about life on an Earth-orbiting space station and the first manned mission to Mars (25). "Rocketmen" like Tom Corbett, Rocky Jones, Commander Buzz Corey, and Captain Z-Ro patrolled the galaxy on children's television series (26). Walt Disney Studios offered three hour-long documentaries about the future of space travel (with von Braun and Ley as onscreen commentators) on its weekly television anthology program *Disneyland* (27).

These diverse visions of the future were united by a shared belief that—as an influential series of articles in *Collier's* put it—"man will conquer space soon," but divided on details such as who, how, and why. All tacitly assumed that the means and motives for such conquest would reflect those of past histories of exploration, and that the machines that would carry humans into space and to other worlds would be spiritual—if not lineal—descendents of those in which they conquered the land, sea, and sky of Earth. American images of space travel in the pre-*Sputnik* era coalesced, therefore, around familiar models of cutting-edge technologies from the past.

Robert Heinlein's "future history" stories, for example, imagined that the commercial potential of space travel and interplanetary trade would be self-evident and that rockets would be developed by deep-pocketed corporations in order to exploit it. The title character in "The Man Who Sold the Moon" (1950) is the leader of just such a corporation, and Heinlein paints him as a visionary, swashbuckling capitalist cast in the mold of nineteenth-century "robber barons" like Carnegie and Rockefeller (28). His name, D. D. Harriman, echoes that of turn-of-the-century railroad magnate E. H. Harriman, and the "future history" stories envision a future where interplanetary travel runs like a nineteenth-century railroad, with "commuter" lines from linking Earth to orbiting termini, regular interplanetary schedules, and spaceports serving as nuclei of civilization on the barren landscapes of other worlds.

The George-Pal-produced film *Destination Moon* also has a visionary capitalist leading the way into space, but imagines him acting virtually alone. Jim Barnes—a millionaire aircraft designer/manufacturer who sees space as the next logical step in the evolution of flight—is a prophet without honor: not only in his boardroom, but in the halls of the US government. Disgusted with the lack of interest in his vision, he joins forces with a scientist and a retired general to build the nuclear-powered *Luna* and fly her to the Moon himself. He thus follows in the real-world footsteps of aviation pioneers like Otto Lilienthal, Wilbur and Orville Wright, R. J. Mitchell, and Geoffrey de Havilland, all of whom pushed privately developed, cutting-edge aircraft on suspicious authorities. Harriman's spacecraft are shaped by the needs of commerce: standardized workhorses built (like nineteenth-century rail cars) for durability and ease of operation, but the winged *Luna*—like Mitchell's "Spitfire" or De Havilland's "Mosquito" as well as the rockets of Barnes' fictional counterparts Richard Seaton, Hans Zarkov, and Capain Z-Ro—is the sleekly beautiful product of a visionary designer's determination to expand the boundaries of flight.

The *Collier's* magazine series, influential in its own right and the model for the three Disney television documentaries, a George Pal film, and a trio of popular books, envisioned a third way. In it, space travel is undertaken by an unnamed (but presumably American) national government, for unspecified (but presumably geopolitical) national motives. The fictionalized views show no expense spared: the development of a wide range of mutually supporting spacecraft simultaneously: from tiny one-man "bottle suits" and space tugs for heavy construction work in orbit to large and elaborate multi-stage vessels of exploration (29). Left implied in all but Pal's film, *The Conquest of Space*, is the idea that all the expense is justified because the construction of a wheeled space-station in orbit or a base on another world parallels the scramble for imperial territory in North America, Africa, or the Pacific[ii]. Once the idea of space travel as literal, not just figurative, conquest is floated, however, the sheer magnitude of the ventures depicted comes into focus. It is the equivalent of fifteenth-century Iberian states, eighteenth-century Britain, or the twentieth-century United States building the navies that allowed them to lay claim to vast terrestrial empires, and thus a worthy investment.

All three visions of the coming age of space—despite their different historical inspirations and extrapolative paths—converged on a single vision of how the future would look: a massive, permanent presence in space facilitated by a wide range of vehicles, stations, and off-Earth habitats.

The reality was something very different. The technological milestones of early space travel—*Sputnik* and *Explorer*, *Vostok* and *Voskhod*, *Mercury* and *Gemini*—were highly specialized vehicles, (virtually) hand built, and optimized for the missions they flew. The *Apollo* spacecraft that went to the Moon exemplified this approach. Its components—a gumdrop-shaped command ship, a spider-like lander, and a giant multi-stage booster to break both free of Earth's gravity—were shaped by a demands of a mission plan built around small crews, short-duration missions, and limited time on the lunar surface. It was neither the best way to explore the Moon in detail, nor the most efficient stepping stone to other worlds and a permanent presence in space, but it was the best—indeed the only—means of meeting the specific challenge posed by John F. Kennedy in his famous 1961 address to Congress: to "land a man on the Moon, and return him safely to the Earth" by decade's end (30).

Optimization for a specific mission achieves narrow efficiency at the expense of versatility, long service, and the potential for future development. It creates vehicles that can do one thing—and only one thing—superbly, but are virtually useless for anything else. Those who, in the late 1940s and early 1950s, imagined that space travel would soon become a reality were right about the timing and spectacularly wrong about the means. They envisioned the spaceships of "tomorrow" as the Atomic Age equivalent of Columbus' caravels, Harriman's freight trains, or (at the very least) the Wright Brothers' kite-like Model B. The conquest of space turned out, however, to be an extension of the technology-assisted record-breaking (higher, faster, farther, deeper) that had made periodic headlines throughout the twentieth century. The first generations of manned spacecraft were the spiritual descendents of William Beebe's bathysphere, Donald Campbell's record-breaking *Bluebird*, and Charles Lindbergh's magnificent ugly duckling, the *Spirit of St. Louis*.

Roads not taken

The ideas about "the conquest of space" that animated pre-*Sputnik* visions of the future did not die with the advent of the actual Space Age. They animate books on humankind's future in space that appeared in the decade after 1957, as well as fictional depictions of the future like the television series *Men into Space* and the film *2001: A Space Odyssey*. Virtually every long-range plan developed by NASA from the late 1960s to the present day has been shaped by them. The now-retired space shuttle and the International Space Station were stunted, compromised attempts to translate a small part of that vision—a substantial human presence in Earth orbit, and regular, reliable Earth-to-orbit travel—into reality. Their failure, and the failure of anything more ambitious to make it off the drawing board, has left the pre-*Sputnik* image of space travel to the realm of "retro-futurism." Like robot servants, food pills, and supersonic travel, it represents a road not taken.

The reasons *why* it was not taken—why Willy Ley, Robert Heinlein, Wernher von Braun, and the rest saw the Space Age coming but utterly misread its shape—are, in retrospect, familiar and predictable. They mirror the reasons why, in general, "yesterday's tomorrows" so often failed to capture reality.

The pre-*Sputnik* vision of the Space Age assumed that space was—as President Kennedy and, later, *Star Trek* creator Gene Roddenberry would put it—a "new frontier:" the interior of eighteenth- and nineteenth-century North America written immeasurably larger. Defining it thus created, in the 1940s and 1950s, an expectation that it would—like terrestrial frontiers before it—need to be explored, occupied, populated, transformed, and commercialized. Doing so would serve national needs (as the conquest of terrestrial frontiers had from the fifteenth century onward, and would necessarily require a vast technological infrastructure: the space-age equivalent of Columbus's caravels, the steamboats that "opened" nineteenth-century Africa to Europeans, and the trains that bound the North American frontier to the settled East. Even before Kennedy numbered the conquest of the "new frontier" among America's "urgent national needs," however, the need to conquer it was giving way to the need to use it as a backdrop of displays of technological prowess—one more form of the ideological theater that shaped the Cold War (30). The winning of the US-Soviet "space race" was, for both nations, a genuine need, but one met by the passage of milestones, rather than by the literal or metaphorical "conquest" of frontier territory. Pre-1957 American visions of the future took it for granted that the United States would soon occupy the Moon, but the actual American space program was shaped by the understanding that it was enough to get there first (31).

The 1950s vision was also undermined—and, in the end, perhaps undone—by the failure of incremental models of technological progress to hold true in reality. The dream of winged, spacecraft that could take off like rockets, fly to orbit, and return to Earth like aircraft was central to virtually every 1950s depiction of space travel. They seemed—in a world where jet aircraft were new and supersonic flight newer still—like a natural evolutionary step forward. The steady forward march of aircraft performance hit a plateau in the late 1950s, however, and while Mach 2 proved to be an "easy" step beyond Mach 1 (the speed of sound), Mach 3 raised problems with frictional heating and fuel-hungry engines that could be solved only with exotic materials and radical designs that sacrificed (nearly) everything for speed (10). The "natural" progression from supersonic aircraft to winged, single-stage-to-orbit rockets (and cheap, easy access to orbit) proved to be anything but that (32).

Finally, and by far most significant, a substantial majority of the American public exercised its right of veto over the ambitious future that pre-*Sputnik* space enthusiasts imagined. The prospect of seeing "that Buck Rogers stuff" come true thrilled (and continues to thrill) a minority of Americans and draw the intermittent, transient interest of a majority (31). Neil Armstrong's "one small step" was one of the touchstone moments of the 1960s, watched live by a television audience of then-unprecedented size. The thrill of the moment did not, however, long allay public criticism of the money spent to achieve it, and excitement rapidly turned to indifference. NASA's budget was being slashed, and further lunar missions cancelled, by the Nixon administration even before *Apollo 11* lifted off; six months later, a live broadcast from orbit by the crew of *Apollo 13* went unwatched because the television networks were unwilling to preempt regular programming for it (33). Space stations, lunar bases, and manned missions to Mars—all staples of the 1950s' unrealized vision of the future—have been proposed multiple times, by multiple presidential administrations, since 1969 . . . and been greeted by the same public indifference as food pills and supersonic airliners. Footprints on the Moon seemed, for a brief moment in hothouse atmosphere of the Cold War, worth the cost to a narrow majority of Americans. Footprints on Mars, for better or worse, have seemed so only to a select few (34).

Conclusion

We have ample evidence that the needs technology meets *are* subject to change, that technological change is *not* invariably linear and incremental, and that "inevitable" technological changes *can* be stopped cold by popular opposition or indifference. Why, then, do we persist in imagining the future as if—in each case—the opposite were true? Part of the answer is that our casual, day-to-day view of technological change readily suggests the myth, just as watching the sky suggests that we stand, fixed, at the center of a spherical universe (35). Another part of the answer is that the reality displaces the myth only in the long—a view that relatively few of us back up and take.

Another—more interesting—part of the answer is that the myth comforts us. Rapid change is unsettling, and technological change is fast and steadily becoming both faster and more difficult to comprehend (36). The archetypal Mad Scientist figure embodies our collective fears about such change and its capacity to disrupt the structures of normal life. He is the malevolent demiurge of the Gnostics given human form—unruly and unpredictable, disruptive and all too willing to overturn the everyday structures of normal life—and he exists to be brought under control by the stolid, order-affirming hero (37). Our myths about technological change raise a deeper fear—that disruptive change is not brought about by selfish or deranged individuals but is a natural constituent of the technological progress we relish—only to quickly allay it. The myths reassure us that "natural" technological change is beyond our control . . . but that we have nothing to fear from it its steady onward march.

The quickening pace of technological change and the ever-rising stakes involved in anticipating its course (38) make it essential that we continue trying to see into the technological future. We must, however, strive to see more clearly: to lay aside the comforting-but-misleading myths that have guided us in the past, and (as we contemplate the technologies of a still-new century) embrace the reality behind them instead. That reality is, in the end, equally comforting, but it demands more of us: Nothing about technological change, not even the seemingly certain future in space that 1950s visionaries imagined, is inevitable. It is ours to shape by the needs we embrace and the choices we make, and we have no one but ourselves to credit (or blame) for the shape we give to our future.

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Competing interests

The author declares that he has no competing interests.

Notes

i. I am indebted to Dr. Julie R. Newell, of Southern Polytechnic State University, for this definition.
ii. The characters in *Conquest* frame the idea in terms of Manifest Destiny, though they do not use that specific phrase.

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