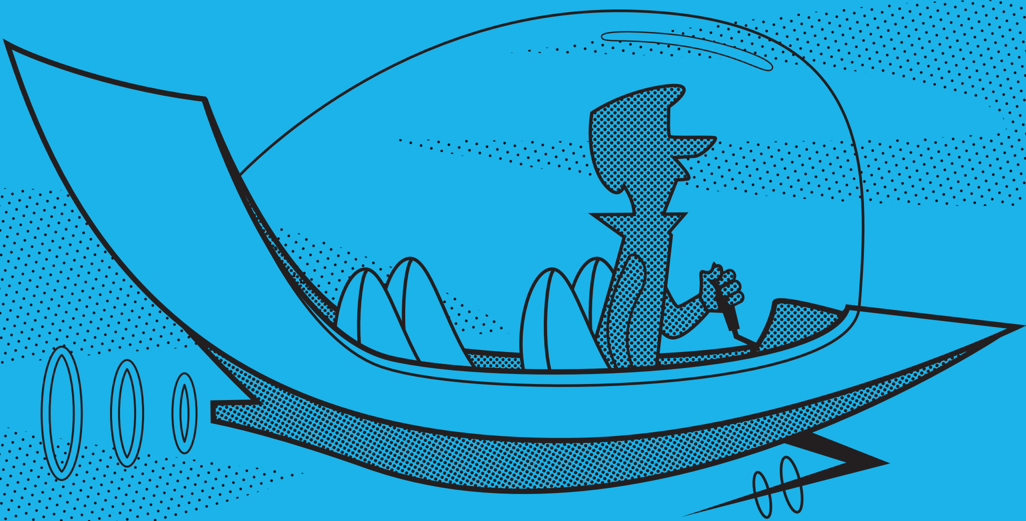

The Future We Were Promised

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An annotated bibliography from *Where Is My Flying Car?*

J. STORRS HALL

“The Future We Were Promised” is an expanded and annotated version of the bibliography from J. Storrs Hall’s 2018 book *Where Is My Flying Car?*, which offers an impassioned account of technological stagnation and an imaginative blueprint for a bold future. Stripe Press is republishing a revised and updated edition of the book in fall 2021.

Where Is My Flying Car? Annotated Bibliography

There are two main classes of works listed here. First, I have tried to include much of what I consider "classic" science fiction, i.e., works that would have contributed to the overall sense of "the future we were promised." Then there are nonfiction references that can form a basis for further and deeper reading about the various topics in the book. I have attempted to include books that are readable, rather than more voluminous academic tomes. You might reasonably expect to read or to have read any, or even all, of these. This list does not include scientific papers, which are referenced in the the footnotes of *Where Is My Flying Car?*.

Of course, it was in the 20th century that we began to have our worldview significantly enhanced by movies and television as well as books. Thus I include various formative films as well.

Chapter 1: The World of Tomorrow

Fifty years ago, it was clear that flying cars were in our future. Or at least it was clear to any 10-year-old boy who read the stories of Tom Swift Jr. His "triphibian atomicar" was held in the air by "repellatron rays" and powered by an "atomic capsule," which could "change atomic energy directly into electricity."

Tom Swift Jr., was, of course, a literary offspring of the original Tom Swift, who was seen having adventures with gadgets like an "electric runabout" and a "photo telephone" just about a century ago. He, in turn, was modeled, in a boy's-adventure-story way, on Thomas Edison, who was something of a popular hero.

"The Future We Were Promised" is the penumbra of a spectrum of works, from science fiction to "serious" futurism, with a seasoning of decades of *Popular Mechanics*.

- Victor Appleton II, *Tom Swift and his Triphibian Atomicar* (1962).
- Arthur C. Clarke, *Profiles of the Future* (1962). This is an eclectic mixture of takes on future technology ranging from specific existing machines (hovercraft) to informed speculation on possible capabilities based on new physics (antigravity). The perspective of a science fiction writer surely helped. Both Clarke and Isaac Asimov predicted self-driving cars; by comparison, "serious"

futurists predicted electric cars (along with pneumatic-tube trains), but not self-driving ones. In their defense, this was a perfectly reasonable prediction in the '60s. But it was Clarke's genius at inspired guessing just outside the box that makes *Profiles* an enduring classic.

- H. G. Wells, *Things to Come* (1935). The book (*The Shape of Things to Come*, published in 1933) is of historical interest, but the work that contributed most to the popular conception of a wonderful future was, of course, the 1935 movie, with a script by Wells. In an amusing side note, when Arthur C. Clarke and Stanley Kubrick got together to plan and plot the movie that became *2001: A Space Odyssey*, Clarke showed Kubrick *Things*, which apparently had had a major influence on his thinking. Kubrick was singularly unimpressed.
- Robert A. Heinlein, *Podkayne of Mars* (1963), and many other works. Heinlein's juveniles are actually a much better part of the fare available for teenagers in the '50s and '60s (more realistic, better written) than Tom Swift Jr.; the latter owe their cachet to the original Tom Swift novels.
- Herman Kahn and Anthony J. Wiener, *The Year 2000: A Framework for Speculation on the Next Thirty-Three Years* (1967). This is a good example of what the "serious" futurists thought the new century would bring. They were actually closer to right with the technology than with their geopolitics.
- *The Jetsons* (first aired 1962–1963, rebooted 1985–1987). It's hard to know where to put *The Jetsons* on a spectrum from pure fantasy to semi-serious, if firmly tongue-in-cheek, forecasting. After all, we would never watch *The Flintstones* to give us any idea at all of what life was like in the Neolithic, nor Yogi Bear to gain an insight into Yellowstone. The cartoonists simply used a smorgasbord of woodland and paleontological creatures and phenomena, totally out of context, to lampoon current American suburban life. *The Jetsons* was much closer to reality, but it's clear that the family and their world were also intended to lampoon the *Popular Mechanics*-style world-of-tomorrow optimism, if only gently and hopefully. If you are at all interested in this subject, you owe it to yourself to find and watch the entire first episode.

Chapter 2: The Graveyard of Dreams

"You call this the future?" Calvin (the little boy) famously complains to Hobbes (the imaginary tiger) in the comic strip. "Where are the flying cars?" That was December 30, 1989. A quarter-century has gone by, and we're still waiting. According to Wikipedia, the question "Where is my flying car?" "is emblematic of the supposed failure of modern technology to match futuristic visions that were promoted in earlier decades." A Google search for the question returns 781,000 results. Flying cars have become a symbol of a mismatch: the future as imagined in the first half of the twentieth century seemed a lot brighter than the present we're living in now. We have seen the future, and it doesn't work as well as we expected. Progress has slowed to a crawl.

- *Back to the Future* (1985). The difference between the future we were promised and what we got is neatly captured by the comparison of the Hill Valley town square between 1955 and 1985, as Marty McFly manages to return to the future.
- Tyler Cowen, *The Great Stagnation* (2011). This book and the work of Gordon, below, are serious treatments of the late-20th-century shortfall of achievement versus expectations.
- Robert Gordon, *The Rise and Fall of American Growth* (2016).
- Henry Adams, *The Education of Henry Adams* (1907). This autobiography of one of the leading American figures of the 19th century shows us that the optimism of the 1950s and sixties had firm roots in over a century of technological progress.

Chapter 3: The Conquest of the Air

In the 1930s, it was understood what would be needed in an aircraft "designed for the needs of the private owner." The autogyro might well have been just the thing to revolutionize private aviation. For one brief historical moment, we had the rare combination of an aeronautical genius, in Juan de la Cierva, and a leading businessman with substantial engineering experience and resources, in Harold Pitcairn, both men dedicated to bringing the flying car to the people. This hope was destroyed by the Great Depression and the war; average Americans could not afford cars, much less airplanes, until the later 1940s.

But you could buy a perfectly useful flying car in the '30s for $5,000. Here is their story.

- Jules Vernez, *Robur the Conqueror* (1886). This novel does for flying machines what *Twenty Thousand Leagues Under the Sea* did for submarines.
- Juan de la Cierva, *Wings of Tomorrow: The Story of the Autogiro* (1931). Very readable account by the inventor himself. This and the following constitute a good background to understand how we almost had flying cars in the 1930s.
- Frank Kingston Smith, *Legacy of Wings: The Harold F. Pitcairn Story* (1981).
- Patrick Gyger, *Flying Cars: The Extraordinary History of Cars Designed for Tomorrow's World* (2011). This book, together with the de la Cierva and Smith accounts, will give you a good overview of all the attempts to build and market flying cars in the 20th century.
- Andrew Glass, *Flying Cars: The True Story* (2015).
- George Green, *Flying Cars, Amphibious Vehicles and Other Dual Mode Transports: An Illustrated Worldwide History* (2010).

Chapter 4: Waldo and Magic, Inc.

In 1942, Robert A. Heinlein, under the pseudonym of Anson MacDonald, published the cover story in the leading SF magazine, *Astounding*. This story introduced the "Waldo F. Jones Synchronous Reduplicating Pantograph." Heinlein is recognized as the conceptual inventor of the telemanipulator, often termed a "waldo" for that reason. It is not as widely remembered that the original waldoes in the story were (a) self-replicating ("Reduplicating") and (b) scale-shifting ("Pantograph").

It seems almost certain that the young Richard Feynman would have read Waldo or known about it. He had been, after all, an undergraduate at M.I.T., at the time perhaps one of the very biggest hotbeds of science fiction fandom. And note his reference to "atomic energy plants," where the telemanipulators were in those days commonly referred to as waldoes.

- Robert Heinlein, *Waldo and Magic, Incorporated* (1950), in which Heinlein conceptually invents the telemanipulator and very nearly invents nanotechnology. Note that the name of the telemanipulator story is "Waldo"; it has been published with the novel "Magic, Inc." so often that the names have become inseparable. This is an amusing coincidence, given that Arthur C. Clarke told us that a sufficiently advanced technology is indistinguishable from magic.
- K. Eric Drexler, *Engines of Creation: The Coming Era of Nanotechnology* (1986). This and the following are popular accounts of what we might expect from a mature nanotechnology.
- J. Storrs Hall, *Nanofuture: What's Next for Nanotechnology* (2007). This includes my early attempts to design flying cars using nanotech, which have been filtered through 10 years of actual flying experience for the present volume.

Chapter 5: Cold Fusion?

> *Petrified with astonishment, Richard Seaton stared after the copper steambath upon which he had been electrolyzing his solution of "X," the unknown metal. For as soon as he had removed the beaker the heavy bath had jumped endwise from under his hand as though it were alive. It had flown with terrific speed over the table, smashing apparatus and bottles of chemicals on its way, and was even now disappearing through the open window.*
>
> —*The Skylark of Space*, E. E. "Doc" Smith

What happens next might have been predicted. When Seaton attempts to demonstrate his new discovery to his friends, it doesn't work, and he is dismissed as crazy. Then he goes off to develop it on his own, and established industrial interests who want to maintain a monopoly on power generation send thieves to steal his work, hit men to assassinate him and his partner, and finally operatives to abduct his fiancée in a spaceship. The novel is only slightly more melodramatic than the reality.

- E. E. “Doc” Smith, *The Skylark of Space* (1928). An electrochemist accidentally discovers a reaction involving a rare platinum-group metal that produces enormous amounts of power.
- John Huizenga, *Cold Fusion, the Scientific Fiasco of the Century* (1992). This and the following are opposing interpretations of the cold fusion phenomenon.
- Charles Beaudette, *Excess Heat: Why Cold Fusion Research Prevailed* (2000).

Chapter 6: The Machiavelli Effect

> *There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.*
>
> —*The Prince*, Niccolò Machiavelli

Machiavelli then goes on to tell us why innovation is difficult, perilous, and uncertain. His analysis illuminates 500 years of history and forms the basis for all of these latter-day elaborations on the phenomenon.

- Niccolò Machiavelli, *The Prince* (1532).
- Edgar Rice Burroughs, *The Gods of Mars* (1913). The ancient religion of the Martians turns out to be a cruel fraud.
- Kevin Kelly, *What Technology Wants* (2010). This and the following argue that innovation and scientific discovery work best as a bottom-up, evolutionary process.
- Steven Johnson, *Where Good Ideas Come From: The Natural History of Innovation* (2011).
- Matt Ridley, *How Innovation Works: And Why It Flourishes in Freedom* (2020).
- Terrence Kealy, *The Economic Laws of Scientific Research* (1996).

Chapter 7: The Age of Aquarius

> *It seemed to me that I had happened upon humanity on the wane. The ruddy sunset set me thinking of the sunset of mankind. For the first time I began to realize an odd consequence of the social effort in which we are at present engaged. And yet, come to think, it is a logical consequence enough. Strength is the outcome of need; security sets a premium on feebleness. . . .*
>
> *. . . . What, unless biological science is a mass of errors, is the cause of human intelligence and vigour? Hardship and freedom: conditions under which the active, strong, and subtle survive and the weaker go to the wall; conditions that put a premium upon the loyal alliance of capable men, upon self-restraint, patience, and decision. . . .*

. . . . For countless years I judged there had been no danger of war or solitary violence, no danger from wild beasts, no wasting disease to require strength of constitution, no need of toil. For such a life, what we should call the weak are as well equipped as the strong, are indeed no longer weak. . . . This has ever been the fate of energy in security; it takes to art and to eroticism, and then come languor and decay.

—*The Time Machine*, H. G. Wells

Wells's account of the degeneration of mankind is iconic and striking. But somehow we have managed to accomplish it in living memory instead of the geologic time he imagined. The following come nowhere near a full story, but they are a start.

- H. G. Wells, *The Time Machine* (1895). This is perhaps the watershed work of science fiction. It established the genre as being not just about this or that amazing machine or discovery, but as encompassing the whole of human history, of the fate of the Universe, of an illimitable sense of wonder. And it introduces the feckless Eloi, whom we are fated to become . . . .
- Robert Trivers, *Deceit and Self-Deception: Fooling Yourself the Better to Fool Others* (2011). . . . But once we are the Eloi, we'll spend all our energy pretending otherwise.
- Kevin Simler and Robin Hanson, *The Elephant in the Brain: Hidden Motives in Everyday Life* (2017).
- Matt Ridley, *The Origins of Virtue: Human Instincts and the Evolution of Cooperation* (1996). One of the really towering intellectual achievements of the 20th century—ranking with relativity, quantum mechanics, the molecular biology of life, and computing and information theory—was understanding the origins of morality in evolutionary game theory. The details are worth many books in themselves, and this is one. But the salient point for our purposes is that the evolutionary pressures upon what we consider moral behavior arise only in non-zero-sum interactions. In a dynamic, growing society, people can interact cooperatively and all parties can come out ahead. In a static, no-growth society, pressures toward morality and cooperation vanish; you can only improve your situation by taking from someone else. The zero-sum society is a recipe for evil.

Chapter 8: Forbidden Fruit

In the name of safety, the FAA has been given control over the airspace of the United States. They have made it a desert, and they call it peace.

Herewith, a family biography, an academic analysis, and a global perspective:

- Austin B. Hallock, *Sky Full of Dreams: The Aviation Exploits, Creations, and Visions of Bruce K. Hallock* (2010).

- Alex Tabarrok, *Launching the Innovation Renaissance: A New Path to Bring Smart Ideas to Market Fast* (2011).
- Hans Rosling, *Factfulness: Ten Reasons We're Wrong About the World—and Why Things are Better Than You Think* (2018). Rosling's "4 Levels" description of the state and development of human welfare is essential to understanding today's world and allows us to ask the key question: why is there no Level 5?

Chapter 9: Ceiling and Visibility Unlimited

Throughout the rest of the book, I have tended to analyze air travel as if it were purely a question of time, or economic productivity, or the like. It is much easier to measure such things, but they don't come close to capturing the full value of flight. Flying has been a dream of mankind since time immemorial, and with good reason. This world is a wonderful place, and you simply don't see it from the ground. Your point of view is terribly limited crawling around on the surface. People get the same experience of taking off blinders and seeing the whole world from mountain climbing, or even from dining in a restaurant on the top floor of a skyscraper. But when you fly, you get to take the mountain with you.

Bishop Wright's sons were, as you might expect, quite literate. The other three books listed are among the great books of the 20th century that captured, to some extent, the romance of aviation.

- Orville and Wilbur Wright, *The Early History of the Airplane* (1922).
- Antoine de Saint-Exupéry, *Wind, Sand, and Stars* (1939).
- Ernest K. Gann, *Fate is the Hunter* (1961).
- Richard Bach, *Jonathan Livingston Seagull* (1970).

Chapter 10: Dialogue Concerning the Two Great Systems of the World

By far the closest you can come in the real world to the experience of a personal flying car as expected by the science fiction writers and pundits of the postwar world is a small helicopter. The Robinson R44 has about the same total weight, interior size, useful load, cruise speed, and operational ceiling as the airplane I own.

But, of course, the real difference isn't in flying; it's taking off and landing. Instead of thousands of feet of runway, 50 to 100 feet wide, the helicopter only needs a pad that is 10 feet by 10 feet. The amount of land taken up is little enough that most hospitals—and many high-end resorts, corporate headquarters, and snooty wineries—have them, even though the amount of traffic is typically small.

- Steve Markham and Bill Holder, *Straight Up: A History of Vertical Flight* (2000).
- James R. Chiles, *The God Machine: From Boomerangs to Black Hawks: The Story of the Helicopter* (2007).

Chapter 11: The Atomic Age

Moving matter (as opposed to bits) around, or so goes the argument, requires a certain amount of energy, period. And energy is expensive. Some people will go farther and argue that the optimism and progress of the first half of the century was due to the rapidly expanding supply of cheap fossil fuel, and we ran out of that. But that doesn't work as an explanation for the divergence of science fiction predictions and what we actually managed to build. In *Profiles*, Clarke wrote specifically of needing new energy sources to take over "when the oil wells run dry."

By the golden age of science fiction, we had already shifted from wood to coal, and from coal to oil, as our major energy source. George Jetson's car isn't going to fold up into a briefcase if its tanks are carrying 1,000 pounds of jet fuel. There was a consensus among futurists and science fiction writers that the next shift was already beginning to happen, and we were on the verge of the Atomic Age.

Again, we have the range from prophetic science fiction through history to the current day:

- H. G. Wells, *The World Set Free* (1914). When this was written, only natural radioactivity was known. Wells imagined that it might be artificially produced as a power source and weapon. Then physicist and inventor Leo Szilard, who had read Wells, realized that this might be accomplished with a neutron-mediated chain reaction.
- L. Sprague de Camp: *Man and Power, The Story of Power from the Pyramids to the Atomic Age* (1961).
- Richard Rhodes, *The Making of the Atomic Bomb* (1966). . . . And the rest is history. If you read only one book about nuclear history, this Pulitzer-winning volume is the one you should read.
- Jack Devanney, *Why Nuclear Power Has Been a Flop* (2020). Imagine a practicing nuclear engineer and entrepreneur expanded this zine to book length. This is what you would get.

Chapter 12: When Worlds Collide

As a member of the Foresight/Battelle *Roadmap to Productive Nanosystems* working group, I was the champion of Feynman's scheme as one of the possible pathways to molecular manufacturing. It was decided, however, that the *Roadmap* should focus only on those techniques which produced atomically precise products. This seems a bit counterintuitive, like insisting that the only area on a map be that of the destination, excluding the starting point and intervening territory. There were, however, sound political reasons for the decision, primarily as a hard stop to exclude the "nanopants" nonsense (which revolves around thin films and particulates) from taking over the proceedings.

But now the time has long since come to examine the possibility of actually doing what Feynman proposed. You may, if you like, consider this the missing *Roadmap* chapter. Outside of this chapter in the book itself, there are not, to my knowledge, many great resources bearing on the project, but the following are useful background material.

- Philip Wylie and Edwin Balmer, *When Worlds Collide* (1933). Of course, the true cultural icon was the George Pal film with the group of scientists working desperately under the giant sign "Waste Anything but Time," racing to build a spaceship to escape the imminent destruction of the Earth.
- Foresight Nanotech Institute/Battelle Memorial Institute, *Technology Roadmap for Productive Nanosystems* (2007). This is a relatively technical guide to achieving nanotech capability, and is mostly bottom-up; the others are more focused on a self-replicating-machine approach that would be used in a top-down approach or a mature technology.
- Robert Freitas and Ralph Merkle, *Kinematic Self-Replicating Machines* (2004). Everything you always wanted to know about self-reproduction but were afraid to ask.
- R. A. Freitas and W. P. Gilbreath, Advanced Automation for Space Missions, NASA CP 2255 (1980). NASA's study of doing the same thing on the Moon.
- Neil Gershenfeld, *Fab: The Coming Revolution on Your Desktop—from Personal Computers to Personal Fabrication* (2005). How to build something that can build anything!

Chapter 14: The Dawn of Robots

A decade ago, in my book *Beyond AI*, I took up cudgels against those who were predicting a major takeoff in artificial intelligence by virtue of a self-improving super-AI. Long before that happens, I said, we will see something a bit more mundane but perfectly effective: AI will start to work, and people will realize it, and lots of money, talent, and resources will pour into the field. That will produce an acceleration of results, which will attract more money, and there's your feedback loop. That's what happened, for example, in aviation in the decades following 1910.

Something of the kind appears to be happening in AI now.

- Karel Čapek, *R.U.R.* (1920). The title of this play stands for "Rossum's Universal Robots." The script coined the word "robot," and also firmly attached what Asimov termed the "Frankenstein Complex" to them.
- Isaac Asimov, *I, Robot* (1950). Asimov's attempt to refute *R.U.R.* (and Frankenstein).
- Erik Brynjolfsson and Andrew McAfee, *The Race Against the Machine* (2011). Of course, they might not wipe us out, they may just take all the jobs.

- Randall Garrett, *Unwise Child* (1962). . . . Or become converted to some strange religion.
- J. Storrs Hall, *Beyond AI: Creating the Conscience of the Machine* (2005).

Chapter 15: The Second Atomic Age

There are something like four billion tons of uranium dissolved in the Earth's oceans. That works out to be over 100 quadrillion watt-years of energy, enough to supply the current American 10-kilowatt-per-capita level of power to 10 billion people for 10,000 years. Economical extraction would be a cakewalk with full-fledged nanotech. We could put the entire world back on generating more energy and harnessing it more effectively—what I call the Henry Adams Curve—and the only environmental impact would be to make the oceans imperceptibly less radioactive.

The book on the thoroughgoing application of nanotech to nuclear technology has yet to be written. Here are a few morsels for thought.

- Richard Rhodes, *Energy: A Human History* (2018).
- Robert Freitas Jr., *Nanomedicine Volume I: Basic Capabilities* (1999). Although oriented toward working with the intricacies of the body at a molecular scale, this technical but not-too-technical tome gives a broad overview of the kinds of things we should expect nanotechnology to be able to do.
- K. Eric Drexler, *Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization* (2013). Drexler brings his previous book, Engines of Creation, up to date.
- Mats Lewan, *An Impossible Invention* (2014). An experienced Swedish technology reporter investigates one of the more publicized cold fusion entrepreneurs. Genius or fraud? Or something in between, like Babbage's Analytical Engine, based on a sound idea but constantly revised to the point of never being completed? Your guess is as good as mine.

Chapter 16: Tom Swift and his Flying Car

Can we go whole hog, and put in down-blowing fans in the trunk and hood areas of our cars for true vertical takeoff and landing (VTOL) flying machines? In theory, there is enough thruster area for 1,000 horsepower to lift the car. The airjeeps of the 1960s were designed along these lines. The ones with turbines (e.g., the actual AirGeep VZ-8P) flew well, while the ones with piston engines (the Curtis/Wright Bee) made barely working hovercraft. The question is, is there room for anything else, including the engine?

Perhaps surprisingly, the answer is probably. In theory, you only need about 20 square feet of footprint (out of the 100 in a typical car) to lift 3,000 pounds, drawing 850 kilowatts. In practice, you might use a few more. In either case, there is plenty of footprint left over for an engine, passenger compartment, wheels, and so forth. The Doak VZ-4 put 1,000 hp into 50 square feet of lift-fan area; a similar area in our car would leave us 50 square feet of floor space for passengers, engine, and so forth. (If that doesn't fit, you can add another 50 square feet and still have the footprint of a Ford F-150 pickup or a 1959 Cadillac.)

Ranging from the popular to the technical, these books explain what you need to know to have a shot at designing a flying car. Or, perhaps more to the point, they'll help you look at a proposed plan for one and see if it makes any sense.

- Henk Tennekes, *The Simple Science of Flight* (1996).
- Daniel Raymer, *Simplified Aircraft Design for Homebuilders* (2002).
- Ira H. Abbot and A. E. von Doenhoff, *Theory of Wing Sections* (1959).
- Barnes W. McCormick Jr., *Aerodynamics of V/STOL Flight* (1967).

Chapter 17: Escape Velocity

A classic 1920s-era Koken barber chair weighs about 250 pounds. It is a solid piece of old-fashioned machinery; many original ones are still in use today. Chairs like that were also something of a luxury item: the Titanic had two of them in its first-class-only barber shop, as did many top ocean liners of the day. But nobody in his right mind would design a spacecraft with a barber chair in it!

Well, nobody except Ted Taylor. Taylor was an interesting figure in technological history: as a nuclear engineer, he designed both the smallest and the largest fission devices that the United States ever built. Taylor's insistence that there be a barber chair in his spaceship was an in-your-face way of saying that this was a ship, like an ocean liner, and not a dinky little capsule stuck on top of a skyrocket.

Taylor's ship, of course, was Project Orion, the very first study funded by ARPA (later DARPA), the now-famous research arm of the Department of Defense (and the second major project of General Atomics, after the TRIGA reactor). They started studying Orion in earnest in 1959. It was a serious engineering effort, with some of the country's top minds (besides Taylor, most famously Freeman Dyson). Some of the design is still classified top secret.

- George Dyson, *Project Orion: The True Story of the Atomic Spaceship* (2002).
- Robert A. Heinlein, *Space Cadet* (1948). This classic Heinlein juvenile spawned a host—nay, a whole industry—of imitators, and added a phrase to the language.
- Tom Wolfe, *The Right Stuff* (1979).
- Eugene Cernan and Don Davis, *The Last Man on the Moon: Astronaut Eugene Cernan and America's Race in Space* (1999).

- Mike Gray, *Angle of Attack: Harrison Storms and the Race to the Moon* (1992). The previous books describe the experience of flying the rockets. This is one of the best at explaining what it was like to build them.
- Gerard O'Neill, *The High Frontier: Human Colonies in Space* (1976). The future is not what it used to be. Most of the golden-age science fiction writers envisioned us getting into spaceships and going to other worlds, interacting with natives and establishing colonies in essentially a rerun of the voyages of exploration in wooden boats 500 years ago. Instead, it seems much more likely that we will go and build brand new worlds where nothing was before. Instead of a few small worlds ill-adapted to humanity, the solar system beckons with the equivalent of 20,000 Earths.

Chapter 18: Metropolis

The value of a city is not to bring people closer together. The value of a city is to reduce the time, the opportunity cost, to get from one place—a home, business, institution, restaurant, recreation—to another. It's pure travel theory.

One would think that, with the density of prospective riders, economies of scale would allow a well-designed and integrated transportation system to do better than private independent vehicles going between ranch houses across the open plains. Instead, our cities do worse by an order of magnitude.

A mystery, a misery, and a mythology:

- Isaac Asimov, *The Caves of Steel* (1953). Although nominally a murder mystery with a robot detective, this is lifetime NYC resident Asimov's best backgrounder for what the city of the future would be like.
- Jane Jacobs, *Dark Age Ahead* (2004). David Altrogge quipped, "A dark age is not when you've forgotten how to do something. It's when you've forgotten that you could." Jacobs's final book about the decay of several North American institutions sounds quite a bit more prophetic today than when she wrote it 17 years ago.
- Randal O'Toole, *The Vanishing Automobile and Other Urban Myths: How Smart Growth Will Harm American Cities* (2000).

Chapter 19: Engineers' Dreams

Current efforts to regulate the Earth's climate cost the world economy something on the order of a trillion dollars a year, not counting the externalities of energy poverty and so forth. What's more, by their own criteria, they are not succeeding: global CO_2 emissions are rising faster now than before the Kyoto Protocols were adopted.

Suppose we instead used that trillion—roughly 50 times NASA's budget—to build a robust orbital infrastructure and simply put up some sunshades. The total area needed to negate the enhanced greenhouse effect would be a two-mile-wide ribbon around the equator. Then not only would you have cooled the climate, you'd have a robust orbital infrastructure, a vastly more valuable thing. For example, if we put up a solar power satellite instead of merely a shade, it would generate more power than the human race currently uses.

If, after reading these, you are not seized with the urge to go out and build something 10,000 times bigger than the Earth, there is no poetry in your soul.

- Ben Bova, *The Weathermakers* (1967).
- L. Sprague de Camp, *The Continent Makers* (1951).
- Olaf Stapledon, *Star Maker* (1937). Freeman Dyson credits this as his inspiration for the concept that has come to be known as the Dyson sphere, a gadget that collects all the power put out by a star and supports a Kardashev Type II civilization.
- John W. Campbell, *The Mightiest Machine* (serialized 1934–1935, collected 1947). Literarily the Verne to Stapledon's Wells, Campbell wrote about a gadget that could tap the power of a star two years before Star Maker, but in an "adventures in a spaceship" style, as opposed to a "history of the universe" one.

Chapter 20: Rocket to the Renaissance

Yes, we should have flying cars. Yes, we should have power too cheap to meter. Yes, we should have orbital hotels and a base on the Moon. Average family income in the U.S. should be $200,000 by now, and growing at a sustained six percent. But what has actually happened is that cultural reaction and regulatory ossification have combined to dam up the normal flow of experimentation in high-power technology. Where the technium would have spilled into the fertile valleys in idea space, we have instead built up a theoretical, scientific overhang. We built and tested molten salt reactors and nuclear rocket engines over 40 years ago, but in the interim the United States has effectively used experimentation with nuclear capability as a *casus belli* against anyone who has tried it. We could have been developing nanotech since 1960, when Feynman first pointed out the possibilities. We know a lot more about the molecular scale now, so when the dam breaks it will come a lot faster. We have system designs for self-replicating nanofactories. We have detailed, atom-for-atom designs and engineering analyses of gears, levers, bearings, shafts, and sprockets. We can simulate the quantum electrodynamics on our almost ridiculously powerful computers. It is as if we had gone into the Industrial Revolution already knowing thermodynamics and high-temperature metallurgy.

We return to our roots of Chapter 1 with classic science fiction and a nonfiction work by a science fiction writer.

- Poul Anderson, *Vault of the Ages* (1952). Five hundred years after a nuclear holocaust, tribesmen fight with swords and spears over a prize: a time-capsule vault of technological knowledge.

- Isaac Asimov, *Foundation* (1951). This time, the collapsing civilization is the entire galaxy, and the old forgotten knowledge is held by an entire planet of scientists. *The Foundation* series was awarded the once-only "Best of all Time" Hugo award in 1966 by the fans; presumably they used a time machine to make sure.
- Robert Heinlein, *Beyond This Horizon* (serialized 1942, collected 1948). Perhaps, instead, we are not doomed to follow historical patterns and become Eloi. This widely misunderstood story (when I say misunderstood, I mean that virtually none of the reviewers or commentators I have seen have a shadow of a hint of a clue what it's about) is Heinlein's attempt to refute Wells's Time Machine, much as Foundation is Asimov's attempt to refute Edward Gibbon.
- Jerry Pournelle, *A Step Farther Out* (1980). If we can keep our heads when all those around us are losing theirs, we have a real opportunity not just to survive but to thrive. As Wilbur Wright said, "It is not really necessary to look too far into the future; we see enough already to be certain that it will be magnificent. Only let us hurry and open the roads."

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