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Enabling Science Fiction

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ENABLING SCIENCE FICTION*

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ABSTRACT

Patent law promotes innovation by giving inventors 20-year-long exclusive rights to their inventions. To be patented, however, an invention must be "enabled," meaning the inventor must describe it in enough detail to teach others how to make and use the invention at the time the patent is filed. When inventions are not enabled, like a perpetual motion machine or a time travel device, they are derided as "mere science fiction"—products of the human mind, or the daydreams of armchair scientists, that are not suitable for the patent system.

This Article argues that, in fact, the literary genre of science fiction has its own unique—albeit far laxer—enablement requirement. Since the genre's origins, fans have demanded that the inventions depicted in science fiction meet a minimum standard of scientific plausibility. Otherwise, the material is denigrated as lazy hand-waving or, worse, "mere fantasy."

Taking this insight further, the Article argues that, just as patents positively affect the progress of science and technology by teaching others how to make and use real inventions, so too can science fiction, by stimulating scientists' imagination about what sorts of technologies might one day be possible. Thus, like patents, science fiction can have real world impacts for the development of science and technology. Indeed, the Article reveals that this trajectory—from science fiction to science reality—can be seen in the patent record itself, with several famous patents tracing their origins to works of science fiction.

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> "By mapping out possible futures, as well as a good many improbable ones, the science fiction writer does a great service to the community."
>
> Arthur C. Clarke (2000)[1]

INTRODUCTION

In science fiction, (almost) anything is possible. If the technology doesn't work in this world, or not yet, that is no problem.[2] In fact, that's kind of the point of the genre.

Patent law has stricter rules than the rules of science fiction.[3] In patent law, an inventor can only get a patent if their invention is "enabled," meaning that a "person having ordinary skill in the art" (the PHOSITA) could actually practice the invention by reading the disclosures revealed in the patent.[4] Newness, even inventiveness, are not enough. The inventor must have a prototype or a version of the invention that's ready to be

1. ARTHUR C. CLARKE, *Foreword*, *in* THE COLLECTED STORIES OF ARTHUR C. CLARKE x (2000) [hereinafter COLLECTED STORIES].

2. *See generally* GARY K. WOLFE, HOW GREAT SCIENCE FICTION WORKS: COURSE GUIDEBOOK (2016); M. KEITH BOOKER & ANNE-MARIE THOMAS, THE SCIENCE FICTION HANDBOOK (2009); DAVE GOLDER ET AL., THE ASTOUNDING ILLUSTRATED HISTORY OF SCIENCE FICTION (2017); JOHN WADE, THE GOLDEN AGE OF SCIENCE FICTION: A JOURNEY INTO SPACE WITH 1950S RADIO, TV, FILMS, COMICS, AND BOOKS (2019).

3. *See generally* DANIEL BREAN & NED SNOW, PATENT LAW: FUNDAMENTALS OF DOCTRINE AND POLICY 81–136 (2020).

4. 35 U.S.C. § 112(a) (2011).

produced or manufactured, or at least have described the invention in enough detail in the patent that someone else (the hypothetical PHOSITA) would be able to make and use it.[5]

This Article argues that there is an enablement requirement in science fiction too. The inventions introduced in science fiction do not have to work today. They do not have to work tomorrow. They do not even have to work in this particular world. They just have to work in some world, at some point in time, and be described in sufficient detail to convince the reader—the "fan of ordinary skill in the art" (FOSITA), if you will—that the invention is sufficiently *plausible* to meet the definition of "science fiction," and that it is not mere "fantasy."

In patent law, the enablement requirement has an important social function. It forces inventors to meaningfully disclose and teach their inventions to others and to thereby stimulate future innovation and productivity.[6] We argue that science fiction's enablement requirement has an important social function too. Meeting a minimum threshold of scientific plausibility does far more than just enhance entertainment value and create a sort of sumptuary code for science fiction's notoriously particular fans.[7] When science fiction posits plausible, albeit currently impossible, inventions, this can stimulate "nonobvious" thinking among scientists and expand the semantic universe for the discourse about science and technology. Thanks to science fiction, we have forums, phraseologies, and archetypes that help us think and talk about inventions that humans can imagine, but not yet practice. Thus, not unlike patents, "enabled" science fiction can positively impact innovation itself, serving as the inspiration for many of the inventions that we see today, from the submarine to the electric car to the iPhone.[8]

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5. *Id.*

6. Jeanne Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 548–49 (2009); *see also* Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 745 (2012) ("The benefit the public gets from the bargain . . . is not (or not just) a new invention but the publication of new learning that might otherwise have been kept secret.").

7. For an example of sci fi haughtiness at its finest, check out this play-by-play critique of the science in the 2015 film adaptation of Andy Weir's *The Martian* (2011). Jeffrey Kluger, *What* The Martian *Gets Right (and Wrong) About Science*, TIME (May 18, 2016), https://time.com/4055413/martian-movie-review-science-accuracy-matt-damon; *see also* Barton Beebe, *Intellectual Property Law and the Sumptuary Code*, 123 HARV. L. REV. 809, 812 (2010) (defining a "sumptuary code" as a system of consumption practices "by which individuals in the society signal through their consumption their differences from and similarities to others").

8. THOMAS M. DISCH, THE DREAMS OUR STUFF IS MADE OF: HOW SCIENCE FICTION CONQUERED THE WORLD (1998) (discussing interactions between science fiction and the real world); Namwali Serpell, *When Science Fiction Comes True*, N.Y. TIMES (Mar. 12, 2019), https://www.nytimes.com/2019/03/12/books/review/namwali-serpell.html ("The designers of the iPhone and the Kindle cite works of science fiction as inspiration. . . . The genre has

Part I of this Article explains patent law's enablement standard, as well as recent criticism that the patent office has started allowing patents for inventions that resemble (literal) science fiction.[9]

Part II reveals that, in fact, the genre of science fiction has its own distinct, and albeit laxer, enablement standard. We argue that anxiety over enablement underlies longstanding debates within the science fiction community over what it means for a work to be science fiction, and how to distinguish science fiction from fantasy.

Part III introduces the concept of the "FOSITA," which is our term for the readers, writers, and critics who consume works of science fiction, and who—for whatever reason—demand a certain standard of scientific plausibility. We offer a few hypotheses to explain this phenomenon.

Part IV argues that science fiction can have an impact on the progress of real science. Even if it does not disclose specific technical information that can be reduced to practice, science fiction can stimulate new and "nonobvious" thinking. As evidence for this theory, we turn to the patent record itself, revealing that several famous patents trace their origins to specific works of science fiction.[10] The Article concludes with some observations on the value of science fiction to the world through the lens of patent law norms.

I. PATENT LAW'S ENABLEMENT STANDARD

To obtain a patent, the inventor must supply enough information about their claimed invention to "enable" a person having ordinary skill in the art (the PHOSITA) to make and use it. This requirement, called "enablement," is codified in Section 112 of the Patent Act, which states, in relevant part that "[t]he specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same . . . ."[11]

Enablement can be satisfied if the invention has been "reduced to practice," meaning the inventor has a working version of the invention containing all its elements. Importantly, enablement can also be satisfied through "constructive reduction to practice," where the patent's disclosure

predicted satellite communication, army tanks, tablets, submarines, psychotropic pills, bionic limbs, CCTV, electric cars and video calling.").

9. *See, e.g.*, Janet Freilich & Lisa Larrimore Ouellette, *Science Fiction: Fictitious Experiments in Patents*, 364 SCIENCE 1036 (2019); *see also infra* note 17.

10. *See infra* Part IV.

11. 35 U.S.C. § 112(a) (2011); BREAN & SNOW, *supra* note 3, at 98–99.

provides enough information that someone else could at least hypothetically make and use the invention without "undue experimentation."[12]

Importantly, enablement is judged based on the state of knowledge at the time of filing. "The law does not expect an applicant to disclose knowledge invented or developed after the filing date." Indeed, such disclosure would be impossible, for how could an inventor enable something that doesn't yet exist?[13]

For example, if someone wishes to patent a "time-travelling DeLorean" and files a patent application on August 1, 2020, that inventor would need to demonstrate that a person having ordinary skill in the art could make the device based on the state of the art as of August 1, 2020. The inventor cannot rely on the hope that technologies will one day arise and enable a person to make a time-travelling DeLorean by the year 2030. The inventor has to enable the invention as of the filing date. If the inventor can't do that, then they should not be granted the patent, no matter how new and innovative the invention itself is.[14]

The result, as the patent law professor Lisa Larrimore Ouellette explains, is that the enablement requirement tends to "weed out many armchair inventors."[15] The archetypical example is the perpetual motion machine—a law-of-physics-violating contraption that is and will continue to be ruled ineligible for a patent because inventors have been unable to enable it.[16]

II. ENABLEMENT IN SCIENCE FICTION

In recent years, patent scholars have brought attention to patentees' use of "prophetic" examples in their applications, based merely on "predicted results" about what might work. The effect, they suggest, is that patent examiners are allowing inventors to achieve patents on what seems, quite literally, like "science fiction."[17] A favorite example of patent law

12. *In re* Wands, 858 F.2d 731, 737 (Fed. Cir. 1988); *see also* Lisa Larrimore Ouellette, *Do Patents Disclose Useful Information?*, 25 HARV. J.L. & TECH. 545, 553 (2012).

13. BREAN & SNOW, *supra* note 3, at 116 (quoting Chiron Corp. v. Genentech, Inc., 363 F.3d 1247 (Fed. Cir. 2004)).

14. That said, thanks to the "doctrine of equivalents," patent claims can be used to reach through time and capture "after-arising technologies" in some circumstances. BREAN & SNOW, *supra* note 3, at 582–83, 598, 601. The invention still must be enabled as of the time of filing, however, even if it can be construed to cover new technologies that arise by the date of infringement.

15. Lisa Larrimore Ouellette, Pierson*, Peer Review, and Patent Law*, 69 VAND. L. REV. 1825, 1827 (2016).

16. Newman v. Quigg, 877 F.2d 1575, 1582 (Fed. Cir. 1989) (affirming district court's judgment that perpetual motion machine is not enabled).

17. Freilich & Ouellette, *supra* note 9; *see also* Janet Freilich, *Prophetic Patents*, 53 U.C. DAVIS L. REV. 663, 666 (2019) (discussing "prophetic examples," the "fictional experiments" permitted to be used in filing for a patent).

professors is a patent issued in 2005, covering what purports to be a space vehicle capable of traveling at light-speed.[18]

But of course, this is an exaggeration: what's acceptable in patent law pales in comparison to what is acceptable in literary science fiction. In science fiction, "undue experimentation" isn't just permitted, it's encouraged. "Reduction to practice" can be, literally, light years away.[19] Indeed, there is an entire subgenre of science fiction devoted to speculating about how the human species might potentially end—an event which is hopefully billions of years in the future.[20] This sort of flight of imagination violates patent law's norm of reduction to practice, but it's celebrated in science fiction.

However, we argue that, counterintuitively, the genre of science fiction has its own unique enablement requirement: works of science fiction must sufficiently "enable" the technologies and inventions that they posit. Otherwise, as we'll discuss in Part III, they are not accepted by the community and are cast out as mere "fantasy."

A. *The Plausibility Standard*

The lodestar for science fiction enablement—which we'll occasionally refer to as "Sci Fi Enablement," to keep the two standards clear—is not reduction to practice. Instead, in Sci Fi Enablement, the standard is reduction to *plausibility*, based on current science knowledge and based on the way the posited science is explained and theorized to the reader. As the ever-insightful Professor Gary Wolfe, a renowned expert on science fiction, puts it, "[o]ne of the first requirements we might list for a work of science fiction is that it should be *possible*—involving things that we might actually create, places we might actually go, or societies that might actually evolve."[21] Science fiction has to work with, relate to, or differentiate itself from real-world scientific facts or hypotheses.

For example, David Brin's *The Practice Effect* (1984) involves a scientist who uses the fictional science of "zievatronics" to travel to an alternate world in which of the laws of physics are subtly different from our own: specifically, inanimate objects can be "practiced" in order to become more efficient. In this alternate world, if an object is sufficiently

18. U.S. Patent No. 6,960,975 (issued Nov. 1, 2005) (expired due to failure to pay fees). Thanks to Josh Sarnoff for this example.

19. Yes, yes, we know that a light year is a unit of distance, not time, but we intend the double entendre. For inventions conceived in science fiction, a reduction to practice may well occur in deep space, deep time, or both. In any event, we acknowledge it might be better to say that reduction to practice is "parsecs away" (as in, "it's the ship that made the Kessel Run in less than 12 parsecs." STAR WARS: EPISODE IV – A NEW HOPE (Lucasfilm 1977)).

20. WOLFE, *supra* note 2, at 27–32; *see also* OLAF STAPLEDON, LAST AND FIRST MEN (1930).

21. WOLFE, *supra* note 2, at 3.

"practiced"—meaning, used for its intended purpose—then the object actually improves its functionality without further human intervention. For example, the protagonist, Dr. Dennis Nuel, discovers that rags can be turned into "rich man's clothes" by ordering prisoners to wear them, thereby "practicing" the clothing into "finery of the most brilliant and eye-pleasing shades." The cheap, low quality scientific equipment that Nuel brought with him from our Earth becomes high quality and much more efficient equipment than it was designed to be—simply due to Dr. Nuel's continual use of the equipment on the alternate world. Obviously, this isn't how real laws of physics operate. And in the hands of a different writer, this might look like, well, magic. But in Brin's novel, these occurrences are explained by the existence of "a subtle difference in physical law" on the alternate world., and this difference in physical law is a major part of the plot. Dr. Nuel, himself a physicist, literally screams it to the reader: "This anomaly world has a different set of physical laws than hold sway on Earth!"[22] Brin's *The Practice Effect* is a masterful illustration of an author pushing the outer bounds of Sci Fi Enablement. The book does not operate within the limitations of real science; but it concedes that those limitations exist, points out violations of physical laws when they occur, and tries to work around and surpass them.

A key feature of Sci Fi Enablement is that it is not judged with the benefit of hindsight. Rather, to quote Professor Wolfe again, the question is whether "the science of the story [is] accurate and defensible in terms of *contemporary* understandings of science and technology."[23] Recall that in patent law, enablement is judged from the perspective of the state of the art at the time a patent is filed, not before and not after. Sci Fi Enablement is similar in this regard; it is judged based on the state of the art at the time the work is created.[24]

A famous illustration of this principle is Mary Shelley's nineteenth century classic, *Frankenstein*. Shelley's protagonist, Dr. Frankenstein, manages to revive a dead corpse using electricity. Needless to say, Shelley had no prototype for her imagined monster. Today we know that it is not possible to use electricity to revive a human corpse.[25] But using electricity in this manner was *theoretically* possible in 1817, when the book was written. In fact, a few decades before Shelley wrote *Frankenstein*, an Italian physician named Luigi Galvani had discovered that an electric shock could

22. DAVID BRIN, THE PRACTICE EFFECT 18 (1984).

23. WOLFE, *supra* note 2, at 52 (discussing Campbell's standards for science fiction, discussed *infra* note 59).

24. Technically, Sci Fi Enablement should be judged at the work's *publication* date, since what matters is when the material is disclosed to the FOSITA.

25. *But see* Jon Cohen, *The Horror Story That Haunts Science*, SCIENCE (Jan. 10, 2018, 1:10 PM), https://www.sciencemag.org/news/2018/01/specter-frankenstein-still-haunts-science-200-years-later.

cause a dead frog's leg to twitch. Thus, Shelley's proposition about reviving a dead human corpse using electricity was "not unreasonab[le] for the science of her day."[26]

When science fiction authors posit technologies without explaining them, this is often referred to as "hand-waving," like a magician with a wand.[27] Fans and critics of science fiction are apt to call out hand-waving when they see it. For example, the well-known science fiction writer Kim Stanley Robinson (whom we interviewed for this Article) recently accused himself of engaging in "a little bit of science fictional hand-waving," by introducing "diamond spray" as a water-proofing substance for his book about a future New York City that is flooded due to global warming.[28]

An oft-cited hand-waver is H.G. Wells. For example, Professor Wolfe writes critically of Wells' most famous work, *The Time Machine* (1895): "Wells hardly bothers trying to rationalize time travel; his time traveler (known by no other name) simply argues that time is merely a fourth dimension and that logically, if we can travel in the other three, we ought to be able to travel in this one, as well."[29] Meanwhile, for his moon-travel story, *First Men in the Moon* (1901), Wells describes the ship responsible for taking men to the moon merely as a sphere covered with a special substance—not a real one—that cancels the effects of gravity.[30]

Still, we need to give Wells serious credit for his efforts at enabling. Just because he didn't enable every single aspect of the technologies he posited doesn't mean the book as a whole was not full of enabled disclosures. In patent law, patentees typically draft multiple claims to cover an invention, even within a single patent. It is common for a court to find some claims are invalid because they are not enabled, while other claims survive.[31]

Another saving principle of Sci Fi Enablement to keep in mind is "commensurability." In patent law, it is a general rule that the patent's disclosure—how much the inventor teaches—has to be commensurate with

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26. WOLFE, *supra* note 2, at 6–7.

27. Wikipedia describes hand-waving as a "pejorative label" for "a scientific discovery" in a work of fiction "that is left unexplained or sloppily explained because it is convenient to the story, with the implication that the writer is aware of the logical weakness but hopes the audience will not notice or will suspend disbelief[.]" *Hand-Waving*, WIKIPEDIA, https://en.wikipedia.org/wiki/Hand-waving (Feb. 14, 2021, 8:21 PM).

28. *See* Sarah Lewin, *After the Flood: Author Kim Stanley Robinson Describes Future NYC Underwater*, SPACE.COM (May 10, 2017), https://www.space.com/36765-new-york-2140-kim-stanley-robinson.html (discussing Kim Stanley Robinson's novel *New York 2140* (2017)).

29. WOLFE, *supra* note 2, at 16 (discussing H. G. Wells's *The Time Machine* (1895)).

30. H. G. WELLS, THE FIRST MEN IN THE MOON (1901); *see also* WOLFE, *supra* note 2, at 13–17; WADE, *supra* note 2, at 19.

31. BREAN & SNOW, *supra* note 3, at 54 ("claims are patented and enforced individually").

the invention that is claimed.[32] If the inventor claims a large range of invention, she needs an equally extensive disclosure to justify it and vice versa.

Likewise, in science fiction, if the claim is small—like "diamond spray" for water-proofing a building (*New York 2140*), or a "communicator" for talking to others when telephones already exist (*Star Trek: The Original Series*)—then less disclosure would be required to justify it. However, if the claim is massive, the explanation for it has to be more carefully constructed. The inventive claim is sort of like a tent, and the explanatory details the poles. The more poles, the bigger the tent it can support. The fewer the poles, the smaller the tent it can support.

To give a famous example, the X-Men are awesome, but they are not enabled, even according to science fiction's laxer standard. Introduced to the world in 1963 in the comic book medium, the X-Men are described as "mutants" who have reached a new state of evolution.[33] They are likely inspired by earlier works of science fiction, like A. E. Van Vogt's *Slan* (1940) (positing evolved humans with psychic powers)[34] or Robert Heinlein's *Orphans of the Sky* (1941) (depicting "muties" living on a massive space craft in low-gravity).[35]

But unlike those precursors, *The X-Men* comics do not plausibly explain how mutants work. The claims about what mutants can do are disproportionate in comparison with the explanations provided. Each mutant is born with a power, such as flight, lasers that shoot out of the eyes, telepathy (mind reading), and telekinesis (moving objects with the mind). These powers would be acceptable science fiction fare if they were accompanied by a plausible scientific explanation—one that dealt with real science or that, as in Brin's *The Practice Effect*, at least recognized and articulated how these powers diverge from what is actually possible.

However, the comics did not offer such a plausible scientific explanation. They originally explained mutants through atomic radiation and, later, through an "X-Factor gene."[36] Radiation or a special gene might suffice to justify minor bodily change or perhaps even psychic abilities. But

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32. MPEP § 2164.

33. The X-Men originated in the comic book medium, in Marvel's *The X-Men* #1, which was written and drawn by Stan Lee and artist Jack Kirby. But the X-Men have reached more generalist audiences in several recent movies, originally at the hands of Twentieth Century Fox, now at the hands of Marvel Studios, which is now part of Disney.

34. Some Slans have tendrils that set them apart, but others do not and blend into ordinary society.

35. The muties in *Orphans of the Sky* have features like two sentient heads ("Jim-Joe") or stunted growth ("Bobo").

36. That's why the X-Men were originally referred to in the comics as the "Children of the Atom." *Mutant Biology*, FANDOM: MARVEL DATABASE, https://marvel.fandom.com/wiki/Mutant_Biology (last visited Apr. 2, 2021).

it does not suffice to justify lasers coming out of your eyes or straight-up flight. It's just not commensurate and the tent collapses.

This is not to say that some aspects of *The X-Men* and their world can't survive enablement—just as certain aspects of H.G. Wells' moon ship can. But as a general matter, non-enabled science fiction like *The X-Men* entertains; it doesn't work with real-world science, as science fiction should.

B. *Science Fiction Versus Fantasy*

The enablement phenomenon we're identifying has not gone unnoticed, but it hasn't been discussed as analogous to the enablement standard used in patent law. Instead, anxiety around enablement has emerged more subtly in debates over how to define the genre and how to distinguish works of science fiction from works of mere "fantasy."

Everyone struggles with how to define science fiction.[37] Some commentators theorize remarkably broad definitions. For example, James Gunn theorizes that science fiction is simply literature that involves "cognitive estrangement," placing readers in a world that is different from our own.[38] This would sweep in many works that contain virtually no actual science—from Jonathan Swift's *Gulliver's Travels* (1726) to Stephen King's *It* (1986).[39]

Other commentators distinguish between "hard" and "soft" science fiction. "Hard" science fiction is more traditional science fiction fare that gives primacy to scientific accuracy and spends a lot of time working out the details of particular inventions. Meanwhile, "soft" science fiction focuses on the social and political ramifications of technology, rather than the "technologies themselves."[40] An example of the "soft" variety is said to be Ray Bradbury's *Martian Chronicles* (1950), because the book is more about how humans live on Earth than about how humans might colonize Mars, and because the prose lacked scientific accuracy even on a contemporary standard, similar to H.G. Wells' books.[41]

The issue lurking within this line-drawing is ultimately one of enablement. It's not just whether there is quantitatively enough science content in the work; instead, it's whether the posited science is sufficiently explained. This anxiety over enablement underlies one of the longest

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37. GOLDER ET AL., *supra* note 2, at 8; BOOKER & THOMAS, *supra* note 2, at 3–4; *see also* WOLFE, *supra* note 2, at 3–5.

38. GOLDER ET AL., *supra* note 2, at 8 (questioning whether science fiction must contain "some science amid the fiction"); BOOKER & THOMAS, *supra* note 2, at 3–4 (discussing Gunn's "Toward a Definition of Science Fiction").

39. Stephen King is a brilliant genius. But demon clowns are not enabled.

40. BOOKER & THOMAS, *supra* note 2, at 9; *see also* GOLDER ET AL., *supra* note 2, 106–07.

41. *See* WADE, *supra* note 2, at 139–40.

running debates in the science fiction community: how to draw the line between science fiction and fantasy.

Arthur C. Clarke was only slightly exaggerating when he observed that "[m]uch blood has. . .been spilled on the carpet" trying to tell the difference between science fiction and fantasy.[42] Putting aside the easy examples like *The Lord of the Rings* and *Game of Thrones,* it can indeed be difficult to tell the difference or explain our intuitions. Some works we are apt to consider fantasy, even when there aren't any hobbits, elves, or dragons in them, and magic is not a plot feature.

Some critics have reductively concluded that it's as simple as where the story takes place: "Fantasy stories take place in a *world*," whereas "science fiction stories take place on a *planet*."[43] However, there have been more serious attempts to distinguish the genres. For example, Clarke's proposal was that "science fiction is something that could happen—but usually you wouldn't want it to. Fantasy is something that couldn't happen—though often you only wish that it could."[44] We assume this was meant as tongue-and-cheek or that it was posited in a time when most fantasy was utopic—Frodo and the Starks certainly had a terrible time of it! But the heart of Clarke's point is well taken: the dividing line between science fiction and fantasy is whether the work is plausible and grounded in real science.[45]

This is not to say there will always be easy answers. The *Star Trek* - *Star Wars* divide proves this. One New York Times critic insists that *Star Trek* is science fiction, because "the fictional science has always been brilliant[,]" whereas *Star Wars* is unabashedly fantasy, because "[t]he science in Star Wars is nonsense, and everyone knows it."[46] But to other fans, the answer is not so obvious. To the contrary: *Star Wars* may actually be "the single most famous science-fiction film, and science-fiction franchise, in the world."[47] At least some commentators have depicted the

42. COLLECTED STORIES, *supra* note 1, at ix; *see also* WOLFE, *supra* note 2, at 4, 82.

43. WOLFE, *supra* note 2, at 82 (emphasis added).

44. COLLECTED STORIES, *supra* note 1, at ix; *see also* WOLFE, *supra* note 2, at 4, 82.

45. Samuel R. Delany's definition was similar, but without the distracting utopia /dystopia distinction. Delany said that fantasy concerns events "that could not have happened," whereas science fiction concerns events "that have not happened, that have not happened yet, or that might happen." WOLFE, *supra* note 2, at 4.

46. J. C. Herz, *GAME THEORY; "Star Wars" World with a Sense of Humor*, N.Y. TIMES (Oct. 29, 1998), https://www.nytimes.com/1998/10/29/technology/game-theory-star-wars-world-with-a-sense-of-humor.html; *see also* Annalee Newitz, 10 Works of Science Fiction That Are Really Fantasy, GIZMODO (Sept. 5, 2011, 1:59 PM), https://io9.gizmodo.com /10-works-of-science-fiction-that-are-really-fantasy-5799837 (concluding that *Star Wars* is fantasy in part because "it's pretty obvious that we're dealing with a non-scientific, spiritual element of the universe that is controlling everything").

47. To be clear, this statement is made from the perspective of a much broader definition of science fiction than is standard. *See* Noah Berlatsky, *Is Star Wars' "The Last Jedi" Science Fiction? It's Time to Settle This Age-Old Argument.*, NBC NEWS THINK (Dec.

science in the original *Star Wars: A New Hope* (1977) as "way ahead of its time," from "light speed to hyper drives to lightsabers and autonomous robots . . ."[48] On the flip side, the science in *Star Trek* has not "*always* been brilliant." Who could forget the *Star Trek: The Next Generation* episode where Dr. Crusher meets a space ghost?[49] Arthur C. Clarke, for his part, excluded both from the genre, writing that although he "enormously enjoyed the best of *Star Trek* and the Lucas/Spielberg epics . . . these works are fantasy, not science fiction in the strict meaning of the term."[50]

When confronted with more ambiguous examples, fans sometimes turn to a spillover category called "science fantasy," where authors are permitted to introduce elements "which violate the scientific laws of the real world" without supplying scientifically grounded explanations for those violations.[51] An example is Gene Wolfe's novel, *The Book of the New Sun* (1980–1983), about a torturer wandering the planet "Urth" in the very distant future. The torturer wields a sword and wears a black cloak and would be comfortable in a J.R.R. Tolkien novel. But there is also a lot of technology: flying cars, space travel, a torture machine that makes a prisoner want to rip out their eyes. Because none of this technology is explained or presented as scientifically possible, the book is classified as science fantasy, not science fiction.[52] Another example is Philip Pullman's *The Golden Compass* (1995), which posits, among other things, parallel worlds that are (inexplicably) accessed through the Northern Lights, and which also features humans with animal soulmates called daemons. As in *Book of the New Sun*, none of this is scientifically plausible and Pullman does not attempt to explain it to the reader as such. But the series dwells significantly on the culture of science, which Pullman calls "natural philosophy," within the world of the novel.[53]

17, 2017, 4:22 AM), https://www.nbcnews.com/think/opinion/star-wars-last-jedi-science-fiction-it-s-time-settle-ncna830281.

48. Jason Maderer, *The Science of Star Wars*, GA. TECH, https://www.news.gatech.edu/features/science-star-wars (last visited Apr. 2, 2021).

49. *Sub Rosa* (Star Trek: The Next Generation), WIKIPEDIA, https://en.wikipedia.org/wiki/Sub_Rosa_(Star_Trek:_The_Next_Generation) (Apr. 1, 2021, 2:17 AM).

50. ARTHUR C. CLARKE, THE SONGS OF DISTANT EARTH i (1986). Clarke was using a highly literal definition of science fiction, focusing on the predictive accuracy of the technology depicted in the work, and he deemed that both *Star Trek* and *Star Wars* had, in this sense, failed. "It now seems almost certain that in the real universe we may never exceed the velocity of light. Even the very closest star systems will always be decades or centuries apart; no Warp Six will ever get you from one episode to another in time for next week's installment. The great Producer in the Sky did not arrange his program planning that way." *Id.*

51. *Science Fantasy*, WIKIPEDIA, https://en.wikipedia.org/wiki/Science_fantasy (Jan. 22, 2021, 2:06 PM).

52. The Book of the New Sun, WIKIPEDIA, https://en.wikipedia.org/wiki/The_Book_of_the_New_Sun (Mar. 6, 2021, 8:39 PM).

53. Northern Lights *(Novel)*, WIKIPEDIA, https://en.wikipedia.org/wiki/Northern_Lights_(novel) (Jan 22, 2021, 2:06 PM).

It seems clear to us that these debates center on whether a work is sufficiently enabled: Does it teach the science and technology that it describes? Does the posited science and technology appear theoretically plausible to the reader as it's been explained to them?

III. PLEASING THE FOSITA

So where do these standards come from? Unlike patent enablement, Sci Fi Enablement is obviously not required by law. Instead, fans create and enforce Sci Fi Enablement.

In patent law, enablement is judged through the lens of the PHOSITA, a hypothetical artisan in the field who is assumed to know all prior art in the field and be conversant with the entire "state of the art" at the time of filing.[54] In science fiction, in contrast, enablement is judged by the "fan of ordinary skill in the art"—the *FOSITA*, if you will. This fan group is multi-faceted. It includes the average reader who purchases science fiction media—books, magazines, comics, movies, television, and so on. It includes the "super fans," who attend popular conventions like ComicCon, engage in cosplay, or try their hand at "fan fiction."[55] It includes the original writers, such as Clarke, Delaney, and Robinson, who vigorously discuss and critique the work of their peers. It includes the editors and publishers who select and distribute material. And, as discussed further below, it includes the institutions that honor outstanding productions through annual awards.

The FOSITA may be a scientist or have the benefit of consulting with scientists, but she need not have a degree or background in science. Rather, she must simply have some level of interest in science and, to some degree, be constitutionally primed to believe—or primed to *want* to believe[56]—that a science fiction author's description is plausible. This creates a sort-of presumption in the author's favor, not unlike the presumption of enablement and utility in the inventor's favor in the patent setting.[57] Fans will go along with an author—at least until there is a glaring reason (or omission) that causes the tent to collapse.

Understanding the origin of Sci Fi Enablement requires understanding the psychology of the FOSITA. Although we cannot know for sure precisely

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54. *See* KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 414 (2007).

55. *See, e.g.*, Rebecca Tushnet, *Legal Fictions: Copyright, Fan Fiction, and a New Common Law*, 17 LOY. L.A. ENT. L.J. 651, 655–58 (1997); *see also Cosplay*, WIKIPEDIA, https://en.wikipedia.org/wiki/Cosplay (Mar. 16, 2021, 11:53 AM); SAN DIEGO COMIC-CON INT'L, https://www.comic-con.org (last visited Apr. 3, 2021).

56. *The X-Files* reference unintended but welcomed. *See* The X-Files: I Want to Believe, WIKIPEDIA, https://en.wikipedia.org/wiki/The_X-Files:_I_Want_to_Believe (Apr. 1, 2021, 1:00 PM).

57. The patent office presumes an invention is operable and enabled unless they have "reason to doubt the objective truth of the statements" in the application. *In re* Cortright, 165 F.3d 1353, 1357 (Fed. Cir. 1999).

why the FOSITA insists on a certain level of science plausibility, we suspect it has to do with the types of people who read, wrote, and published science fiction in the early years of the genre. For better or worse, the FOSITA came of age in the 1950s, considered by many to be the "Golden Age" of science fiction.[58] Many of the most beloved science fiction stories were initially serialized in pulp magazines, the most popular of which was *Astounding Science Fiction* (1929–present).[59] The early "pulps" were often criticized for not even attempting scientific accuracy. For example, in Edgar Rice Burroughs' popular and enduring *John Carter of Mars* series (begun in 1912), John Carter romps around on Mars. But it's really just a "Western in outer space," with little basis in what scientists thought Mars looked like. Carter arrives on Mars through magic, no explanation given. He uses a "ray gun." He can jump over 100 feet in the air, supposedly because of lower gravity. But it's never explained how he can breathe.[60]

This changed as the magazines came under the leadership of influential editors like John W. Campbell, Jr., who was in charge of *Astounding* from 1937 until his death in 1971.[61] Although this narrative could be exaggerated, Campbell is often credited as being single-handedly responsible for the genre's exacting standards of scientific plausibility, as he strove to move beyond childish adventure stories like *John Carter*, towards "more realistic, finely textured futures and innovative but logically rigorous ideas."[62] Without a doubt, during his reign at *Astounding*, Campbell published some of most science-heavy writers in the field, such as Clarke,[63] Heinlein,[64] and Isaac Asimov.[65] He intentionally selected writers who posited recognizable and realistic-seeming science and technology.[66] For example, Asimov was an actual scientist who received a BA, an MA, and a PhD from Columbia

58. *See* WADE, *supra* note 2, at vii.

59. WADE, *supra* note 2, at 179; WOLFE, *supra* note 2, at 41–47. *Astounding* is still around. It's now called *Analog Science Fiction and Fact*—a name John Campbell himself chose to emphasize the seriousness of the science ideas the medium presented. *See* BOOKER & THOMAS, *supra* note 2, at 322; Trevor Quachri, *History of Analog Science Fiction and Fact*, ANALOG: SCI. FICTION & FACT, https://www.analogsf.com/about-analog/history (last visited Apr. 3, 2021); Nathan Vernon Madison, *Astounding Stories*, PULP MAG. PROJECT, https://www.pulpmags.org/content/info/astounding-stories.html (last visited Apr. 3, 2021).

60. EDGAR RICE BURROUGHS, A PRINCESS OF MARS (1912); *see also* WOLFE, *supra* note 2, at 44; GOLDER ET AL., *supra* note 2, at 54–57, 72–76. One of us was obsessed with John Carter in high school, and we do not mean to denigrate the series.

61. *See* WADE, *supra* note 2, at 179–99.

62. WOLFE, *supra* note 2, at 51; *id.* at 50–52; *see also* BOOKER & THOMAS, *supra* note 2, at 322, 7–9; GOLDER ET AL., *supra* note 2, at 75–76.

63. WADE, *supra* note 2, at 128.

64. Heinlein's first story, "Life-Line" was published in *Astounding* in 1939. BOOKER & THOMAS, *supra* note 2, at 155.

65. BOOKER & THOMAS, *supra* note 2, at 139–40 (noting that many of Asimov's works, like some of the *I, Robot* stories, and the *Foundation* series, originally appeared in *Astounding*).

66. GOLDER ET AL., *supra* note 2, at 97–98.

University. Asimov eventually became an Associate Professor of Biochemistry at Boston University School of Medicine.[67]

Along with the influence of editors like Campbell and science-heavy writers like Asimov and Clarke, we can't discount the pressure exerted by the Hugo[68] and Nebula[69] awards. These famous science fiction awards are selected annually by the World Science Fiction Society and the Science Fiction and Fantasy Writers Association, respectively. Technically, the awards can go to pure fantasy novels (that is, with elves, dragons, and the like).[70] However, science fiction is given serious primacy. For example, on the short list of novels that have won both the Hugo and Nebula awards, approximately four works that would not likely be classified as science fiction according to contemporary/technical standards.[71] According to the full lists of Hugo and Nebula winners, there are far fewer straight fantasy novels than science fiction novels.[72]

IV. SCIENCE FICTION AND INNOVATION POLICY

Science fiction's enablement standard is enforced by the fans and driven at least in part by the copyright-supplemented market rewards achieved by the most successful authors. But what does it mean that science

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67. WADE, *supra* note 2, at 117.

68. The Hugo Award for science fiction achievement was named for Hugo Gernsback, founder of *Amazing Stories*, mentioned above. The Hugo Award started in 1954 and is determined by the members of the World Science Fiction Society. WORLD SCI. FICTION SOC'Y, http://www.wsfs.org (last visited Apr. 3, 2021); *A Short History of the Hugo Awards Process*, HUGO AWARDS, http://www.thehugoawards.org/hugo-history/a-short-history-of-the-hugo-awards-process (last visited Apr. 3, 2021).

69. The Nebula Award was founded in 1965. The Nebulas are determined by the members of Science Fiction and Fantasy Writers Association. *About the Nebulas*, NEBULA AWARDS, https://nebulas.sfwa.org/about-the-nebulas (last visited Apr. 3, 2021).

70. The Hugo rules state (grudgingly?) that "[w]hile the World Science Fiction Society sponsors the Hugos, they are not limited to sf. Works of fantasy or horror are eligible if the members of the Worldcon think they are eligible." *Hugo Award Categories*, HUGO AWARDS, http://www.thehugoawards.org/hugo-categories (last visited Apr. 3, 2021). Similarly, "[a]ll works first published in English, in the United States, during the calendar year, in the genres of science fiction, fantasy, or a related fiction genre are eligible for the Nebula Awards® in their respective categories." *Nebula Rules*, NEBULA AWARDS, https://nebulas.sfwa.org/about-the-nebulas/nebula-rules (last visited Apr. 3, 2021).

71. For a list of dual winners, see *List of Joint Winners of the Hugo and Nebula Awards*, WIKIPEDIA, https://en.wikipedia.org/wiki /List_of_joint_winners_of_the_Hugo_and_Nebula_awards (Apr. 2, 2021, 2:48 PM). The outliers are Lois Bujold's *Paladin of Souls*, Jo Walton's *Among Others*, Neil Gaimon's *American Gods*, and N. K. Jemison's *The Stone Sky*—though the last three are of somewhat ambiguous categorization.

72. *See Hugo Award for Best Novel*, WIKIPEDIA, https://en.wikipedia.org/wiki /Hugo_Award_for_Best_Novel (Mar. 28, 2021, 11:52 PM); Nebula Award for Best Novel, WIKIPEDIA, https://en.wikipedia.org/wiki/Nebula_Award_for_Best_Novel (Mar. 28, 2021, 11:58 PM).

fiction is enabled? Why does this matter? In this final part of the Article, we propose that the disclosures in works of science fiction—because they are to some degree enabled—serve a similar purpose to the disclosures in real patents.

The main justification for patent law's enablement requirement is that disclosure of information about inventions "stimulates productivity[,]" by supplying information that scientists and researchers can use, both during the patent's lifetime and after the patent expires.[73] The inventor is encouraged to give away information that "can be useful for other technologists" and serve "as academic inspiration to develop further related inventions."[74]

Science fiction writers, perhaps not surprisingly, often insist science fiction can perform valuable exploratory work for real science. Clarke, for example, believed adamantly in the value of science fiction for science.[75] If Clarke was still alive, he would likely agree with our thesis that science fiction can promote innovation. But is there any evidence for the proposition? We think there is. It turns out that many inventions that were originally introduced in science fiction also end up in the patent record.

The U.S. Patent & Trademark Office proudly features several patented inventions on its website that it claims began as science fiction. For example, the automatic door, which was first mentioned in H.G. Wells' *The Sleeper Wakes* (1899), was patented in 1967 and 1969, respectively.[76] Many more such examples can be uncovered on the internet (including on the aptly-titled website "Technovelgy: where science fiction meets fiction™"[77]). We focus here on very specific examples for which we were able to find evidence of a causal link between a work of science fiction and one or more subsequent patents. In other words, we looked for proof that some later inventor was indeed inspired by a specific work of science fiction.[78]

One example we came across many times is Jules Verne's moon cannon. In his book, *From the Earth to the Moon* (1865), Verne

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73. Fromer, *supra* note 6, at 548–49.

74. *Id.* at 550.

75. *History of the BIS*, BRITISH INTERPLANETARY SOC'Y, https://www.bis-space.com/bis-history (last visited Apr. 16, 2021).

76. Messina Smith, *Science Fiction to Science Fact*, USPTO, https://www.uspto.gov/learning-and-resources/newsletter/inventors-eye/science-fiction-science-fact (July 18, 2016, 1:24 PM) (citing U.S. Patent No. 3,327,428 and U.S. Patent No. 3,464,159); *see also 6 Pioneering Inventions Inspired by Science Fiction*, BOOKISH ELF, https://www.bookishelf.com/science-fiction-inspired-inventions (last visited Apr. 3, 2021); Alison Oswald, *Hugo Gernsback's Unconventional Inventions*, LEMELSON CENER (July 31, 2018), https://invention.si.edu/hugo-gernsbacks-unconventional-inventions.

77. Yes, they trademarked it. TECHNOVELGY, http://www.technovelgy.com (last visited Apr. 3, 2021).

78. This is not to say there aren't uncounted other examples where no proof can be found, because we cannot go back and peer into the inventor's mind and see what they read and what they remembered.

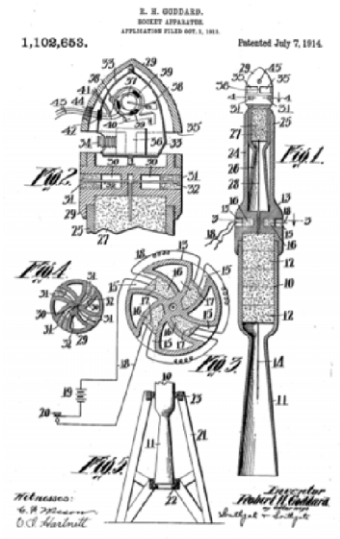
meticulously depicted a cannon, called "the Columbiad," that could launch a manned capsule to the Moon. Verne described a projectile with an aluminum shell in the shape of an oversized bullet, which would be shot from a 900-foot cannon. Verne even included actual mathematical calculations.[79]

Obviously, Verne's cannon is not what Neil Armstrong arrived in. The space craft used in the Apollo missions to the Moon was very different from the cannon, because the space craft had to deal with the physics of reality. Yet Verne's cannon provided inspiration for a scientist named Robert Goddard—widely credited as the real-life inventor of the liquid-fueled rockets that made space flight possible. Goddard first launched his liquid fuel rocket in 1926 on a small Massachusetts farm. Goddard had built on the work of Romanian physicist Hermann Oberth, who in 1920s Germany generated national interest in rocketry and space travel. And Oberth, in turn, had built on Jules Verne. "As a young boy, [Oberth] calculated the acceleration of an object under the Earth's gravitational pull and found his calculation for escape velocity—11.2 kilometers per second—to be in agreement with his hero, Jules Verne."[80]

79. A recent study suggests Verne came pretty close to what would be required to shoot the cannon. PAUL BILLIG, "FROM THE EARTH TO THE MOON": WHAT WOULD IT TAKE TO BUILD JULES VERNE'S SPACE CANNON?, https://www.csuohio.edu/sites/default/files/79-2015.pdf. The problem would have been that the human inside would not have survived the massive acceleration! *See* GOLDER ET AL., *supra* note 2, at 39.

80. Richard Wallace, *Tsiolkovsky, Goddard and Oberth—Three Fathers of Rocketry*, MUSEUM OF FLIGHT (Sept. 13, 2007), https://web.archive.org/web/20130514103011/http://www.museumofflight.org/education/tsiolkovsky-goddard-and-oberth-three-fathers-rocketry.

Goddard's landmark patent, obtained in 1914, is shown below.



U.S. PATENT NO.
1,103,653 (JULY 7, 1914), ROBBERT H. GODDARD

This trajectory—from science fiction, to scientist, to scientist, to reality—illustrates how scientists can be influenced by science fiction. Science fiction authors like Wells may not have gotten it exactly right in their works. Ironically, as we discuss below, if these authors had accurately described the science, this could have actually *preempted* future patents for the same invention. But the science fiction authors got it right enough to stimulate someone else to think about and eventually tackle the real science. The results eventually ended up in the patent record. The Appendix provides a few additional examples where we've located a demonstrable causal link between a specific work of science fiction and a specific patented invention.

Of course, it's important not to read science fiction's impact on these patents too literally. For example, while it's possible the submarine in Verne's *Twenty Thousand Leagues Under the Seas* (1870) or the "communicators" in *Star Trek: The Original Series* (1966-69) spurred a race to obtain patents for these devices, it seems equally plausible that these inventions were simply "in the air." [81]

Yet we still suspect science fiction inspires scientists to innovate in more substantial ways. In patent law, novelty alone isn't enough—inventions also cannot be "obvious" to persons of ordinary skill in the art.

81. Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 490 (1974) ("If something is to be discovered at all very likely it will be discovered by more than one person.").

This means scientists need to be primed to explore hypotheses that their peers rebuff.[82] There are plentiful examples of scientists prematurely announcing impossibility. In 1896, only eight years before the Wright Brothers flew the first airplane, Lord Kelvin, the president of the elite Royal Society of England famously called the feat of flight impossible.[83] In 1934, Albert Einstein—whose own relativity theory laid the foundation for nuclear power—deemed the notion of humans harnessing atomic energy a "near impossibility." Einstein of course was proven wrong, and in a most horrific fashion, when in the following decade the United States. dropped atomic bombs on Hiroshima and Nagasaki.[84]

When even the most brilliant scientists can't see outside the box of the obvious, science fiction can help by stimulating the imagination and expanding mental boundaries. People born in the early twentieth century would likely have had trouble envisioning the feats humans would accomplish through, for instance, artificial intelligence. But their children and grandchildren would grow up reading about Isaac Asimov's robots.[85] These future generations would go on to create such technology and change our very way of life. It's certainly possible that the art simulated the imagination required for the science.

V. TECHNICALITIES

Before we close, it's important to address a crucial objection. A patent theorist might reasonably point out that highly predictive science fiction, along with stimulating "nonobvious" thinking, might actually render more inventions ineligible for patents, discouraging the work of real-world inventors.

As one of us has discussed, works of science fiction can constitute prior art that preempts (renders invalid) later patents.[86] On this view, the more "enabled" science fiction is, the more likely it is to render a later patent invalid for lack of novelty or nonobviousness. Like a snake eating its own tail, science fiction might (at first glance) preempt patents on "a tremendous

82. 35 U.S.C. § 103; *see also* United States v. Adams, 383 U.S. 39, 44 (1966) (upholding inventor's patent on "wet battery" against obviousness challenge in part because the military had found inventor's claims to be "unusually large" and "far from convincing").

83. Kitty Hawk, *Remarks by NASA Deputy Administrator Gregory*, NASA (Dec. 17, 2003), https://www.nasa.gov/audience/formedia/speeches/fg_kitty_hawk_12.17.03.html; *see also* Deepak Mehta, *Everything Is Impossible*, MEDIUM: HYGGELIG (June 27, 2020), https://medium.com/hyggelig/everything-is-impossible-5ace789ffdcb.

84. *Atom Energy Hope Is Spiked by Einstein*, PITT. POST-GAZETTE, Dec. 29, 1934, at 13.

85. ISAAC ASIMOV, I, ROBOT (1950).

86. *See* Daniel Harris Brean, *Keeping Time Machines and Teleporters in the Public Domain, Fiction as Prior Art for Patent Examination*, U. PITT. J. TECH. L. & POL'Y, no. 7, Fall 2006/Spring 2007, at 1.

number of valuable inventions" from the ray gun to the flying car, and "discourage real world inventors from making them if they are unable to obtain patents."[87]

This objection assumes, however, that the inventions posited in science fiction are sufficiently enabled to meet patent law's higher standard of actual or constructive reduction to practice. Similar to a patent's disclosures, patent prior art needs to be sufficiently enabled, or it doesn't count.[88] As already explained, this is unlikely to be the case for most science fiction.

Take the following example: in the famous film, *Back to the Future* (1985), mad scientist Doctor ("Doc") Emmett Brown invents a time machine. According to Doc, time travel is made possible by his invention of the "flux capacitor," a mysterious device depicted in the movie as just a box with tubes, wires, and lights. The flux capacitor is installed into the dashboard of a DMC DeLorean car, which Marty McFly and Doc use to drive into the past or the future.

The inner workings of the fictional flux capacitor are not disclosed in any meaningful way in the film—certainly not in enough detail to actually enable the creation of a time machine. Being told a flux capacitor uses plutonium to generate "1.21 gigawatts of power" and triggers the jump in time when the DeLorean reaches the speed of "88 miles per hour" is not enough for the PHOSITA to build a time machine. Therefore, a real flux capacitor would still be both novel and nonobvious over the scant disclosure in the movie. At worst, all the film might obviate is the particular size, color, and shape of a flux capacitor, or the idea of placing a flux capacitor (once it exists) into a DeLorean car.

In fact, in one rare case in which the patent office cited a work of science fiction as prior art, the patent was ultimately granted anyway. Acclaimed science fiction author Robert Heinlein's novel, *Stranger in the Strange Land* (1961) provided details for a then-hypothetical "waterbed." A patent examiner cited the book as prior art against a later patent for a real waterbed, filed by the inventor Charles Hall. Hall was able to get a patent on his waterbed anyway, by adding additional technical details to his application in a continuation filing. Hall enforced the patent in 1991, earning him a $4.8 million judgment for infringement.[89]

In sum, the social benefits of enabled science fiction for innovation and patenting outweigh the slight possibility of preemption.

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87. *See id.* at 12.

88. Prior art relied on to show *obviousness* (as opposed to a lack of novelty) need not be strictly enabled in the patent law sense, but it still must include adequate technical information to support a "reasonable expectation of success." *Id.* at 12; *see also* Sean B. Seymore, *Rethinking Novelty in Patent Law*, 60 DUKE L.J. 919, 954 (2011).

89. Brean, *supra* note 86, at 3–4. Hall's claims were still quite broad. *See* U.S. Patent No. 3,585,356 (issued June 15, 1971); *Waterbed*, WIKIPEDIA, https://en.wikipedia.org/wiki/Waterbed (Mar. 23, 2021, 12:53 PM).

CONCLUSION

The patent system is sometimes critiqued for admitting inventions that don't work or that aren't disclosed in enough detail to let others practice them. Inventions that aren't "enabled" under the standards of 35 U.S.C. § 112 can cleverly be derided as mere "science fiction."

However, this Article has shown that, ironically, the literary genre of science fiction has its own uniquely demanding standard for scientific plausibility that in many ways resembles patent law's enablement requirement. To be worthy of the moniker "science fiction," a work needs to be sufficiently grounded in real scientific fact and theory. It cannot ignore or avoid real science, without being accused of bad writing or, worse, being denigrated as mere fantasy.

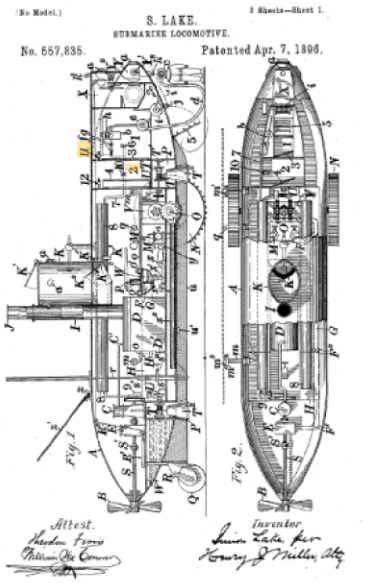
Recognizing science fiction as having an enablement standard has two implications. First, it helps explain and resolve long-running debates between fans within the science fiction genre. When fans struggle to define science fiction and distinguish it from mere fantasy, this is a symptom of readers' underlying demand for scientific plausibility. The categorical question—is it science fiction or is it fantasy?—is often just a species of the broader question of enablement—is the technology depicted with sufficient accuracy and grounding in science reality?

Second, conceptualizing science fiction as having an enablement requirement brings the social role of science fiction to light. The technical disclosures revealed in enabled science fiction can serve an important disclosure function that is similar to patent law's. By stimulating new and nonobvious ideas for future technologies, science fiction can influence the direction of science. We find support for this thesis in the patent record itself, where patents for inventions like the submarine and the cellphone drew inspiration from works of science fiction.

This is not to say works of pure fantasy don't have value; of course they do. But they have value in the copyright world of creativity and original authorship, not the patent law world of science and technology development. Non-enabled science fiction entertains in the way ordinary novels do, but it doesn't teach in the way patents do. It does not serve the same function within innovation policy that we argue enabled science fiction can.

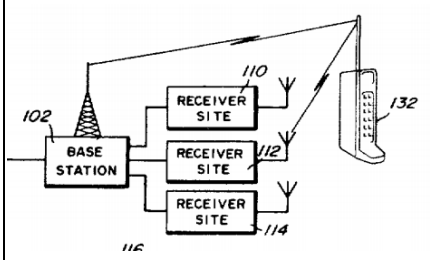
Appendix

THE SUBMARINE[90]

Science Fiction Source	Patented Invention
Jules Verne, *Twenty Thousand Leagues Under the Seas* (1870)	Simon Lake, U.S. Patent No. 557,835 (1896) "Submarine Locomotive"
	
"It is an elongated cylinder with conical ends. It is very like a cigar in shape. . . . If we want to sink 3,000 feet, . . . I have supplementary reservoirs capable of holding a hundred tons [of water]. . . . When I wish to rise to the level of the sea, I only let off the water . . ."	"When it is desired to submerge the car, its water-tanks . . . are filled to the necessary extent . . . . Such weights being deposited upon the bottom, the valves M" are opened and the tanks filled sufficiently to nearly destroy the buoyancy of the car . . . and thereby draw the car downward to the bottom."

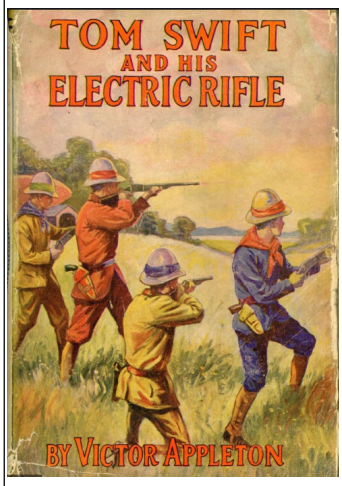
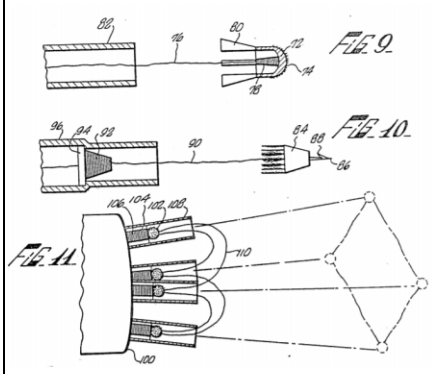
90. Simon Lake, *Biographical Sketch*, SIMON LAKE, http://www.simonlake.com/html/simon_lake.html [https://web.archive.org/web/20070706082323/http://www.simonlake.com/html/simon_lake.html] ("Inspired by Jules Verne . . . Simon Lake designed and submitted plans to the Navy in 1892. In 1894 he built his first experimental submarine, 'The Argonaut, Jr.,' that was successfully demonstrated in at Atlantic Highlands, New Jersey by Sandy Hook. The success . . . subsequently drew a congratulatory telegram from Jules Verne.").

THE CELL PHONE[91]

Science Fiction Source	**Patented Invention**
Star Trek: The Original Series (NBC, 1966–69) "Communicator"  "[A] member of Starfleet spoke directly into the device to give commands and speak with other personnel. Once it was flipped open, it locked onto the originating ship's communications system. https://memory-alpha.fandom.com/wiki/Communicator (citations omitted)	Martin Cooper et al., U.S. Patent No. 3,906,166 (1975), "Radio Telephone System"  "In operation, outgoing messages are transmitted from a base station, such as the base station 102, to a portable unit, such as the unit 132. Incoming messages from the portable unit 132 are received by a receiver site such as the receiver site 112 and routed to the base station 102 and the central control center 130."

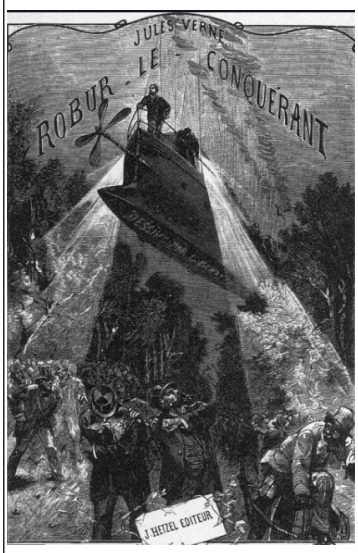
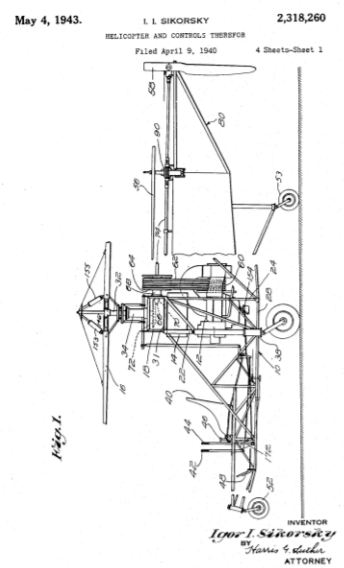
91. Michael Venables, *Why Captain Kirk's Call Sparked a Future Tech Revolution*, FORBES (Apr. 3, 2013, 11:49 PM), https://www.forbes.com/sites/michaelvenables/2013/04/03/captain-kirks-call-to-spock/#7a8ed7dda92c (describing Cooper's inspiration).

THE TASER[92]

Science Fiction Source	**Patented Invention**
Victor Appleton, *Tom Swift and His Electric Rifle* (1911)  "The electric weapon was not unlike an ordinary heavy rifle in appearance . . . "It works by electricity," explained Tom. "That is, the force comes from a powerful current of stored electricity. . . . There are no bullets used. . . . It's just as if you concentrated a charge of electricity of five thousand volts into a small globule the size of a bullet. That flies through space, strikes the object aimed at and—well, we'll see what it does in a minute."	John H. Cover, U.S. Patent No. 4,253,132 (1981), "Power supply for weapon for immobilization and capture"  "[Fig. 10 shows a] projectile 84 which is a dart such as is used with compressed air or compressed CO2 weapons. As shown, the dart 84 may include a point 86 with barb member 88 to enable a slight penetration of the target through clothing and the barb 88 enables the dart to become implanted and to be held in place. A conductive filament extends back to a bobbin 92 which is mounted in a 'cartridge' 94 which is electrically coupled to the power supply."

92. TASER is an acronym for "Thomas A Swift and His Electric Rifle." *See* William C. Plouffe, *Taser*, BRITANNICA, https://www.britannica.com/topic/TASER (last visited Apr. 3, 2021).

THE HELICOPTER[93]

Science Fiction Source	**Patented Invention**
Jules Verne, *Robur the Conqueror* (aka *Clipper of the Clouds*) (1886)	Igor Sikorsky, U.S. Patent No. 2,318,260 (1943), "Helicopter and controls therefor"
	
"Above the deck rose thirty-seven vertical axes, fifteen along each side, and seven, more elevated, in the centre. The Albatross might be called a clipper with thirty-seven masts. But these masts instead of sails bore each two horizontal screws, not very large in spread or diameter, but driven at prodigious speed. Each of these axes had its movement independent of the rest, and each alternate one spun round in a different direction from the others, so as to avoid any tendency to gyration. Hence the screws as they rose on the vertical column of air retained their equilibrium by their horizontal resistance."	"An object of the invention . . . resides in the provision of a direct-lift aircraft of the character referred to having a plurality of rotary aerodynamic instrumentalities and means for controlling said instrumentalities to provide positional and directional control of said aircraft in various directions in space. A still further object resides in the provision in a direct-lift aircraft of the character indicated having one or more engines, and a main lifting rotor, of a pair of auxiliary rotors for providing lateral and pitching control and providing additional lift for said aircraft and a third auxiliary rotor for balancing torque reactions imposed on said aircraft and providing directional control thereof."

93. "The inspiration of his father to build a helicopter, Mr. Sikorsky said, was a Jules Verne book he had read when he was 10 or 11. 'It was called "Clipper of the Clouds," and in it Jules Verne had invented a helicopter-like vehicle. My father referred to it often. He said it was "imprinted in my memory." And he often quoted something else from Jules Verne. "Anything that one man can imagine, another man can make real." ' " Bill Ryan, *What Verne Imagined, Sikorsky Made Fly*, N.Y. TIMES (May 7, 1995), https://www.nytimes.com/1995/05/07/nyregion/what-verne-imagined-sikorsky-made-fly.html; *Igor I. Sikorsky (1889-1972)*, NAT'L SCI. FOUND., https://www.nsf.gov/news/special_reports/medalofscience50/sikorsky.jsp (last visited Apr. 4, 2021).