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Science and Literature: An Exploration Through a Shared Language

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Abstract: Science and fiction are often deemed opposing forces, incompatible "languages" and "cultures." Science is the realm of fact and reality while fiction is mere fantasy, useless to the rational mind. Yet, the works of Jules Verne, Mary Shelley, Aldous Huxley, H.G. Wells, and numerous others continue to stand the test of time even as scientific knowledge and understanding broaden. Science and fiction, science and literature, are so often thought of as separate, irreconcilable entities and yet science fiction enraptures and intrigues. Science fiction is the playground of science. Where science has not yet or cannot dare to go, science fiction leaps forward eagerly. This creative thesis seeks to demonstrate a bridge between science and literature through a collection of original science fiction poems. This exploration is a culmination of research into the relationship between science and literature through scholarship and works of fiction, poetry's relationship to both subjects, and scientific research into artificial intelligence, deep space travel, and time travel. The chapbook produced, *The Silver Dark*, uses science fiction as the thematic backdrop for the demonstration that science and literature can be and are connected through poetry, while also communicating complex scientifically accurate (with only a few artistic liberties) concepts in verse.

Keywords and phrases: science fiction, poetry, science fiction poetry, artificial intelligence, deep space travel, time travel, science and literature

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Personal Statement

My father wrote a poem when I was born and has a book of poetry dedicated to my mother. I have been writing poetry since adolescence and it has always been a powerful expression of my emotions, functioning as a coping mechanism when grief was too much to bear. As a STEM major, there is often little time or reason to explore artistic or creative pursuits beyond the realm of science. Emotion and logic are often portrayed as contrary to one another and with science so closely tied to rational and logical thought, it has never seemed that there was any place for emotion in science. This creative thesis is heavily influenced by my personal history with poetry and science and my profound love for both. I begin this thesis, perhaps a bit unorthodoxically, with a personal statement because *The Silver Dark* is a work of art, a work of poetry while also heavily informed by scientific and other research.

Literature Review

The supposed boundary between science and literature is longstanding and probably best articulated by C.P. Snow in "The Two Cultures and the Scientific Revolution," wherein literature and science compose the "two cultures." They are not merely two cultures, different in their customs, but at odds with one another, hostile even (p. 7). In every way they differ and fail to find common ground, fail to communicate yet the fusion, the unity of these disciplines can and should be a place of creative progress (p. 17). Yet this divide, though seemingly timeless, is much more modern than not. There was no distinction between literature and science during the Middle Ages and the literary works of this period reflect this, such as the

works of Chaucer and Dante (Cartwright p. 116). The Scientific Revolution, the beginning of this divide, saw Galileo fight his contemporaries and the church on the nature of our solar system. The famous scientist employed rhetoric, the realm of the philosopher and that of literature, to sway his audience, to make his case (Battistini p. 38).

The divide between science and literature is both very real and transparent. This contradiction is best expressed by the field of science and literature. John Cartwright in his "Science and Literature: Towards a Conceptual Framework" proposes categories in which the interactions between science and literature can be placed which include: Science as a source of images, metaphors or explanatory devices, didactic verse – poems of science, the Romantic dismissal: science as cold and inhuman, scientific irresponsibility: Faust and Frankenstein figures, literature or science claiming ontological primacy (p. 117). There are eight categories but these five are of particular interest in regards to my purpose. Literature or science claiming ontological primacy is expected given the so-called divide between the studies but refers to one providing a framework or a better understanding of the other, what science can provide to literature and what literature can provide to science (p. 133). Science as a source of images, metaphors or explanatory devices is quite an obvious interaction between science and literature and yet often overlooked. This of course is to the exclusion of science fiction at the moment given that of course science fiction would involve images and the like from science. Yet even works unrelated to science fiction employ science, such as the presence of astrology in Chaucer's *The Canterbury Tales,* where the Wife of Bath credits her

sexual energy to her "constellation" (p. 118). The Romantic dismissal is probably the most obvious and easily identifiable interaction between science and literature and reflects one of the defining characteristics Snow discussed about his "two cultures," making science cold and calculating, rigid and rational where literature is everything but, teeming with life and transcendental. The Romantic dismissal and scientific irresponsibility are intertwined. Science being unsympathetic and inhuman is its source of irresponsibility, its lack of value for life over progress. *Frankenstein* exemplifies these characteristics. Victor Frankenstein's weakness of will, disregard for the ramifications of his creation, and ultimate selfishness makes him not the quintessential "evil" scientist, but the quintessential man corrupted and consumed by the worst of science (p. 132). Didactic verse – poems of science is the key category for my research. It cannot be forgotten that the beginning of scientific study in Western Civilization, the inquiries of the Greeks, was written in verse. Poetry was the language of the philosopher, the scientist, as they were one in the same (p. 127). More importantly, scientific language can lend itself to poetry. The poet Constance Naden utilized the language of science in her "Evolutional Erotics," a collection of four poems to create metaphors exploring courtship (Tange p. 201). In fact, the language of poetry already exists in science. Metaphors are characteristic of poetry, often described as or seemingly used as "flowery" language. It is a tool for imagery, but metaphor is not just a poetic device. Metaphors can be thought of as analogies and in the case of science, this is very useful. In science, analogies are used to bridge the gaps in language (Børtnes p. 250). Words and phrases that we associate with science are not purely jargon. They

have been taken and adapted. First they are a general, loose fit for something we do not understand. A metaphor to confer understanding that over time is adjusted and cut down until the precision bestowed by furthered study is obtained (Børtnes p. 257). Models are also a form of metaphor. The Bohr model of the atom was based on the solar system and thus a metaphor (Battistini p. 37). The Bohr model is a vital component of physics and understanding atomic theory and without poetic language, this knowledge would be nearly incomprehensible. Science then becomes an interpretation of reality and its characteristic language the tool for conceptualizing discovery and breakthroughs. Though with the connotation of leaning more toward fantasy and the imaginary, poetry can be considered an interpretation of reality (Saunders p. 16). Robert Shaw, a physicist who helped pave the way for chaos theory (Saunders p. 16), said "You don't see something until you have the right metaphor to let you perceive it" (quoted in Morris p. 162). This revelatory nature of science easily applies to poetry. As stated previously, metaphor and analogy are often employed by science and poetry to this end. Metaphor is not the only similarity between the languages of science and poetry however. Poetry, so often reviled for its obsession with beauty and "flowery" language, is not alone in its appreciation for aesthetics. Science is considered a universal language, mainly, because of its basis in mathematics, the true universal language in that mathematics can be understood regardless of one's native tongue. Yet it is not uncommon for mathematics to be described as beautiful or perfect. In science, Occam's Razor is a principle in which, at its most basic definition, the simplest answer or explanation is most often the correct one. Other definitions include

references to “beauty” and “elegance” (in simplicity), all relating more to aesthetics than cold, hard truth as many would expect (Saunders p. 17). The principle’s emphasis on simplicity is also applicable to poetry, where meter, rhyme, syllables and other factors must be considered to produce a poem, as Lesley Saunder says, that is “particular, precise and economical” (p. 17), which sounds suspiciously like what is expected of scientific works and ideas.

The Science

Speaking of scientific works and ideas, the poems in *The Silver Dark* were created with the previously stated research in mind and in fact the flagship Conversations poems were each inspired by and thematically represent this research, but the science in the science fiction poems produced are not mere fantasy. Scientific research was conducted into the topics explored.

Artificial Intelligence

Alan Turing, considered the father of artificial intelligence, Alonzo Church, and Kurt Gödel demonstrated that mathematics was not complete, consistent, nor decidable. Church and Gödel accomplished this using only mathematical calculations but Turing devised a theoretical universal computing machine, which represented a mathematician doing the calculations as Church and Gödel had. This model based on human calculation and reasoning set the framework for the development of artificial intelligence, the question of to what extent could computers perform human-level and more recently, super-human-level reasoning (Muggleton p. 3). This was in the 1930s. Turing’s “The Imitation Game,” which

has become known as the Turing Test and is used as the bench mark for "true" artificial intelligence, came in 1950. The test involves a human "interrogator" who questions a hidden computer and person. The interrogator must try and identify who is who. This test's purpose is to determine if a machine can think (Muggleton p. 4). "Passing" the Turing Test would indicate a machine that is mistaken as human. Artificial intelligence today involves speech transcription and translation, spellcheck, facial recognition (Cristianini p. 38), and other technologies that are now commonplace and often taken for granted. Siri is clearly recognizable AI but still a far step away from the models in *I, Robot*, though robots have permeated human society, present in essentially every industry. Currently, the question is not so much as if there will be artificial intelligence equal or superior to human reasoning, but when, which has led to much discussion regarding robot ethics. Robots and AI are not synonymous but for the purposes of this project and the research presented, robots refer to humanoid machines capable of human or superhuman reasoning. Since *Frankenstein*, the price of scientific discovery has been questioned and examined and the relevance of such discussion has only been reinforced by the development of nuclear and biological weapons of mass destruction. The ethics of scientific progress has become just as vital to science as progress itself and is often the subject of science fiction exploration. Stephen Hawking even signed an open letter in early 2016 that "argued for research and regulatory and ethical frameworks to ensure that AI benefits humanity" (Campbell). Threats from AI are not limited to the dystopian apocalyptic variety, but also include economic disruption, mass unemployment, mass surveillance (to

an even greater degree than it is currently), and AI dependence that could cripple industries (Campbell). The most notable threat of the dystopian kind are actually quite close to becoming reality: lethal autonomous weapons systems. As with most of the "future" artificial intelligence technologies a la Isaac Asimov and *Terminator*, an intersection between AI and robotics is required. This intersection is already here for weaponized drones. Lethal autonomous weapons systems involve enemy target engagement without human involvement, which differs greatly from current human piloted drones and missiles. Autonomous weapons raise several concerns ranging from potential violations of the Geneva Convention to making it easier for countries to go to war when the assumed risk is greatly lowered. The fundamental difference between human piloted and autonomous weaponry is the ability to discern between combatants and noncombatants (Russel pp. 415-416). These systems lack the proper sensory systems for discerning between civilians and combatants and simple common sense and environmental awareness necessary for making decisions in a battlefield environment. There is also no easily programmable definition of a civilian. In fact, the laws governing war only define civilian as opposed to a combatant (Sharkey pp. 788-789). Creating a system for computerized differentiation potentially could result in immeasurable human loss of life due to the lack of proper distinction. Robotic ethics discussion is not limited to militarized drones, but also involves the theoretical development of humanoid, sentient robots, the usual scourge of futuristic dystopias. In addition, robotic ethics is not limited to the questions of their development, but involves endowing robots with ethics, developing a robotic code of ethics for their

interactions with humans and each other. Such discussion is not important just from a worst-case catastrophe perspective, but also from a practical perspective. A theoretical situation proposed by Michael and Susan Leigh Anderson plays out like this: a robot assistant monitors assisted-living facility residents and determines who is allowed to control the television remote in the common space. One resident is chosen over another because the other resident had their pick previously (Anderson). This is a simple, seemingly nonconsequential decision by the robot but it is in fact an ethical choice based on the idea of fairness. Robots are programmable beings but for practicality's sake, a robot could not be programmed with a response for every possible scenario it may encounter. The most famous example of a programmed ethical code is Isaac Asimov's Three Laws of Robotics:

1. A robot may not injure a human being,
   or, through inaction, allow a human being
   to come to harm.

2. A robot must obey the orders given it
   by human beings except where such orders
   would conflict with the First Law.

3. A robot must protect its own existence
   as long as such protection does not conflict
   with the First or Second Law.

However, Asimov poked holes in his own laws in the later story, *The Bicentennial Man* where a robot pulls himself apart at the command of human tormenters (Anderson). The Andersons' solution was machine learning which utilized an algorithm that developed a collection of cases with decisions that were determined

ethical by human standards. An ethical principle is then produced from inductive reasoning that is then programmed into a robot. Their healthcare robot was programmed to violate human patient autonomy when not doing so would cause or fail to prevent harm or would violate the robot's duty of aiding in patient welfare (Anderson). Robot-to-human interaction is of course of major interest to human researchers but robot to robot interactions must be considered also. Victor Frankenstein is reviled for not only his unholy creation, but also his treatment of Creature. The parallels between AI on Frankenstein's creation are difficult to ignore and though the definition of life is brought into question, considerations regarding robotic welfare must be made. AIonAI, as coined by Hutan Ashrafian in "AIonAI: A Humanitarian Law of Artificial Intelligence and Robotics", interaction would also ultimately impact interactions with humans. AI, designed by humans, that harm other AI, reflect poorly on their human creators, just as encouraging dogfighting is considered inhumane. Regardless of AI intelligence and consciousness in comparison to animals, they would serve a similar role in society in that humans are responsible for them (Ashrafian pp. 33-34). Rational and sentient AI would be vulnerable to the emotional trauma and stress humans can suffer, at the hands of their human creators or other AI. Ashrafian proposes, as a solution, a law protecting AI rights in the style of the Universal Declaration of Human Rights (p. 36). Such a law would not only police AIonAI interactions, but would also guide human development of AI. An equivalent law would also reinforce the principles that govern human society (p. 39).

Deep Space Travel

Three years before the successful Apollo 11 moon landing, Max Born, one of the founders of modern physics and a Nobel Prize recipient, said “I am unable to see any blessing in space travel as it is pursued today in the United States, the Soviet Union, and in other countries” (Blessings, p. 14). Of course, the American moon landing only invigorated the global space race and humanity’s fascination with space has only grown exponentially with Mars the next leaping point. However, landing on the moon and on Mars are vastly different endeavors. A trip to Mars would take months as opposed to the days the moon landing took, which brings the future of deep space travel, travel beyond our solar system, into doubt. Exoplanets have been identified, seven recently orbiting the same star (NASA). Reaching such exoplanets would take years. Stasis through therapeutic hypothermia has been considered for missions to Mars to keep astronauts comfortable and to lower the costs of such a mission (Brumfield). Psychological and other health factors must also be considered for missions of extraordinary length. Deep space travel and the microgravity environment of space vessels impacts the immune system, from the rate of wound healing to white blood cells production. Bacteria grow faster in microgravity and display greater virulence. The vessels used for extended space flight become containers for disease since bacteria and other particulates remain airborne due to microgravity (Mermer). Looking to exoplanets for permanent residence of humanity requires social and cultural considerations also. Under the current and potential restraints to interstellar travel, which is bound by Einsteinian physics and the incapability of current technologies to reach near lightspeed,

journeys into deep space would be a matter of years. At the turn of the twentieth century, when Einstein revolutionized physics, conceptualizing deep space flight changed. So the idea of the generation starship came to be, first appearing in the work of Konstantin Tsiolkovsky, a Russian scientist who helped develop spaceflight. His 1928 paper, *The Future of Earth and Mankind*, depicts space arks where humans lived over generations until descendants finish the voyage (Caroti, p. 430). This concept has been explored numerous times throughout the decades since its inception, in science fiction. The social structure and governance of such a ship has been of particular interest. The attitudes of those on the voyage and the social structure of the ship would need to be carefully crafted to weather the unique stress and situations created by deep space travel (Caroti p. 435). Many stories, such as *The Voyage that Lasted 600 Years* written by Don Wilcox and *Universe* and *Common Sense* by Robert Heinlein depict societies that break down over time due to a lack of connection to the past and societal catastrophes such as overpopulation and mutiny (Caroti pp. 431-433). Caroti suggests a sort of technocracy as the model government for generational space flight, to ensure the preservation of knowledge necessary for continued survival, an environment that encourages a unique cultural identity tailored to the scientific and incredible endeavor each person is a part of on such a ship (pp. 436-437). Again, the social ramifications and ethical considerations of scientific advancement are just as important to consider as the technology and knowledge necessary for such advancement. Despite the limitations of spacetime and Einsteinian physics, research has been conducted into the kind of technology necessary to sustain deep space flight. The radioisotope thermoelectric generator

(RTG), which creates electricity from radioactive decay, is the preferred power source for space craft, particularly over photovoltaic batteries which converts sunlight into electricity and is thus dependent on the Sun (Woo p. 1). The first RTGs were developed during the space race between the United States and the Soviet Union, in the 1950s and 60s. This power source has been used by the United States on 27 missions, including a Navy Transit 4A spacecraft (1961), Pioneer 10, Pioneer 11, Voyager 1, Voyager 2, and the Mars Curiosity rover (Woo p. 1, Witze p. 484). RTGs function via the thermoelectric effect, producing electricity from the heat released during radioactive decay. Plutonium 238 is the radioisotope of choice. NASA's favored modeled as of 2014, the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG), provides 2,000 watts of heat and 110 watts of electricity from 4.8 kg of plutonium dioxide. Plutonium, which has a half-life of 87.7 years, can power such a generator for decades (Witze p. 485).

Time Travel

In 1905, Einstein revolutionized physics with his Special Theory of Relativity, which related space and time. Time is not absolute. It slows at speeds close to the speed of light. An object or person moving at speeds close to the speed of light observes time moving slower than someone at rest or moving slower. This confirms, in a nontraditional sense, that time travel into the future is possible. Arrival at a destination is "ahead of schedule" (Al-Khalili p. 15). Einstein's later General Theory of Relativity demonstrated that gravity can also slow time. Special Relativity also implies that space and time are not separate, but constitute spacetime, which gravity and energy can bend. Theoretically, travel backwards in

time would be possible at speeds greater than the speed of light, but this itself is impossible. However, General Relativity through the bending of spacetime would allow backwards time travel via a "closed time-like curve" (Al-Khalili pp. 15-17). However, many solutions to Einstein's equations have been found that further indicate the possibility of time travel via wormholes, which are all true mathematically but are impossible in practical terms. Wormholes link to specific locations in spacetime, like a folded piece of paper. Such locations would be "lined up" so to speak and connected by a narrow passage. However, wormholes, in theory, are not practical time machines since it takes an infinite amount of time to travel across a wormhole, they are unstable and collapse at slight disturbances (such as a spaceship entering it), could close by itself, and require speeds greater than the speed of light to travel through. Essentially, wormholes do not exist long enough to be useful. Yet, Kip Thorne, Michael Morris, and Ulvi Yurtsever found a solution to Einstein's equations that allowed for "transversible wormholes." The solution of course relied on "an arbitrarily advanced civilization" and "exotic matter," which possesses unusual properties that are contrary to matter as it is currently understood, such as negative energy (Kaku 233-251; Thorne pp. 484-489; Hawking). Quantum theory does allow for negative energy, as demonstrated by an experiment performed by Henrik Casimir in 1948. Potential time machines based on "transversible wormholes" could consist of metal plates capable of ripping spacetime with impossible intense electric fields, which produce a hole in space. Two sets of these plates could be separated by a large distance across the universe with one set travelling close to lightspeed. The second set would observe time

travelling slower. Anyone stepping through the portal created would be travelling in time. Another possibility could be a cylinder created from exotic matter that alters the outside time and space (Kaku p. 249).

The Poems

The Silver Dark is a chapbook comprised of twenty poems. Every poem was influenced and informed by the above compiled research. The majority of the research in the Literature Review section was compiled before any of the poems were written. The rest of the research was conducted, often, in a leapfrog sort of fashion. Research into a particular topic resulted in interesting articles that inspired poem concepts, sometimes whole verses, that then required further research. The Conversations series, which consists of four separate poems, are used to divide the chapbook into sections based on the topics of interest: artificial intelligence, deep space travel, and time travel. The Conversations poems themselves thematically represent the research conducted into the relationships and similarities between science, literature, and poetry. The poems depict a nameless scientist and writer, imprisoned together, arguing over the events that led to their imprisonment. Eventually, the conversation, which occurs over an uncertain period of time, ends with the writer and scientist saying the same thing, reciting adapted lines from *Romeo and Juliet*. The manipulation of the opening chorus to Shakespeare's famous play serves ties the writer and scientist together not only by them speaking in tandem but by equating them with "two houses alike in dignity." In these four poems, science and literature are sat face to face and equated, both speaking in verse, serving as the chapbook's own thesis statement. The three poems that follow

“Conversation I” are also part of a series. Each is titled for the generation spaceship they depict. The ships are named for the governments each one utilizes for their journey, based on the ideas discussed in Caroti’s "Theater Of Memory Against A Background Of Stars: A Generation Starship Concept Between Fiction And Reality." The poems are all Shakespearean sonnets, an effort to bring a sense of antiquity to the futuristic content. The three ships, launching for a new world, are meant to emulate Columbus’ Niña, Pinta, and Santa Maria. As with Columbus’ journey, only one of humanity’s ships is successful. “Haiku I” ponders the common reason for deep space colonization in science fiction, a theme present in other poems in the chapbook. “Starship Humanity” also explores ideas discussed in Caroti’s work, but a different aspect, focusing on the cultural consequences of a generation starship. Humanity abandons a broken Earth for a new world but as the original Earthlings die off, the memory of Earth is reviled and not understood. When the crew finally reach their destination, several generations later, they see no point in settling an empty planet when they have everything they need on their ship, flirting with questions such as what makes us human and how important is Earth to humanity? “Virus” plays out a troubling scenario where the failure of a humanity saving starship is not in the folly of humankind but caused by a lone virus that wipes out the entire population, based on discussion in Mermel’s "Infection Prevention And Control During Prolonged Human Space Travel." “Edge of the Nucleus” is a much more technical poem than the others in the chapbook, describing the engine powering another space ark. The poem even discusses the principle on which the engine runs, all in verse. “Robots in Red” depicts an alternate history of Communist

victory during the Cold War where the invention of Sputnik leads to a robot apocalypse, all inspired by the unfavorable stance Born takes on space travel in "Blessings and Evils of Space Travel," written three years before the Moon Landing and in the middle of the Cold War. "Robotic Rights" toys with the idea of a Robotic Declaration of Rights as suggested in Ashrafian's "AIonAI: A Humanitarian Law Of Artificial Intelligence And Robotics." The poem is also a social commentary based on current events regarding the rights of certain individuals in our society. "Eureka! Destruction" is based on similar themes, but explores more of the implications of giving robots an ethical code and what such a code would look like as the Andersons in "Robot Be Good" and Campbell in "Anticipating Artificial Intelligence" discussed. Thinking is an additional exploration into a particular issue of artificial intelligence brought up by Campbell: the loss of jobs. This poem also serves as a commentary on what is considered good and useful and other common "human" activities. "Chats with AI" is a found poem produced from conversations with the online AI chatbot, Cleverbot, discussing AI and humanity with actual AI. The conversation is between the poet and Cleverbot. "The Year Nowhere" was inspired by an attempt to avoid paradoxes using parallel universes discussed by Abbruzzese in "On using the multiverse to avoid the paradoxes of time travel." The paper discusses the unreality of tense, where there is no past or future to travel to (p. 36). "Haiku II" is another brief, more philosophical consideration of time travel. "Not Your Grandfather's Time Machine," the title a play on the well-known Grandfather Paradox where one goes back in time and kills their grandfather, creating the paradox of keeping them from existing and therefore making the

murder impossible, discusses the time travel and time machines proposed by Thorne, Morris, and Yurtsever. “The Doing of Things” also discusses time travel theories and physics, but is framed around the life of a female scientist, a commentary on the current state of STEM and gender equality. Each poem was directly influenced by either particular pieces or collections of research. Other sources of inspiration not discussed are cited. Inspiration is an odd, difficult to define phenomenon, intangible, but sources have been cited to the best of my ability.

Conclusion

In short, *The Silver Dark* is a collection of poems that tie science and literature together through verse. The Conversations accomplish this directly with the literal interaction between the two disciplines while the rest of the poems explore artificial intelligence, deep space travel, and time travel with scientific backbones of content, through verse, binding science and poetry together. Scientific jargon is even turned into verse, as exemplified by “Edge of the Nucleus.” *The Silver Dark* is an attempt to demonstrate the relationship between science and literature, in verse.

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