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## Feature Articles

# Between Research and Responsibility: The Invention of Dynamite

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**Abstract.** The myth surrounding the creation of The Nobel Prize and an incorrectly published newspaper article has long dominated the conversation about the famed inventor Alfred Nobel. In actuality, this myth appears to have been fabricated by biographers. Nobel had a complicated relationship with views on scientific progress; he long contemplated the role of researchers and morality in the face of scientific advancement. He was not the sole contributor to his discoveries; many researchers played a role in the inevitable discovery of the explosive material dynamite. Their stories, combined with the musings of Nobel discussing his explosives empire, provide an interesting insight into the ethics surrounding inventions of destructive materials. Many scientists have claimed their discovery will be the one to end all wars. Can we justify destruction in the name of deterrence?

**Keywords:** History/Philosophy, Chemical History, Misconceptions, Ethics, Undergraduate Research

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## DEATH BEFORE DEATH

The myth surrounding the creation of the Nobel Prize is fascinating. It goes as follows. In 1888, a local French newspaper mistakenly assumed dead the famed inventor of dynamite, Alfred Nobel. Instead, his brother Ludvig had died recently of a heart attack, but the newspaper, assuming the death of the elder Nobel, published an article with the attached scathing headline: “The Merchant of Death is Dead.”<sup>[1]</sup> The cruel obituary included in this article stated that Nobel had gotten rich by developing new ways to “mutilate and kill.” The article also included multiple references to Nobel as a “merchant of death” due to his creation, production, and fortune gained from the explosive material dynamite.<sup>[2]</sup> The myth is that Nobel was distraught by what his legacy may become upon seeing this headline and article. Purportedly, this induced him to change his final will and testament, establishing what we still know today as the Nobel Prize, which went into effect after his death in 1896. Upon further examination, this oversimplification of Nobel’s character does not appear to be true.

This is the story that was circulated by famed Nobel biographer Nicholas Halasz in his 1959 book, “Nobel: a Biography.”<sup>[3]</sup> Prior to this text, the

use of the moniker “Merchant of Death” does not appear to be widespread. After its use for Ludwig in 1888, there are few spikes in usage involving the term, and I find it extremely unlikely that its use was the core determinant of Nobel’s decision.

This is not the only biography that purports this tale. In 1991, Swedish actor and director Kenne Fant wrote “Alfred Nobel: A Biography,” his book also pointed to the article as the reason for Nobel’s peace prizes.<sup>[4]</sup> Since these two biographies, the myth has become widespread, as even the Nobel Foundation and the Smithsonian have supported the fib. Alfred Nobel’s physique and thoughts surrounding his creations appear very different from these fabrications. He was a complicated man, and notes to friends suggest his inward notions as much different from those suggested.

In fact, there is evidence that the article was titled something different and less scathing: “A man who can not very easily pass for a benefactor of humanity died yesterday in Cannes. It is Mr. Nobel, inventor of dynamite. Nobel was Swedish.”<sup>[5]</sup> There has been no record found of the original newspaper claimed by The Nobel Foundation: *Ideotie Quotidienne* (or Daily Nonsense). Instead, the quote I provided was published by a different French newspaper: *Le Figaro*. There is a record of a premature obituary in this newspaper, although its contents do not appear scathing enough to have drastically affected Nobel.<sup>[3]</sup> Nobel also had an extremely tumultuous relationship with the French press, and something of this nature wouldn’t have come close to surprising him.<sup>[6]</sup>

In short, this story is most likely fabricated. Even if it were true, Nobel would not have acted as dramatically as changing his entire will in response to a newspaper blurb. He believed his weapons were saving the world and is quoted as saying the following to a close friend: “Perhaps my factories will put an end to war even sooner than your Congresses; on the day when two army corps may mutually annihilate each other in a second, probably all civilized nations will recoil with horror and disband their troops.” This quote from Nobel not only foretold nuclear weapons of the next 50-60 years but also demonstrates Nobel’s emphasis on weapons technology for the goal of peace. Nobel believed his weapons could help the world, and following this narrative of “The Merchant of Death” feels counterintuitive to those goals. In fact, it is far more likely that the peace conferences Nobel attended later in life were the main contributions to his change of heart. His interactions with Bertha von Suttner, a peace advocate and writer, suggest Nobel’s change of heart was long determined and could also be a result of some ingrained socialist ideals.<sup>[7]</sup> These included his disdain for familial inheritances and his value for

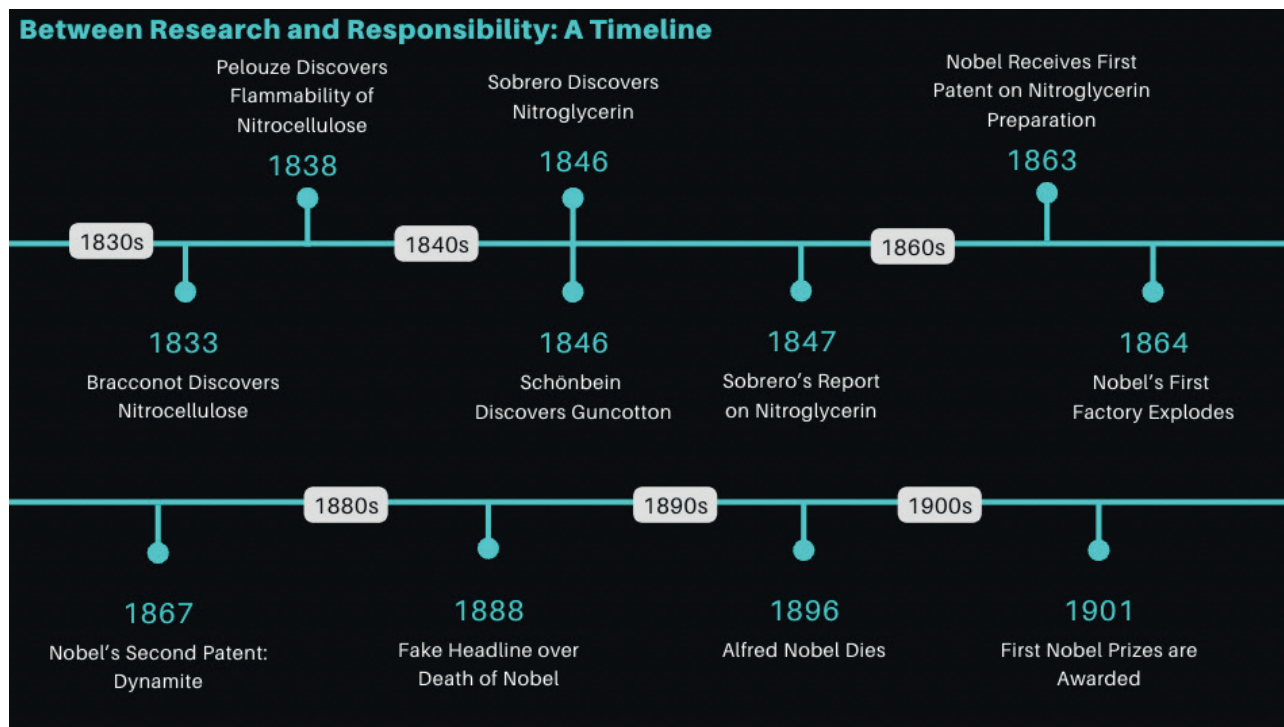
peace in an ideal world, with deterrence as a best-case replacement. This decision does not appear to be instantaneous but long deliberated over.

Nobel’s decision most likely centered around the previously mentioned Bertha von Suttner. Before she married her previous lover, Nobel and Bertha worked together for 8 days. It is contentious whether Nobel was romantically involved with Suttner, but either way, the two were deeply connected. Their correspondence lasted years and involved many philosophical and ethical discussions regarding peace.<sup>[8]</sup> Suttner was referred to as “the generalissimo of the peace movement,” and founded the Austrian Peace Society in 1891.<sup>[9]</sup> In fact, Nobel has quoted evidence from before the founding of the prizes backing this claim. Nobel said the following to Suttner: “Inform me, convince me, and then I will do something great for this movement.”<sup>[9]</sup> Suttner was given the first Nobel Prize for Peace, awarded in 1905.

The Nobel Prize is the most famous scientific prize given out annually. Monetary awards are given out yearly to those with exceptional achievements in physics, chemistry, physiology or medicine, literature, and peace.<sup>[10]</sup> The prize for achievements in economics is also awarded yearly, added in 1969. This additional prize is based upon a donation received from the National Bank of Sweden.<sup>[11]</sup> There was controversy surrounding the creation of the initial Nobel Prize categories. Many members of the Nobel family were upset upon receiving smaller portions of the Nobel fortune and fought legally to overturn the changes to Alfred Nobel’s will. In addition, there was a public uproar in Scandinavia over a lack of a Scandinavian nationality requirement for the Nobel Prize. It took five years, but eventually, an independent Nobel Prize foundation was created, and the first awards were given out in 1901.<sup>[12]</sup> They have been given out annually after that. The Nobel Prize has since become one of the most coveted scientific prizes.

#### THE SCIENTIFIC PREDECESSORS OF NOBEL

As is the case with most scientific advances, the discovery of dynamite included many contributions from different scientific actors prior to its eventual perfection by Nobel. Figure 1 shows the initial discovery dates for the important milestones involving dynamite. First mentioned is Henri Braconnot, a professor of Botany at the University of Nancy in France. Braconnot practiced pharmacy, chemistry, and botany throughout his professional career. He served as his town’s botanical garden director and was also a member of the town’s scientific academy.<sup>[13]</sup> Braconnot discovered a material that he



**Figure 1.** A timeline describing the scientific discoveries that led to Nobel's ultimate discovery of dynamite. Created using Canva

called xyloïdine, now more commonly known as nitrocellulose. He made his discovery in 1833 by combining concentrated nitric acid with starch or various wooden materials. At the time of the discovery, Braconnot did not realize the substance's explosive potential and only noted that it caught fire quickly. Braconnot attempted to make coatings and films with the substance but found little success overall.<sup>[14]</sup> His discovery received little public recognition due to its limited use cases. Little did Braconnot know, this substance had extremely explosive potential, which would slowly be realized by those scientists who succeeded him.

In 1838, chemist Théophile Pelouze picked up where Braconnot had left off and attempted to create practical uses of these new explosive materials derived from nitrocellulose. Pelouze is most famous for his laboratory, which performed various explosive-based experiments, and eventually included students such as Alfred Nobel. He also held positions at institutions, including *Collège de France* and *Commission des Monnaies*,

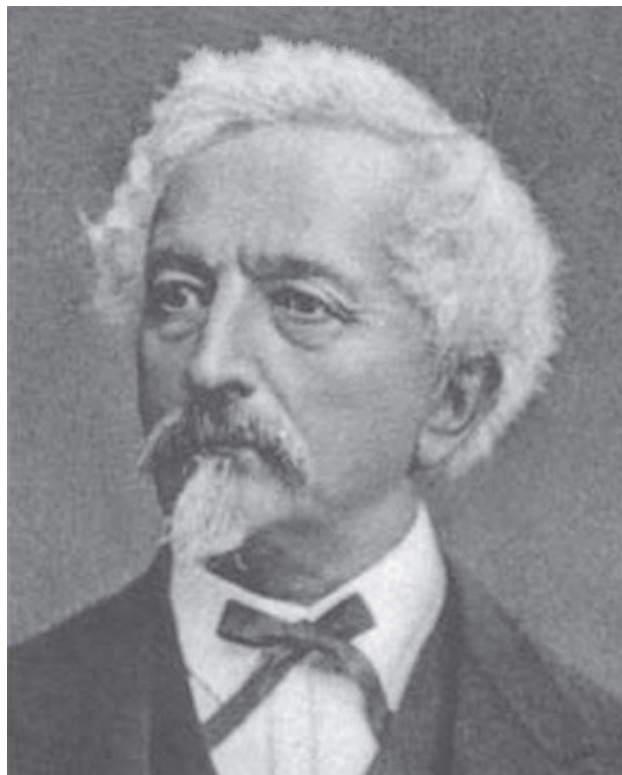


**Figure 2.** Portrait of Théophile Pelouze. Image credit: <https://picryl.com/media/theophile-jules-pelouze-chimiste-e453c6>. This image is taken from the public domain.

although he resigned from these positions in 1851 after the coup d'état. He continued working in his laboratory long after his professional career had ended and housed many students, including the likes of Alfred Nobel and another explosives scientist, Ascanio Sobrero.<sup>[15]</sup> Pelouze attempted to submerge materials such as paper, cotton, or tissues in a cold solution of concentrated nitric acid. This process produced a resultant parchment-like material that Pelouze found to be highly flammable. Pelouze's research process was more complicated than Braconnot's. Pelouze reacted a mixture of starch and concentrated nitric acid until the starch had been fully removed with no disengagement of gas from the reaction. The resultant substance was liquid, retaining the yellowish tint of concentrated nitric acid. Pelouze then applied water to the substance and used mechanical filtering and evaporation processes to remove the solid substance, nitrocellulose.<sup>[13]</sup> Pelouze described the material as "a white non-crystalline deliquescent solid, weighing much more than the original starch." After his experiments, Pelouze believed that this material could be used in artillery, but he personally found no significant use cases for the substance.<sup>[13]</sup> If it weren't for a congruent discovery made in 1846, xyloidine, Pelouze, and Braconnot's research could have been lost in the depths of history.

Swiss chemist Christian Fredrich Schönbein revolutionized the explosives world in 1846. More famed for his discovery of ozone, Schönbein wrote to scientists worldwide that he had successfully converted cotton into a material more destructive than gunpowder. He did not immediately reveal the process publicly.<sup>[16]</sup> This material was later named guncotton, or among chemists, nitrocellulose. Schönbein eventually announced the process publicly, but even before it was revealed, many scientists immediately connected this discovery to the chemical properties of xyloidine and Pelouze's material. Schönbein accomplished this feat by immersing cotton in a mixture of nitric and sulfuric acid, later washing the product to remove any excess acid that had not fully reacted. There was a good deal of communication between Schönbein and others inquiring about his discovery, and he pointed them toward the works of both Braconnot and Pelouze. This led to the release of a short historical note by Pelouze, which clarified both his and Braconnot's findings to preserve historical accuracy. In this report, Pelouze states that he believes the explosive capabilities of this new material are four times greater than that of gunpowder. He also concludes with the statement that a similar experiment conducted by Flores, Domonte, and Ménard had reacted gaseous nitric acid with mannitol in addition to different kinds of sugars and gums, producing a substance similar to that created with starch in Bra-

connot's earlier experiment.<sup>[13]</sup> A professor of chemistry at the University of Turin, Ascanio Sobrero, takes specific note of this concluding remark and writes to Pelouze. Eventually, this earned him a position in Pelouze's lab. Short of Alfred Nobel, no researcher is as essential to the discovery of dynamite as Ascanio Sobrero.



**Figure 3.** Portrait of Ascanio Sobrero. Image source: [https://commons.wikimedia.org/wiki/File:Ascanio\\_Sobrero.jpg](https://commons.wikimedia.org/wiki/File:Ascanio_Sobrero.jpg). Image is currently in the public domain

Ascanio Sobrero was born in 1812 in Italy to a wealthy academic family. Figure 3 portrays Sobrero. His father was the secretary of the Royal University of Turin, and Sobrero grew up with a strong focus on academics and the sciences. In 1833, Sobrero graduated from the Royal College of Casale Monferrato with degrees in medicine and surgery.<sup>[17]</sup> For his graduate studies, Sobrero struggled to choose between medicine and the hard sciences. He obtained his medical license the following year, but he was slowly convinced toward chemistry by his uncle Carlo Raffaello, a general of artillery and the director of the chemical lab of the Arsenal of Turin. Eventually, by 1845, Sobrero had decided to dedicate his talents entirely to chemistry. He accepted a job as a professor of chemistry at the University of Turin, and shortly after, he wrote the above-mentioned letter to Théophile Pelouze.<sup>[18]</sup>

Upon receiving this letter from Sobrero, Théophile Pelouze invited the young chemist to his explosives-centered laboratory. In this lab, Pelouze experimented primarily with guncotton and other nitrosulphates. We previously described his submersion of parchment or cardboard in concentrated nitric acid, but, in addition, Pelouze executed a variety of experiments to explore the newly expanding explosives field. He also conducted many experiments involving research into salicin, beet-root sugar, and their effects on various organic acids, nitrosulphates, and glass composition.<sup>[15]</sup> Despite this, Pelouze never made any personal discovery of note. Instead, his historical relevance comes from his influence on his two most famous students, Ascanio Sobrero and Alfred Nobel.

Sobrero did not make his most famous discoveries while working in Pelouze's laboratory, but it is clear that some influence occurred based on the research material. While studying with Pelouze, Sobrero did various experiments involving guncotton, combining it with different materials in an attempt to produce useful resultant products. His tenure in the laboratory lasted less than a year, and when he returned to Italy, he soon made his most famous discovery of his career: nitroglycerin.<sup>[19]</sup> Sobrero emphasizes that the discovery occurred after his tenure in the laboratory, purely on Italian soil. The process he used to create this material is reminiscent of the experiments conducted by Pelouze and Braconnot before him.<sup>[18]</sup>

Sobrero created nitroglycerin by stirring drops of glycerin into a cooled mixture of nitric and sulfuric acids. He initially named the substance 'pyroglycerine', and, unlike the procedures discussed for nitrocellulose, this resultant material was oily instead of solid.<sup>[13]</sup> Upon its discovery, Sobrero conducted many tests on the substance. The most famous involved heating a drop of the substance in a test tube which exploded, permanently scarring his face. Eventually, Sobrero deemed the substance too destructive and volatile for practical use. He feared the implications of the commercialization of nitroglycerin. He was quoted to have said later in a communication to the University of Turin, "When I think of all the victims killed during nitroglycerin explosions, and the terrible havoc that has been wreaked, which in all probability will continue to occur in the future, I am almost ashamed to admit to be its discoverer."<sup>[19]</sup> Initially, after discovering nitroglycerin, Sobrero kept his findings secret for over a year. Yet, with the popularity of Schönbein's research on guncotton, he knew that it would be impossible to hide forever. He released his studies on nitroglycerin in 1847.<sup>[20]</sup> Shortly after that, engineers worldwide envisioned its practical and deadly applications.



**Figure 4.** Portrait of Alfred Nobel. Image Source: [https://snl.no/Alfred\\_Nobel](https://snl.no/Alfred_Nobel). Image is taken from the public domain.

#### THE EMPIRE AND CREATIONS OF ALFRED NOBEL

Due to his work with explosive substances, Alfred Nobel was able to prosper from the nightmare of Ascanio Sobrero. His ability to neutralize nitroglycerin was critical in the discovery of dynamite, an extremely explosive substance. Nobel succeeded because of his unique traits - a combination of research prowess, organizational talent, and entrepreneurship. Nobel's upbringing was modest and the situations surrounding him as a child never suggested the explosive empire he would one day create. In fact, the majority of his discoveries resulted from desperate attempts at saving his family from bankruptcy. Additionally, long into his career, Nobel constantly contemplated the effects of his research with close friends and relatives. He was obsessed with the societal effects resulting from scientific research and was insistent that the creation of a large enough weapon would permanently end all wars. He is quoted as saying: "I wish I could produce a substance or a machine... of such frightful efficacy for the wholesale devastation that wars should thereby become altogether impossible."<sup>[21]</sup> This is a notion shared by many inventors, specifically pertaining to the creation of inventions with possible ill intent.

Alfred Nobel was born in Sweden in 1833, but he soon moved to Russia at the age of nine in 1842. Alfred Nobel was the son of a man who supplied war material to the Russian military. Nobel's father was an eccentric personality and an inventor. He began as a building constructor and contractor in Stockholm. He very soon began building beyond his capabilities and fled to Russian-ruled Finland in 1837 after going bankrupt. His wife and two sons joined him five years later, in 1842.

While working in Finland, Nobel's father, Immanuel Nobel, produced wagon wheels, steam hammers, and other mechanical tools. His interests quickly shifted to explosive mines, bought up by the Russian military in bulk at the onslaught of the Crimean War.<sup>[22]</sup>

During the Crimean War, the Nobel family business was highly profitable. In 1851, when Nobel was 18, Immanuel Nobel could afford to send Alfred to Pelouze's lab, where he studied guncotton and Sobrero's nitroglycerin. After this, he briefly apprenticed with an inventor in New York. These few years abroad proved vital to the development of Alfred's chemical engineering skills. Upon returning home to Russia, the war had ended, and so had his father's period of profitability.<sup>[23]</sup> The family desperately searched for new solutions for more efficient construction, eventually moving the entire family back to Sweden. Here, Nobel turned his attention on nitroglycerin, which he had previously studied in Pelouze's lab.

Nitroglycerin was known to be highly explosive, and engineers envisioned uses for many different industries, including construction, terraforming, and weapons. Its problem was its stabilization, as the material was extremely volatile, and mass-scale production would be impossible to carry out safely. Nobel began experimenting with the material around 1860, a year after his father's company had declared bankruptcy.<sup>[24]</sup> He had been trained as a chemical engineer and had experience from his time in Pelouze's lab and his additional apprenticeship. After securing financial support, Nobel opened up his own laboratory for testing explosive materials. The goal was to develop a series of more reliable explosives for consumer and military use. Unfortunately, in 1864, his factory exploded due to a nitroglycerin reaction, killing his brother Emil in the process. The local authorities barred Alfred from experimenting with nitroglycerin inside city limits, and he had to take his research to a barge on a lake outside of town.<sup>[25]</sup> He was also mandated to work alone, and he began overseeing all aspects of his operation.<sup>[22]</sup> The surroundings of this factory would eventually expand into Nobel's explosives empire, but its beginnings were humble. With

a new laboratory in hand, Nobel's goal became simple, develop a safe method for dealing with and producing nitroglycerin-based explosives. His dedication has to be envied, specifically after such a tragic death due to his own research.

Nobel spent the following years perfecting the nitroglycerin-based explosive. His research began with some of the first detonators and blaster caps as safer mechanisms for explosions. Previously, in attempted explosions utilizing nitroglycerin and gunpowder, a tube of nitroglycerin was inserted into a large tube of gunpowder to create the explosive effect. Nobel's method was different. He inserted a small tube of gunpowder with an attached fuse into a larger tube of nitroglycerin. This is Nobel's "Patent Detonator," the invention that kickstarted his explosives career.<sup>[22]</sup> This entire mechanism could then be placed inside of an iron pipe filled to the brim with nitroglycerin. A small "cap," or the included gunpowder, ignited the remaining explosive material.<sup>[26]</sup>

Nobel then turned his attention to safer mechanisms for the transport of the explosive material. His use of kieselguhr (clay) is most notable, stabilizing the explosive when mixed with liquid nitroglycerin. Nobel molded rods and cylinders using kieselguhr, which he refined into the explosive material dynamite using his patent detonator design.<sup>[23]</sup> Dynamite is formed by submerging blasting oil into kieselguhr. Dynamite could be safely handled and transported en masse, and then instantaneously exploded on site when desired. Blasting caps could also be removed for transport. With the use of kieselguhr and newly invented blasting caps, the safe, mass transport of explosive material proved possible.<sup>[22]</sup>

Prior to Nobel's innovations, the idea of nitroglycerin-based explosions proved attractive to many. Unfortunately, their volatility caused an array of accidents. I previously mentioned the Nobel factory explosion in 1864. There are numerous other examples of unintentional explosions occurring due to nitroglycerin. Examples include accidents in New York, Panama, San Francisco, Australia, Germany, and Belgium. These accidents created public fear surrounding nitroglycerin-based explosives and their use, even after safer mechanisms for transport and use had been developed. At this time, Nobel's role shifted from scientist to salesman. He traveled from country to country, pitching construction firms and militaries alike, all while building factory upon factory on the way. Nobel patented Dynamite in 1867, a year in which he produced 11 tons of the material. By 1874, the production had risen to 3,120 tons produced annually.<sup>[22]</sup>

The discovery of dynamite ultimately led to the chief product of Nobel's legacy, his company, and his fortune. He continued to produce blaster caps and also invented gelignite, a more stable nitroglycerin-based explosive. His final invention of note is ballistite, a safer and more explosive material created from a combination of nitroglycerin and nitrocellulose. Ballistite is a propellant explosive and was noteworthy in the production of ammunition.<sup>[22]</sup>

Over the following years, Alfred Nobel patented these discoveries in Sweden, the UK, and the US. Eventually, he amassed 355 patents worldwide and, adjusted to today's dollars, over 160 million dollars to his name when he passed in 1896.<sup>[27]</sup> His company had over 100 active factories producing nitroglycerin-based explosives at his death.

Nobel was an extremely successful scientist and entrepreneur, harnessing a chemical discovery that preceded him by almost twenty years. His inventions proved capable of supporting multiple wars while also revolutionizing the construction industry. Production of dynamite was imminent. In less than ten years after its discovery, Nobel's factories produced over 5000 tons of dynamite annually.<sup>[28]</sup> This empire only expanded. By the early 1940s, long after his death, Nobel's explosives campus had grown to over 700 buildings, mostly in Germany. Much of this was destroyed during World War II by the British. In the 1970s, a nuclear plant was built on the location, but it was shut down in 2011. Today, Nobel's empire and the land it sat on stand empty.<sup>[28]</sup> All that remains are small remnants for tourism purposes, including a guesthouse. Figure 5 displays the nuclear power plant, now dormant for over a decade.

A large remaining part of Nobel's legacy also lies in the prize, which was created in his will. Annual prizes are given out to outstanding discoveries in the fields of physics, chemistry, physiology or medicine, literature, peace, and economics. Prizes include a generous cash payment. In addition, the Nobel Prize Foundation has gained significant prestige since Alfred Nobel's passing. It is the most significant scientific honor. It is probably the most famous remaining occurrence of the namesake of Alfred Nobel. Its origin is disputed, but I believe his decision to create the prize was the result of a long-standing deliberation, and not an instantaneous knee-jerk reaction to an incorrectly written newspaper article. Without the Nobel Prize, the discoveries of Nobel may have been left in the annals of history.



**Figure 5.** Picture of the Krümmel Nuclear Power Plant, which occupies the former real estate of part of Nobel's explosives empire in Germany. Image source: [https://commons.wikimedia.org/wiki/File:Kernkraftwerk\\_Kruemmel\\_Back.jpg](https://commons.wikimedia.org/wiki/File:Kernkraftwerk_Kruemmel_Back.jpg). Image taken from the public domain.

#### WHO ARE YOU, ALFRED NOBEL?

Dynamite has had both positive and negative effects on today's world. Although Alfred Nobel can be referred to as a "Merchant of Death," he could also be described as a merchant of transportation, modern infrastructure, and many other aspects of modern living. Dynamite, although most famous for its use in wartime in weapons such as cannons, bombs, missiles, and simple handheld explosives, transformed the railroad industry in the late 19<sup>th</sup> century.<sup>[29]</sup> Previously, workers had to mine through mountains or tediously build long bypasses. Now, they could safely and efficiently blow a hole straight through the middle of an obstacle. In the U.S, railroad tunnels spread nationwide, while projects like Mount Rushmore became possible.<sup>[30]</sup> Tunnels were dug through hard-to-pass mountain ranges, such as the Alps. Canals like the Panama and Suez Canal were also constructed, aiding international transport.<sup>[29]</sup>

In addition, natural resource collection, including rare earth metals and other natural resources, became easier to collect. Although they did not quite exist in Nobel's time, dynamite has also helped provide the com-

ponents for the mass production of modern-day electronics and other products required for our technological progress. In addition, dynamite is often used for the mass mining of coal, which powers much of our society's energy consumption. The discovery of dynamite facilitated many aspects of our world that we enjoy but inevitably also led to destruction.<sup>[31]</sup>

Nobel's discoveries increased the ferocity of warfare. The invention of dynamite caused further advancement in various designs for bombs, grenades, and mines.<sup>[32]</sup> Ballistite also helped create various innovations in artillery and ammunition.<sup>[22]</sup> Shortly after Nobel's death, between 6 and 7.5 million individuals died in World War One as a result of heavy machinery, poison gas, and small artillery in warfare.<sup>[33]</sup> Although these losses cannot be individually attributed to Nobel, it is undeniable that many of Nobel's innovations in military technology led to higher death counts in warfare.

Many modern derivatives of Nobel's inventions are currently banned weapons of warfare. Without international regulation, they could prove extremely dangerous. Sometimes, they still do. Examples of these weapons include cluster bombs, land mines, and booby traps.<sup>[34]</sup> In addition, other modern explosives utilize designs created and patented by Nobel. Plastic explosives and other explosive mechanisms still use blaster caps and the overall detonator design. Modern detonators are more sophisticated, utilizing precisely applied waveforms to achieve detonation, as opposed to just heat.<sup>[26]</sup> All of these explosive devices have been employed in warfare. They have also been utilized by many terrorist organizations.<sup>[35]</sup> Inevitably, Alfred Nobel created an invention that led to tools that armies have used for destruction and death for over a century. Ascanio Sobrero foretold this future and attempted to hide his discovery, but is withholding the flow of science as ethical as Sobrero made it seem?

Ethics surrounding inventions of dangerous nature is a topic bigger than Alfred Nobel. Many inventors have made hazardous and catastrophic discoveries and regretted their decisions much later in life. After contributing to the invention of the atomic bomb, the leader of the Los Alamos sector of the Manhattan Project, J Robert Oppenheimer, was quoted to have said: "Now I am become Death, the destroyer of worlds."<sup>[36]</sup> Oppenheimer led the Los Alamos project and played a large role in the overall assembly and creation of the atomic bomb. At the time, he assumed the creation of such a weapon was necessary for ending the ongoing conflict with the Axis powers. Later on, research into fission technology spiraled into the creation and testing of the H bomb. While Oppenheimer condoned research into this technology,

he disapproved of its production and actualization.<sup>[37]</sup> If used, the H bomb could erase entire cities in seconds.

It should be noted that fission discoveries have also led to advancements in atomic energy, which can provide a possible solution to climate issues. Nuclear pharmaceuticals also offer a possible new frontier for new drug creation. Similar to Nobel and dynamite, both positive and negative effects resulted from this discovery. Oppenheimer and Nobel were recollective later in life, but neither considered trying to thwart their own personal research paths. Remorse surrounding the creations of inventors and entrepreneurs can come in many forms.

The most famous example of an invention of hazardous applications comes from Fritz Haber, inventor of the Haber-Bosch process in Chemistry. The Haber-Bosch process transforms Nitrogen and Hydrogen into ammonia. Ammonia is used in 99% of all nitrogen-based fertilizers and is a large reason for boosts in agriculture technology. These boosts have allowed global populations to grow and, in many areas, also caused food insecurity to shrink. Yet, the production of ammonia also directly led to the creation and use of chemical weapons.<sup>[38]</sup> Before being banned, chemical weapons were extremely dangerous and effective in warfare.<sup>[34]</sup>

Scientific discoveries, especially those with dangerous applications, raise moral questions. Should scientists be expected to suppress discoveries for the safety of the general public and to prevent devastating applications? Would this diminish the positive societal effects caused by the flow of science? If concessions need to be made, whom should we entrust to make the proper regulatory decisions?

Knowledge production relies on the publication process. Recently, the question of scientific censorship in the name of a greater good has come to light. A recent paper in PNAS has pointed out the need to better understand the consequences of scientific censorship.<sup>[39]</sup> Others over the last few years have also suggested that scientific censorship can prove detrimental to the field censored.<sup>[40]</sup> A recent paper out of Stony Brook University suggests that over the 31 institutions polled, scientific censorship is on the rise.<sup>[41]</sup>

Scientific oversight also exists in legislation. Via public oversight, inventions can be withheld from public grasp even after their inception. Regulations can be used to recall dangerous inventions from the general public, without incurring major losses. Nobel, Haber, and Oppenheimer are all examples of inventors whose inventions have been withheld from public use successfully by the government. A more childish example surrounds the children's toy *Lawn Darts*, banned in the US for safety.<sup>[42]</sup>



Science fiction writers have long imagined what would happen when technological research went awry. They describe dystopian realities created by unfettered scientific breakthroughs. Among the most popular examples are *The Terminator*, *The Matrix*, and the *Jurassic Park* franchises. These and other examples show that the public has become fascinated by the idea of dangerous runaway technology and research. It is clear that many of these ideas stem from a fear of the unknown, but it is also apparent that the public does not have confidence in scientists to protect them from their own research.

Yuval Noah Harari, writing about pressing issues in the modern age, provides insight into the conflicts between progress and human nature. Specifically, Harari writes, “Humans were always far better at inventing tools than using them wisely.” Harari believes that humans can become blinded by their visions of good and evil and that, in the realm of scientific advancement, this can lead to disastrous implications. He also states the following: “Technology is never deterministic, and the fact that something can be done does not mean it must be done.” Progress is not linear, and many assume that because something can be created, it will be created. Harari fights back against this notion, reaffirming that given the right moral reasonings, an actor like Ascanio Sobrero or a governmental entity should be allowed to disrupt the flow of research given moral qualms.<sup>[43]</sup>

In conclusion, I note that the lines drawn surrounding moral issues are often subjective. There is rarely one right answer to morality, and recently, publications have taken scientific censorship to the extreme on both sides of the political aisle. It is extremely difficult to simultaneously foresee both the costs of censorship and the repercussions from dangerous or runaway technological innovations.

We cannot let our fear of technological destruction or societal shifts due to technology bring about a dystopian future. At the same time, historical examples exist where earlier foresight could have prevented the inception of dangerous inventions. The general public may have created fearful portrayals of technological cataclysms in science fiction, but they have also envisioned oppressive regimes like in Orwell’s *1984*. Both extremes must be avoided.

#### CONCLUSION

As discussed, a basic study of Alfred Nobel’s life refutes the reported origin of The Nobel Prize as resulting from an erroneous obituary with a disturbing moniker and instead shows the impact of Nobel’s interaction

with pacifist Bertha von Suttner as the primary catalyst. Like other examples in the scientific discovery of dangerous technology, Nobel struggled with balancing the positive and negative effects of research and engineering. Nobel also failed to heed the warnings of preceding scientists such as Ascanio Sobrero, who had attempted to hide his discovery of nitroglycerin, a crucial component in dynamite, in Nobel’s path to building an explosives empire. The conversation on this topic is ongoing and has recently gained a lot of national attention in proposed changes to school curricula and regulations surrounding scientific publication. The effects of scientific censorship require further careful study, as illustrated by this paper.

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