

## AFD Ep 413 Links and Notes - The Explosives Empire [Bill/Rachel] - Recording Feb 13, 2022

- [Intro] The 19th century was a time for experimentation in chemistry, consolidation of corporations, and expansion of imperialism to remote and obscure corners of the globe. All three of these trends came together in the field of explosives – for war, mining, quarrying, tunneling, and more. To get sufficient quantities of ingredients for these explosives, the US empire expanded and that growth in turn stood atop the quantity, quality, and innovation of the explosives on hand. In the same era that saw the consolidation of sugar into a monopoly ([covered in episode 376 from May 2021](#)), the same thing was happening in the explosives industry. And the commonality doesn't stop there because of the importance of islands and horrific labor conditions. So, this week we're focusing on 19th century American explosives and Guano Islands imperialism. We'll start off by talking about the classic, the O.G.: original gunpowder...
- [Gunpowder](#), a compound typically used as a propellant more than an explosive, was more or less standardized by the 1780s after centuries of trial and error and irregular production formulas and methods. Later in the episode we'll talk about guano-derived potassium nitrate (aka saltpeter, always the biggest ingredient unless substituted with sodium nitrate), but gunpowder also included charcoal and (in order to lower the ignition temperature) sulfur. There were different ingredient ratios for different uses such as guns versus rockets but also civilian uses. For example, blasting powder for mining was further refined, standardized, and patented by DuPont, the most important US munitions company, in 1857. DuPont had been operating a gunpowder factory in Delaware since 1802, and they were the Union's leading supplier during the American Civil War in the 1860s. [https://en.wikipedia.org/wiki/DuPont\\_\(1802%E2%80%931867\)](https://en.wikipedia.org/wiki/DuPont_(1802%E2%80%931867)) Just four powder mills in the northeastern US, owned by four companies including DuPont, were producing 69% of US gunpowder at the height of wartime production. [https://en.wikipedia.org/wiki/Powder\\_mill#In\\_the\\_United\\_States](https://en.wikipedia.org/wiki/Powder_mill#In_the_United_States) (One of the other big suppliers was [Lafin](#), which had been in the industry since the American Revolution.) Seven years after the war, the four firms formed a trade association, basically a cartel, that dominated the industry in the 1870s and DuPont actually continued gunpowder production for a further century until 1971. Although there had been over 200 powder mills in the US back in 1810, often small ones, this was an industry that was well-suited to industrial mergers and consolidations that became such a defining feature of the Second Industrial Revolution because if a powder mill exploded, it was easier for a big firm with deep pockets to recover and rebuild instead of going out of business. The mill sites also required a lot of land and complicated expensive building arrangements for accidental blast mitigation. (For example, the [Confederate Powderworks](#) in Augusta GA stretched across a mile and a half, although it was unusually large.) Until the advent of electricity, powder mills were also generally powered by waterwheels, not steam engines, as a further precaution against accidental explosions of the product. On the other hand, water and humidity were the enemies of dry powder production and usefulness.
  - See March 2021 bonus episode on the development of air conditioning: <http://arsenalfordemocracy.com/2021/03/10/preview-mar-9-2021-early-air-conditioning-arsenal-for-democracy-ep-357/>
- Gunpowder had always been problematic for industrial production and industrial-scale uses in mining, quarrying, tunneling, and warfare because even if you were willing to write off the inherent dangers of gunpowder as the cost of doing business, it was extremely messy, prone to causing mechanical failure in guns or mining equipment, and threw huge black clouds into the air immediately upon use, obscuring everyone's ability to do their job. So apart from the first industrial revolution's contribution to the field in the

form of standardized gunpowder (what we would today anachronistically label as things like Black Powder and B Blasting Powder) and factory production of various graphite-coated grain sizes and less erratic propulsion from clumping, substitutes for gunpowder had to wait until the Second Industrial Revolution. By the mid-1840s, “guncotton” (which we discussed in our episodes on [Nitrocellulose for film reels](#) and [Jules Verne’s ideas about human spaceflight](#)) had indeed been developed in Europe, but it was not safely manufacturable for mass production for nearly two decades, eventually being [deployed in the American Civil War for new high-explosive shell artillery](#) (as opposed to more traditional powder-launched cannonball artillery, which was also in use but had the powder haze problem). After this, in the Second Industrial Revolution, the race was on to develop and mass produce replacements for gunpowder for military and civilian purposes. DuPont built a guncotton factory in New Jersey and eventually they achieved total monopoly control of all smokeless powder patents in the US and were forced to divest in 1912 due to antitrust enforcement, although by that point they had significantly consolidated American production.

- [California Powder Works](#) (nitroglycerine, Peyton Powder, Hercules Powder) – this early and important Second Industrial Revolution explosives factory was originally created out of necessity when California was suddenly cut off from reliable access to eastern-made mining explosives during the Civil War. It is one of the clearer examples of the constant intermingling of the development and production of civilian explosives and military explosives, which partly reflected the reality that mining, quarrying, and transport tunneling were big and long-term national industries, while the US military was once kept very small except during major wars. The California Powder Works, located in the Santa Cruz area for about half a century, were eventually integrated into the DuPont explosives production empire in the early 1900s following a significant factory explosion in the late 1890s.
- Dynamite (not a US invention – see Alfred Nobel, 1867 patents – but of course used here and reformulated)
  - This replaced the use of (or more accurately enclosed in safe diatomaceous earth) the highly unstable nitroglycerin explosives which had to be manufactured on site at blasting projects because it was unsafe to ship
  - The US Army used dynamite extensively in San Francisco after the 1906 earthquake to try to create fire breaks  
[https://en.wikipedia.org/wiki/California\\_Powder\\_Works](https://en.wikipedia.org/wiki/California_Powder_Works)
  - In 1910, DuPont published a pamphlet on suggested uses of dynamite in day-to-day farm activities, primarily as an efficient way to clear obstacles  
[https://en.wikipedia.org/wiki/DuPont\\_\(1802%E2%80%931917\)](https://en.wikipedia.org/wiki/DuPont_(1802%E2%80%931917))
- [Smokeless powder](#) [a generic term for various reformulations of nitrocellulose propellants, sometimes with nitroglycerin, for less hazy, less dangerous, and less failure-prone small arms or artillery use] (1884 onward; not a US invention but crucial to the US arms industry, including Winchester Repeating Rifles although earlier designs had already been popularized by Union Army purchase orders in the Civil War)
  - Smokeless powder is unfortunately the effective birth of modern snipers as a significant thing. Sharpshooters previously could not be concealed for any length of time because black powder haze gave away their position after basically one shot. White powder or smokeless powder not only didn’t give away their hiding spot after firing, but it also allowed for much longer distance shots with more accuracy, due to the higher velocity of the bullets, so there was less vertical drop or lateral wind drift.
  - Once again, major firms in the post-1872 cartel, like Laflin, were key players in developing or acquiring patents or existing smaller factories for smokeless

powder variants.

[https://en.wikipedia.org/wiki/Laflin\\_%26\\_Rand\\_Powder\\_Company](https://en.wikipedia.org/wiki/Laflin_%26_Rand_Powder_Company) By 1900, DuPont and Laflin controlled over two-thirds of US explosives production and then DuPont bought them out, becoming the de facto monopoly until 1912 as previously mentioned.

- Anglo-American Explosives Company: smokeless shotgun powder factory in NJ in the 1890s, taking advantage of smokeless powder's particular usefulness in smooth-bore guns vs rifled barrels
- The role of the US Navy in the explosives industry
  - Naval Powder Factory (Maryland): Developed various nitrocellulose-based propellants or explosives in the late 1890s and then sold the patents to DuPont, although the Naval Powder Factory could keep producing it as well...
    - Today this a US Navy R&D facility that designs explosives, propellants, pyrotechnics, and ordnance for US by the US Navy  
[https://en.wikipedia.org/wiki/Indian\\_Head\\_Naval\\_Surface\\_Warfare\\_Center](https://en.wikipedia.org/wiki/Indian_Head_Naval_Surface_Warfare_Center)
  - Naval Torpedo Station (Newport RI, 1869): "Indurite" nitrocellulose/guncotton reformulation in the early 1890s (a kind of smokeless powder variant) which proved crucial to both WW1 & WW2 –  
[https://en.wikipedia.org/wiki/Naval\\_Undersea\\_Warfare\\_Center](https://en.wikipedia.org/wiki/Naval_Undersea_Warfare_Center)
  - Explosive D (Dunnite) – the US Navy's preferred shell explosive in WWI (for time-delayed exploding shells after ripping through ship armor)  
<https://en.wikipedia.org/wiki/Dunnite>
  - This is a good transition to the other naval angle on the US explosives industry...
- **[Rachel] Guano and the American overseas territorial empire:**
  - Although guano refers to manure from any flying animal, seabird guano and bat guano differ in composition. Bird guano is very high in nitrogen, due to the seabirds' diet of fish; bird guano can be up to 21% nitrogen by mass. Bird guano can also be a significant source of phosphorus, calcium and magnesium. Bat guano contains a high amount of carbon, especially fresh guano, as well as nitrogen, sulfur, and phosphorus.
  - Used (for its high potassium and nitrogen content) in the 19th century for both agricultural fertilizer and gunpowder production following an 1802 publication by globally famous German naturalist-explorer Alexander von Humboldt, for whom many American places are named, and an 1813 publication by Humphry Davy of Britain. It was also a lucrative secondary transport good for empty whaling ships. The peak "Guano Age" was from about 1840 to 1883, reaching a fever pitch in the 1870s, but the implications were profound for years to come until the advent of synthetic ammonia fertilizers in 1913 in Germany.  
[https://en.wikipedia.org/wiki/Guano#Western\\_discovery\\_and\\_the\\_Guano\\_Age\\_\(1802%E2%80%931884\)](https://en.wikipedia.org/wiki/Guano#Western_discovery_and_the_Guano_Age_(1802%E2%80%931884))
  - From *How to Hide an Empire* by Daniel Immerwahr: Britain had a monopolistic stranglehold on guano exported from Peru and kept prices high. Guano prices were of such importance that the subject appeared in four presidential annual messages. Millard Fillmore in particular stressed that he saw it as "the duty of the Government" to secure guano at a "reasonable price." "Nothing will be omitted on my part," in the search for a supply of cheap guano. This led to a near-war between Peru and the U.S. in 1852, when Secretary of State Daniel Webster gave speculators the go-ahead to sail to the Lobos Islands off the coast of northern Peru and mine them. He even promised naval protection and dispatched a warship. Peru claimed sovereignty over the islands, and started

preparing for a war with the U.S., with a Peruvian paper even admonishing its readers to “exterminate the hated race” and “kill before Peruvians should be killed.” The U.S. later backed down, but it was clear that the question of sovereignty over guano islands was going to be a major problem of the time.

- American speculators started to look to more far-flung, unclaimed islands for guano. Two islands in the Central Pacific, Howland and Jarvis Islands, looked promising. They were more than a thousand miles from the nearest large landmass, and they were known to whalers for decades. These speculators formed the American Guano Company, and asked President Franklin Pierce to send the navy to protect the company from foreign interference. And thus the Guano Islands Act was passed in 1856.
- [https://en.wikipedia.org/wiki/Guano\\_Islands\\_Act](https://en.wikipedia.org/wiki/Guano_Islands_Act): The Guano Islands Act states that “Whenever any citizen of the United States discovers a deposit of guano on any island, rock, or key, not within the lawful jurisdiction of any other Government, and not occupied by the citizens of any other Government, and takes peaceable possession thereof, and occupies the same, such island, rock, or key may, at the discretion of the President, be considered as appertaining to the United States.” It also allows the President to use the military to protect these interests, and establishes the criminal jurisdiction of the U.S. in these territories.
- The Guano Islands Act spurred a new land rush in the Pacific and Caribbean. By 1863, the U.S. had annexed 59 islands. By 1902, when the last claim under the Act was filed, there were 94 guano islands, creating the U.S.’s oceanic empire.
- Once the guano was discovered and claimed for the U.S., there was still the matter of mining the guano. Guano mining was a terrible and dangerous job. Breathing in the nitrogen-rich guano caused extensive lung damage, resulting in workers passing out or coughing up blood. Gastrointestinal diseases were also common, as there were no sources of fresh food or water on these desolate islands, and workers were forced into crowded accommodations. On Howland Island, there was also a rat infestation, adding another disease vector into the mix. While Peruvian guano businesses used conscripted Chinese laborers, the U.S. used mainly Hawaiians on their Pacific mines, who they saw as a workforce hardened to the tropical conditions.
- One of the worst mines was in the Caribbean island of Navassa, near Haiti, also known as Devil’s Island. Navassa didn’t have much actual guano, but its coral reef had rich deposits of tricalcium phosphate, which was used as fertilizer. The island was controlled by the Navassa Phosphate Company. The Navassa Phosphate Company hired African American laborers from Baltimore. The company promised a life of picking fruit and wooing women to get the workers to sign long-term contracts and sail to Navassa. Once there, the conditions were not as promised, but grueling and barbaric. The company overseers were abusive, and necessities such as clothes, mattresses and pillows were sold to the workers in company stores at inflated prices. Workers who were too ill to work were fined. Workers who caused trouble were “triced” tied up for hours in the hot sun with their arms in the air and their feet barely touching the ground.
- Things finally came to a head in 1889, when an argument between an overseer and a worker touched off an uprising. White officers fired at their workers, who fought back with axes, dynamite, and stones. Five white officers died in the fighting, and the workers were arrested and sent back to Baltimore to stand trial.
- This trial eventually came to the Supreme Court, known as Jones v. United States (1890). The defense stated that the rioters could not be convicted in a U.S. court because they lacked jurisdiction. Haiti also claimed sovereignty over

Navassa. They also pointed to a lack of government presence on the island. If Navassa was truly a U.S. territory, where were the U.S. officials? The Supreme Court sided with the prosecution, affirming that Navassa was U.S. territory, and was under the rule of U.S. law. This ruling also affirmed the legality of U.S. empire-building, the legacies of which are felt to this day, according to Immerwahr:

- The legal establishment of the principle that the U.S. needn't be confined to the continent.
- The strategic holdings of Pacific Islands. These islands later became desirable sites for airfields.
- Industrial agriculture as a means to feed an expanding population. While guano didn't live up to all its promises, its use did hold famine at bay until the industrialized manufacture of synthesized ammonia using atmospheric nitrogen in 1914 using the Haber-Bosch process.
- The Haber-Bosch process also allowed Germany to synthesize the ammonia necessary to manufacture nitrate explosives. Germany's munitions were dwindling, and Haber's process restored Germany's capability to produce munitions. According to Immerwahr, "The president of the American Chemical Society calculated that Germany would have lost the war by early 1916 had Haber not replenished its stocks of nitrate explosives."