

Disrupting Time

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New York

Chapter 1

In the Palace of Industry



Opening day of the 1876 Centennial Exhibition in Fairmount Park, Philadelphia (Centennial Photographic Company, Public Domain)

Centennial Exhibition – June 1876

In the summer of 1876, Philadelphia's Centennial Exhibition celebrated America's first 100 years. The Exhibition represented the rapid advances of the world, but primarily America's industrial success and massive economic growth. While still a very young

country by most standards, America was establishing itself on the global stage.

Alexander Graham Bell, the inventor of the telephone, which would debut at the Centennial, wrote about the Exhibition: "It is wonderful! You can have no idea of it till you see it. It grows upon one. It is so prodigious and so wonderful that it absolutely staggers one to realize what the word 'Centennial Exhibition' means. Just think of having the products of all nations condensed into a few acres of buildings."¹⁵

Almost 10 million people would visit the Centennial across its six months of operation. Walking through the grounds and buildings, one joined the sea of humanity assembled from all over the world.¹⁶ It was described as a "journey around the world, giving an insight into the life and thought of all manner of men, and lifting the visitor above the narrow limits of his surroundings, so that his horizon stretched out to embrace the whole human race. Bigotry, conceit, and local pride vanished as the great panorama of the achievements of mankind, of all races and in all climes, passed before his eyes."¹⁷

The Centennial Exhibition displayed national progress, but the descriptions of visitors emphasized the clash of attitudes in America at a time that promoted nationalistic feelings and protectionism. It was not apparent that Americans were ready for the assortment of people who attended from all over the world. The same author of the previous passage also noted the "stalwart Indian that stalks through the hall...the small but alert Japanese...the 'Heathen Chinees' with his almond-eyes and long pig-tails, his comical dress, and his 'ways that are dark and tricks that are vain,' [and] the turbaned Turk."¹⁸

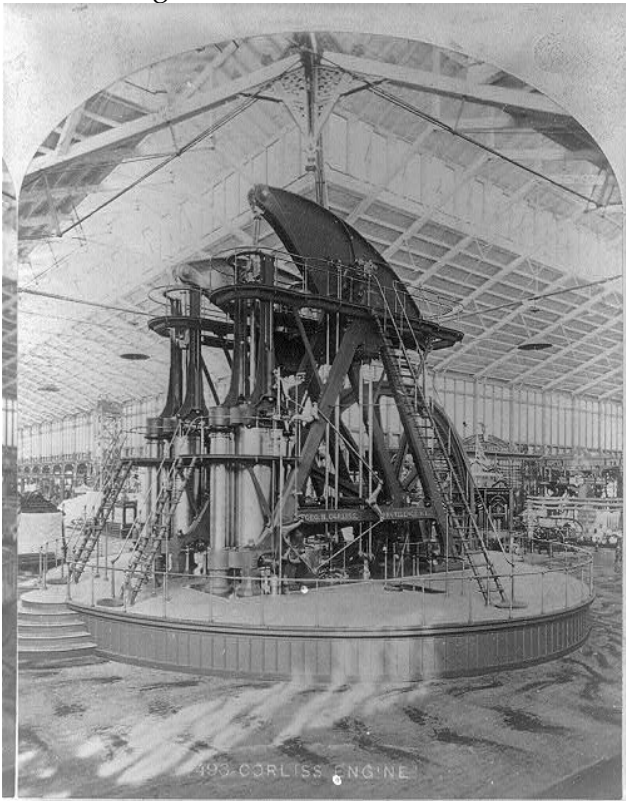
At the epicenter of the Centennial's 2,470 acreages lay the Main Building and Machinery Hall, which enclosed the central plaza that welcomed visitors to the world's fair. The Main Building was impressive, being the largest enclosed space in the world at the time.¹⁹

Inside the Main Building, fountains fired gushes of water, and music occasionally filled the air. Sometimes the Centennial's organ broke through the cacophony of exhibitors and visitors. Everyone was universally amazed: "On all sides were heard exclamations of wonder and delight. Few had imagined the Exhibition either so extensive or so grand an affair, and all were delighted."²⁰ Endless showcases, country areas, national flags and banners, people from all over the world, the unceasing pandemonium, the musty stench of thousands of people crowding the hall, and the severe heat that soaked the glass-covered building in the summer sun.²¹

Across the plaza from the Main Building was Machinery Hall, a much smaller but equally impressive building housing much of the emerging technology of the era. To those visiting the Centennial, Machinery Hall was a temple of innovation and a palace of industry. The machines shown in the hall were symbolic of the advancement made by humankind over the previous decade. During the opening ceremonies, the visitors to the Centennial even bowed their heads in prayer to thank God for America's "social and national prosperity and progress, for valuable discoveries and multiplied inventions, for labor-saving machinery relieving the toiling masses."²²

The Hall was constructed with glass, iron, and wood, standing 70 feet tall and extending over a quarter

mile. At the center of the palace of industry was the 800-ton Corliss Steam Engine that rose 45 feet tall. It symbolized the industrial horsepower that America provided to the burgeoning global economy. The two 44-inch cylinders served as the ventricles of this mechanical heart, producing 1,400 horsepower that supplied the lifeblood to the machines in the entire Hall through a two-mile-long venous network of shafts and belts. One visitor described the Corliss engine as “a sight to behold – a sight for a lifetime.”²³



Corliss Engine in Machinery Hall. The Waltham exhibit was located directly behind at the epicenter of Machinery Hall (Centennial Photographic Company, Public Domain)

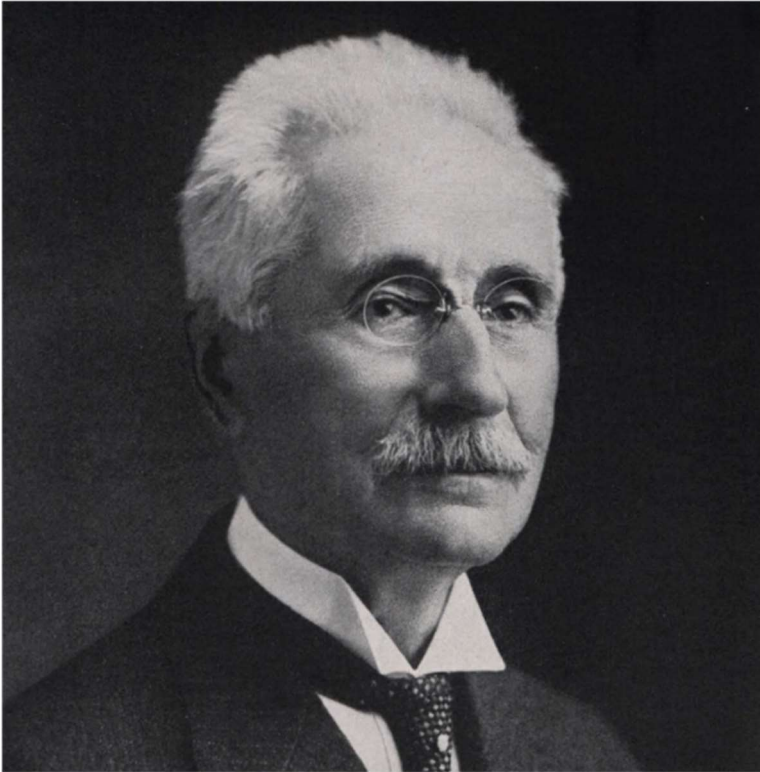
“The One that Cuts the Screws”

Despite showcasing many physically large inventions, those with the most poignant effect in the years following were ones with more delicate intricacies and had a much smaller presence at the Centennial. Alexander Graham Bell’s first telephone debuted in the Main Building and could be experienced on each end of the hall.

The German area displayed novel machines powered by “a series of explosions” where “gas and air are mixed in such proportions as to give an explosive compound,” demonstrating early examples of the combustion engine.²⁴ In addition, the Centennial featured the monorail that could be ridden across the grounds. It also showcased the sewing machine and typewriter.

Theophilus Gribi was one of the visitors who would leave the Centennial having had his entire imagination altered as the fair revealed the frighteningly novel advances made by American inventors. Gribi was a middle-aged Swiss man. He had arrived from Switzerland into Philadelphia in the spring of 1876. The watchmakers of the mountainous regions of Switzerland sent him to the Centennial Exhibition to serve as a judge at the world’s fair while searching for reasons why Swiss watch sales had declined by almost 80% from 1872 to 1876, a sharp decrease for Switzerland’s primary market.²⁵ Gribi was a skilled watchmaker and had spent much of his career working in Philadelphia for the jeweler Bailey, Banks, and Biddle, only recently moving back to his native Switzerland.²⁶ He was an ideal choice for this seemingly innocuous mission of discovery.

Gribi arrived before the opening celebrations on May 10th. There was one company that Gribi noticed that was almost certainly set up on time and operating on the opening day. This American company was organized and calculated, showing something so novel that Gribi struggled to describe the ingenuity. His concern was a machine displayed by the Waltham Watch Company, about the size of a large shoebox, operated by a young woman.



*Theophilus Gribi, shown later in life.
(From "Horology," June 1937, Public Domain).*

The disturbing machine was Waltham's proprietary automatic screw-making machine. The nickel-plated machine with robot-like arms could produce a tiny screw every five seconds. This was a rate so fast it was not even worth calculating the efficiency compared to that of a skilled watchmaker in Switzerland, though Gribi felt compelled to try. He took out his notepad and scribbled a note: "Screw machine make[s] 17 screws a minute 10,200²⁷ per day."²⁸ This figure was significant because it was at least eight to ten times more efficient than anyone Gribi knew.

This machine captured the imagination of correspondents and tourists alike. A San Francisco newspaper wrote: "It would be impossible to describe in detail the many operations of ingenious machines one can see in the making of these watches in Machinery Hall. [Waltham's] space is surrounded from morning till night to see the delicate and yet swift workings of the machines, particularly that which cuts the screws."²⁹

The device automatically fed a small piece of wire and then began to form the screw from the wire, which was then cut. A tiny mechanical pincer reached over, grabbed the screw, slotted the head, finished it, and dropped it into a small bin for collection. All in five seconds. Even more shocking was that one person could operate ten machines simultaneously. This system multiplied the potential output of a single worker from 1,000 to 80,000 screws in a single day. The screw machine worked so effectively that it would remain in use at Waltham until its final closure in 1954 and even longer at another company until 1981.³⁰

The automatic screw-making machine was not the only noteworthy aspect of Waltham's exhibit. Visitors also noticed the overwhelming presence of

Waltham's women employees, thirteen of the eighteen total workers at the exhibit.³¹ Women's participation in the labor force was something of a debut at the Exhibition, which, in addition to the machinery, the women were also blessed during the opening prayer: "We pray thy benediction especially on the women of America, who for the first time in the history of our race take so conspicuous a place in our national celebration."³²

One writer visiting the Exhibition noted the presence of the women working the Waltham exhibit as if they were meant to be decorative flourishes. While the writer only chose to comment on three exhibits from Machinery Hall, he noted that Waltham "has its machinery and its pretty girls at work, making every part of a watch, and keeping jealous wives on the watch, as their husbands suddenly become interested in the wonderful mechanical manipulation of that delicate machinery and those deft fingers. This alone is worth going a hundred miles to see."³³

The capabilities and appearance of the Waltham exhibit were no accident. While Machinery Hall was a temple devoted to mechanical ingenuity, for Waltham it was an opportunity to show the world the superiority of its pocket watches and production methods. It allowed the company to demonstrate to competitors that it could produce enough watches to dominate the global watch market through quality mass production. That was the goal of treasurer Royal E. Robbins, who served as Waltham's chief executive and principal owner.

Some viewed displaying Waltham's proprietary machines in operation at the Centennial as a risk. Competition in the American watch industry was fierce.

The Centennial Exhibition offered Waltham a chance to demonstrate its superiority like an advancing army parading through the streets of captured watch markets. Robbins had convinced investors that there could be “no greater discouragement” to competitors “than by the free exhibition of the factory itself and of all it contains.”³⁴ He was most concerned about the American competition, which had become numerous and taxing in the years leading up to the Centennial. Discouraging further American competition was his primary goal.



The large Corliss Engine in Machinery Hall. The Waltham exhibit sits just feet from it and can be seen to the bottom right of the Engine with 3 white windows (Centennial Photographic Company, Public Domain)

In the end, the company’s shareholders were complicit in approving his plan to display and operate the machines in front of millions of visitors. Many investors did not believe this was wise, but the shareholders trusted Robbins.³⁵ He was a well-respected businessman who had served on the board of directors

for companies like the Union Pacific Railroad (1871-1874), acting alongside Andrew Carnegie and George Pullman.³⁶ Additionally, Robbins' careful selection of machines ensured that not *everything* would be on display.

The Waltham exhibit was deliberately planned to demonstrate the production of a select few pieces or parts of the watch. The purpose was a calculated demonstration of Waltham's dominance over its American competitors and the irrelevance of the handmade Swiss watch.³⁷ Waltham was cautious to ensure its trade secrets would not be given away. It had no interest in the free sharing of ideas nor the promotion of competitors' advances.

The shock of Philadelphia

The exhibit served its purpose. What Gribi saw was enough to call into question the Swiss watch industry's future existence. By 1876, watchmaking was a national industry for Switzerland, a source of pride and an exhibition of Swiss skill. As Waltham's machines produced precision wheels, pinions, and screws for a mechanical watch, which were usually produced by an artisan in a home in Switzerland, one American newspaper gloated that old-world observers like Gribi, "gaze in astonishment [and] apparently admit that their occupation is going, if not gone."³⁸

There was nothing the Swiss watchmakers could do that would match Waltham's automatic screw machines, not to mention the rest of the company's capabilities. After just a few days of observing the machines, Gribi wrote: "I have been examining, as an expert on the jury, the products and tools of the

Waltham Watch Company (Massachusetts) and I must admit that I was filled with admiration for their watches of various types and quality, and for the splendid machines and tools that this factory has exhibited.”³⁹ However, the problem was not isolated to Waltham’s machines or its watches. The Swiss disadvantage lay in the industrial mindset for the Swiss did not have the American penchant for mass production innovation, which seemed to multiply yearly.

One member of Switzerland’s delegation to the Centennial Exhibition, a shoemaker named Edward Bally, quickly and accurately recognized the dire position of the Swiss watch industry. He knew that machines and mass production were only symptoms of a more significant problem emanating from American ingenuity. “Have you ever compared a rake, a spade, a knife, a hatchet, made in America, with tools made here? How much Europe is left behind!” he wrote.⁴⁰

Bally owned the largest shoe factory in Europe and had already experimented with copying American production methods. He had paid American engineers to install American-made machines in his shoe factory. Yet, even through imitation of American techniques, he could not compete with the Americans. Shoes produced in Massachusetts were brought to his European factory, having traveled the ocean for a fee, and then presented to him for a price below his cost of production.⁴¹ He claimed that his employees “work also with American machines. They have the same tools, [yet] their productive capacity is far inferior to that of the American operative.”⁴² From Bally’s point of view, attempting to imitate the Americans was not enough to match American industry or its workers.⁴³

Bally noted that Americans had an inherent advantage over the Europeans that emerged from structures within the professional economy. Europeans learned a specialized craft over decades through apprenticeship and repeated exactly what their master taught them. In contrast, most Americans had no artisanal skills and had to invent production methods that substituted for their lack of skill. This led to unimaginable improvements in designs and production methods in many American industries.⁴⁴ Even if the Swiss could replicate the American machines and work ethic, there was little encouragement they could ever match American innovation.

This was industrial combat. According to Bally, America had “armed itself as for a battle for the moment when it would have to enter upon the peaceful combat of industry... The world has never seen so considerable a sum of new ideas and of applications of these new ideas as that which was presented by the Exhibition at Philadelphia.”⁴⁵

The growing technology sector of its era

Watches were the emerging technology of the era. They presented an opportunity for growth and immense wealth for whichever producer could gain a competitive advantage in the market. Watches and timekeepers were not as novel as the telephone but were far more relevant to the average person's needs.

The shift towards time consciousness had accelerated during the American Civil War, which had ended only eleven years prior. Soldiers had become dependent and somewhat addicted to time. Before the attack on Vicksburg, General Ulysses Grant emphasized

the importance of timekeeping to his army by ordering that all watches be synchronized. Many soldiers worried they would not survive the impending attack. Before the battle, one Union soldier gave his watch to a friend, saying, "this watch I want you to send to my father if I never return," demonstrating the importance of timekeepers, not just for their utility but also for their connection with the owner.⁴⁶ Society for so many millennia had thrived on a generalized concept of time. With the synchronized maneuvers of warfare and the increasing distribution of watches, timekeeping was becoming central to society.



*The mechanical movement of a Waltham Ellery model from the 1870's. It was a typical watch for soldiers, viewed as cheap and reliable.
(Author's photo)*

Following the Civil War, a population of time-driven soldiers from all ranks left the service, and society became indentured to punctuality. Watches were much more than jewelry; instead a critical tool that was quickly becoming a part of life. Public clocks still served as the primary source of time as they were

universally accessible, though not ubiquitous in their location.⁴⁷ In contrast, the watch allowed people to harness time in their pockets if they could afford one. Historian Alexis McCrossen noted: "The pocket watch was an indispensable part of the self-made American's tool kit. It was a vehicle of self-realization, rather than a privilege and inheritance."⁴⁸

Historian Michael O'Malley noted that beginning in 1870 and continuing into the twentieth century, advertisements pushed Americans to view mechanical timekeepers as essential. Among other things, the advertisements of the era promoted that "standardized clock time [was] a tool of education and industry, a sort of uniform that all laborers in the commercial army were required to put on at childhood and wear through life."⁴⁹ An 1870 journal article exemplified this: "ingenuity and perseverance have compassed the possibility of [the watch's] endless multiplication. Once the luxury of the rich only, it is now the necessity of all."⁵⁰

Within four years after the Centennial, the societal transformation towards punctuality would be virtually complete. O'Malley noted that by 1880, "Americans experienced one aspect of this reformation of time consciousness in a new emphasis on strict punctuality in work, in private life and at public events, theaters and concerts."⁵¹ Thus, the 1876 Centennial found itself amidst a revolution in timekeeping.

The price range of most watches, even 'affordable' watches, was still expensive for the era. The necessity and desire for watch ownership drove consumers to spend a notable portion of their annual income on a watch to be able to tell the time in a punctually driven economy.⁵² In 1870, about one in

every twenty-one American adults owned a watch, making ownership far from universal, but the increasing importance of timekeeping meant that demand was on the rise. Within thirty years, ownership would quadruple to an estimated one in every five American adults.⁵³

As the societal shift began, the Swiss watchmakers responded to the growing demand. The Swiss were willing to produce any quality of watch; few of the watches sold were works of art. The average quality was so dubious that American publications of the era portrayed the Swiss as if they were equivalent to an untrustworthy but mass-producing emerging economy.

One publication wrote: “such is her unrivalled cheapness of production that she has undermined the manufacture in the other European countries, which now send to Switzerland to have the pieces of their own watches made.”⁵⁴ The devolution into poor quality was aptly captured in an English publication of the era:

During the time of prosperity of the trade a good many [Swiss] agricultural labourers [left] their former occupation and dedicate[d] themselves to the watch industry. A superabundance of hands soon ensued, accompanied by a falling of wages, and besides, the quality of the products manufactured became yearly worse and worse. Only some few tradesmen continued to manufacture watches of higher qualities, while the majority of them supplied the markets with the lowest kind of products...An over confidence in monopoly led to deterioration of the article. The result

*was that Swiss watches fell into discredit in the United States.*⁵⁵

Even widely read publications such as *Appleton's Journal* began heralding the problem. *Appleton's* wrote that Swiss "products of a fraudulent commerce are scattered broadcast over the country, while its victims are taxed millions of dollars annually for the repair of shabby and dishonest work."⁵⁶ The Swiss leaders later acknowledged allowing their fellow citizens to take advantage of America's increasing demand, sending the "worst trash" to unsuspecting customers an ocean away.⁵⁷

The panic of 1873

By some measures, watches were Switzerland's most important export industry, and America was the top consumer. One Swiss leader referred to America as Switzerland's "milk cow."⁵⁸ 1873 would prove to be a critical year for the Swiss industry, marking the beginning of the Panic of 1873, which would turn into a global depression, the worst of which struck from 1873 to 1879. Exports of Swiss watches to America suddenly dropped from 366,000 in 1872 to 75,000 by 1876.⁵⁹ The Swiss were alarmed to see their U.S. exports fall, but the Panic provided a facade for an underlying shift in the watch industry that was taking place simultaneously.

While the Swiss focused on the Panic of 1873 as a central cause of declining exports, Waltham was advancing and growing. During this period, and leading up to it, Waltham was earning an untarnished reputation. The official history of the Centennial noted: "The Waltham watches have long been regarded as the best of American manufacture, and the universal

testimony of all who have used them is that they are unexcelled by any in the world.”⁶⁰ A prominent Swiss watchmaker, upon seeing Waltham’s exhibit confessed: “I personally have doubted that competition. But now I have seen –I have felt it–and am terrified by the danger to which our industry is exposed.”⁶¹

It had finally set in – it was not the Panic of 1873 that caused Switzerland’s “milk cow” to run dry, but rather a quickly growing American industry that had unequivocally transformed the existing market order. David would observe: “Business [in America] is rock bottom as far as concerns Swiss watches. They do not want to see them, they do not want to talk about them and everyone is undercutting his neighbour to get rid of any stock he has, without success.”⁶² In June 1876, Gribi wrote to his fellow watchmakers in Switzerland: “we have been left behind.”⁶³

Jacques David

As news arrived back in Switzerland describing the watchmakers’ situation at the Centennial Exhibition, the Swiss watchmakers’ professional society decided to send an additional expert to join Gribi.⁶⁴ The Intercantonal Society of Jura Industries (SIJ), a newly formed trade association for watchmakers that represented their collective interests, selected Jacques David. David and Gribi had specific instructions from the SIJ: “make a serious and detailed study of the organization, tools, financial situation and in general any other aspect of American watch factories.”⁶⁵

The young Jacques David was an early advocate of using machines to produce watches and served as an engineer, making him a natural and

convenient choice. After a ten-day voyage, David arrived in New York aboard the *Amerique* on August 23, 1876, and proceeded onto Philadelphia, almost exactly halfway through the Centennial Exhibition's run.⁶⁶



*Jacques David, shown later in life. He was 31 in 1876.
("La Patrie Suisse," No. 500, 1912, Public Domain).*

With his arrival, David and Gribi, embarked on their mission, one that would be essential to the future survival of their industry and the Swiss national economy. These two unsuspecting watchmakers were about to become industrial spies, playing a critical part in the transformation of Swiss watchmaking, one that would change the history of the global watch industry forever.⁶⁷