Figure 1. Carl W. Gay’s depiction of the biological “mechanics” of a horse, explained in terms of propulsion and locomotion in Productive Horse Husbandry, 1914.
“33,000 foot pounds of work per minute”: what better anticipated the increasingly mechanized and rational worldview that would come to characterize the nineteenth century than James Watts’ reduction of horses to units of labor output that we still call *horsepower*? Watts, who used this concept to explicate his invention of the steam engine, crudely fashioned his definition of horsepower from empirical observation and experimentation with draft horses. By 1821, however, the logics of measurement and standardization and their applications to both steam engines and horses found renewed precision in Baron Prony’s invention of the dynamometer. With its ability to “measure force overcoming resistance or producing motion,” the dynamometer became “the biggest thing that has ever happened in draft horse history. Horses…[could] now be chosen because of their worth, ascertained by actual performance.”

In a striking reversal of Watts’ attempt to characterize his machines as horses, the dynamometer was now able to definitively render horses as machines. This conception of horses-as-machines extended well into the twentieth century, as exemplified in 1914 by agricultural economist and professor Carl W. Gay’s aptly titled “The Horse—a Machine.” Gay analyzes the anatomy of horses and the mechanism of steam engines: “The digestive system of the horse may be regarded as the boiler whence the energy is supplied; the muscular system as comprising the motors; the power exerted by the muscle motors… [operates] the bone columns, by the alternate flexion and extension of which locomotion is accomplished” (fig. 1). In Gay’s conception of horses as engines, the best horses were those that produced the most work for the least food.
Figure 2. Alfred Speer’s proposal for an elevated moving sidewalk, 1871.
Figure 3. The first test of Charles T. Harvey’s elevated railway, 1867. Courtesy Museum of the City of New York Photo Archives. X2010.11.14495.
Figure 4. R.H. Gilbert’s elevated pneumatic rail system, 1872.
Between Watts’ attempt to frame machines as horses in the late eighteenth century and Gay’s attempt to characterize horses as machines in the early twentieth century lies the paradox of a nineteenth century horse. Within the high-modernist ideals of rationalism, standardization, and efficiency, horses were forced to toggle between their roles as living-breathing animals and indispensable labor objects. The fact is, during the nineteenth-century, horses were central and highly visible actors in the everyday operations of the transatlantic economy and the inner workings of daily city life. They powered public transportation, hauled materials, dug canals, pulled ferry boats and fire engines, facilitated dredging and brickmaking, drove hoists and grain elevators—horses were called upon to provide any operation that required locomotion and power to be performed. As this paper will demonstrate, disruptions to the flow of horsepower—that is, disruptions to the health and availability of horses—would devastate nineteenth-century commerce, the rhythm of domestic and international supply chains, and the experience of everyday urban life. Thus, when Watts invented his low-pressure steam engine in 1775 and attempted to sell it to manufacturers, the same question always arose: “How many horses can it replace?”

The concept of horsepower helped to answer this question and build public confidence in Watts’s steam engine. The power supplied by actual horses nevertheless remained indispensable to various industries while debates raged on about animal versus mechanical labor. As historian Joel Tarr identifies, a key example of this debate occurred in 1860 when the Polytechnic Association of the American Institute of New York City sponsored a discussion comparing horses to steam engines, spanning over which provided the most hygienic, efficient, and economical means of locomotion. One attendee who advocated for horses noted that a single-horsepower steam engine cost $300, required an operator at $1.50 per day, and had fuel and maintenance needs of $0.57 per day. A horse, meanwhile, could be purchased for about half the initial cost, required no additional technical training to operate, and required only about $4.20 per day to maintain. In opposition to this argument, supporters of the steam engine lauded its reliability, noting how horses were prone to injury as they aged, grew weary, and needed to be fed and cared for even when they were not working.

The terms of the debate shifted in the fall of 1872, when an unforeseen vulnerability of horses suddenly and indisputably demonstrated their biological and non-mechanistic reality. On September 30th of that year, a terrible epizootic plague appeared in Toronto, Canada. Following the paths of least resistance and greatest transmissibility, the epizootic quickly made its way along the Erie Canal to New York City, where it infected, disabled, and killed tens of thousands of the city’s workhorses. Named “The Horse Plague” of 1872 by The New York Times, this epizootic stripped society of its primary source of mobility and power, bringing the Erie Canal and all major east coast cities to a standstill before infiltrating the whole of North America and halting large swaths of the US economy. This paper focuses on the effects of the epizootic in New York City, where daily life was greatly altered by the decimated equine population. Although New York City continued to depend on horses until 1917, when the city’s last horse-drawn streetcar line was discontinued, the Horse Plague nevertheless shifted public discourse around issues of public transportation, urban sanitation, and the ethical treatment of animals at the end of the nineteenth century; New York City residents and the media pressured the city to implement alternative, more diverse, and more reliable sources of power.

To understand how the Horse Plague enabled such vast social and technological transformations, it is important to understand the historical conditions under which it emerged. New York City was a very different place just prior to the Horse Plague of 1872. The United States was yet to turn one hundred years old, and the Civil War had ended only a few years earlier. Central Park would not be officially completed for another four years, 1873.
the Statue of Liberty, Brooklyn Bridge, and the opening of Ellis Island were all more than a decade away, and there were not yet five boroughs to consol- idate into the singular metropolis that we call New York City today. What was the same, however, were perva- sive issues surrounding congestion, sanitation, and a nagging need for added and improved means of public transportation. As the city grid and its rapidly growing population spread across Manhattan Island in accord- ance with the Commissioner’s Plan of 1811, the city faced the emergent and growing problem of how to safely and efficiently transport people back and forth between its congested economic center in lower Manhattan and its north- ward expansion. Indeed, even in the late nineteenth century, New York was an urban environment ripe for experiments in urban mobility.

Well before 1872, there were numerous and remarkable attempts to establish rapid transit systems in New York that did not rely on horse labor, chief among them were proposals to construct elevated railways powered by steam or compressed air. Though proposals for a mechanically powered, elevated rail system in New York date as far back as 1832, after which one-off ideas for elevated transit peppered popular media throughout the 1840s and 1850s, they did not begin to capti- vate the public imagination until the 1853 “Exhibition of the Industry of All Nations” held in New York’s Crystal Palace on the plot of land that is now Bryant Park. Primarily remembered for its 315-foot tall Latting Observatory and the first public demonstration of Elisha Otis’ elevator safety brake, the 1853 World’s Fair also hosted three propos- als for an elevated rail system, including one designed by John Randel, the chief surveyor of the 1811 Commissioners’ Plan. Demonstrating his “New Broadway over Broadway” using a 40-foot long model made of iron, Randel’s proposal was well received by both the public and the media, who called it a “magnificent plan in consid- eration.” But when submitted as a formal proposal to the city, Randel’s “New Broadway” was rejected with the remark that it “would no doubt destroy the appearance of the street, as well as drive the citizens entirely from it.”

The infrastructures and economies surrounding horse-powered street- cars, omnibuses, and stagecoaches that had been New York’s estab- lished and accepted means of trans- portation for decades would not be easily supplanted by newer and unproven technologies. Many propos- als for alternative and mechanically powered public transit continued to emerge in the months just prior to the Horse Plague. Like Randel’s “New Broadway,” however, they were dismissed for being aestheti- cally or spatially undesirable, financial impractical, or simply a frivolous novelty (figs. 2-4).

Nineteenth-century New York not only faced rising congestion but, as the city had only just begun to lay pipes for its first sewer system in the 1850s, it also suffered from dismally unsan- itary streets and public life. In 1865, after repeated outbreaks of cholera, typhoid, and smallpox, a group of resi- dents formed the Citizens Association of New York to pressure the city over its intolerable state. City officials responded by conducting a complete evaluation of the sanitary conditions of New York, the results of which were published in The 1865 Report of the Council of Hygiene and Public Health, which The New York Times described as “the first interior view of the sanitary and social condition of the population of New York.”

At this moment in the nineteenth century, germ theory was still in its infancy, and Louis Pasteur’s vaccines for anthrax and rabies were still decades away. The existence and transmission of pathogens smaller than bacteria remained purely theoretical as viruses would not be verified until 1892. Rather, the 1865 Report aligned with the leading scientific and medi- cal theory of its time, miasma theory, which, broadly speaking, attributed the cause of diseases to toxic “miasmatic” air originating from stagnant waters and rotting organic matter. The Report argued that perceptibly clean spaces produce healthy inhabitants by noting, for example, how the highest rates of cholera were found in “localities where
the streets are dirtiest." 18 Linking the unsatisfactory state of public health to the city’s expanding horse population, the Report cited the unsanitary condition of New York’s many stables as a primary cause of the miasma, along with the improper disposal of horse carcasses and the prevalence of horse manure in city streets. The Report visualized evidence for these claims in “Encroachment of Nuisances Upon Populous Uptown Districts,” a map that depicts only a narrow strip of Manhattan between Thirty-Fourth and Forty-Sixth Street, and yet identifies over two dozen locations for manure yards, animal stables, and slaughter houses, including a large and centrally located space for “manure heaps in summer” at the intersection of Forty-Fourth Street and Seventh Avenue, the future site of Times Square (fig. 5). 19 In its survey of public health, the 1865 report thus also provides a glimpse into the vast amount of space and infrastructure dedicated to maintaining the city’s substantial populations of equine labor. More generally, such requisite inspection of transit infrastructures within a city-mandated report on public health affirmed the critical link between public sanitation and public transportation in nineteenth-century cities.

The 1865 Report successfully empowered bureaucratic shifts within New York City’s municipal government, which responded by establishing its first Board of Health the next year. Nevertheless, the material reality of the city’s sordid living conditions remained intact.21 Recounting the “old story over again,” an 1871 article in The New York Times endorsed the causal link between horse-powered transit and the hostile miasma with a startlingly fetid scene: “There is a mass of putrid matter too horrible to describe…the surest fertilizer of disease and death…streets are over ankle deep with putridity…the distillation of dead horse…and stale manure…localities too numerous to mention are in proportionally disgusting condition.”22 A subsequent article unequivocally identified horses as the chief cause of the miasma, claiming new forms of locomotion and power to be the only viable solution for eliminating all at once the city’s health and transportation issues: “…the odious mixture that accumulates in our thoroughfares...is an absurdity. Really clean and economical roads...cannot be had in a great City like this until horse power is superseded....”23 The 1865 Report formally declared New York “unsuitable for human development.” Indeed, the city disturbingly proved to be the perfect environment for the proliferation of highly contagious diseases.24 According to the US Department of Agriculture, after the first documented case of Horse Plague surfaced in Toronto on September 30th, 1872, it moved quickly “along the great lines of commerce and travel.”25 In his 1874 paper “History and Course of the Epizootic Among Horses Upon the North American Continent 1872-73.”26 United States Department of Agriculture, Report of the Commissioner of Agriculture for the Year... (U.S. Government Printing Office, 1874), 236.
North American Continent in 1872-73,” Dr. Adoniram B. Judson mapped the spread of the epizootic across space and time (fig. 6). He noted how this plague, migrating outward from Toronto, was rapidly carried west via the Great Lakes and east along the Erie Canal, taking only three weeks to reach New York City, four weeks to infiltrate Chicago, and roughly seven months to traverse the entire North American continent.

As the Horse Plague spread, the biological “flaws” of the so-called living machine were quickly revealed. The effects of the epizootic on horses’ bodies were swift and unforgiving; horses throughout North America became infected with respiratory symptoms akin to severe cases of influenza: coughing, chills, fever, weakness—symptoms that were often debilitating and frequently fatal. Believing his map was key to understanding disease behavior, Dr. Judson, departing from the miasma paradigm, argued that the Horse Plague spread by means of close contact among horses and not through “specific atmospheric conditions.”

By mapping the intercity railroad network of North America, and overlaying this map with a time signature denoting outsets of the plague, Judson was able to visualize the communicability of the epizootic as a function of the relative distance and connectivity between cities, thus identifying the importance of physical distance, movement, and social contact in the transmission of diseases. He hypothesized that quarantine is the only effective measure against future epizootics but concludes that “the enforcement of quarantine regulations...would probably be considered more disastrous than an epidemic of influenza.”

The sudden loss of horse labor was unexpected and crippling for many cities and the US economy at large. In New York, the Horse Plague struck with such celerity that there was little time to evaluate quarantine measures, let alone implement them. While a different epizootic had struck New York the year prior, its effects paled in comparison to the Horse Plague of 1872, and therefore did little to prepare the city for the coming disaster. In October 1872, as many as 17,000 horses powered New York City’s eighteen stagecoach and streetcar lines alone, with an estimated total population of 150,000 horses in city stables (approximately one horse for every seven residents).
Within seventy-two hours of this plague’s arrival, 15,000 horses throughout the city were declared “unfit for use.” And by October 25th, four days after New York’s first reported case, public transportation was suspended city-wide as there was “scarcely a stable in the city without the disease.”

The speed with which the epizootic spread at the urban scale can be better understood by looking at the spatial configuration of late-nineteenth and early-twentieth century urban horse stables and the science underlying their design. For instance, returning to Gay’s 1914 Productive Horse Husbandry, it is clear that neither Judson’s research on the relationship between distance and disease transmissibility, nor the break-through discoveries in microbiology in the 1880s, was incorporated into the design of stables in the decades following the Horse Plague. Rather, Gay primarily cites two problematic sources for his recommended “city subway stables”: US Army veterinarian Fred Smith’s 1887 Manual for Veterinary Hygiene and Francis M. Ware’s 1903 First Hand Bits of Stable Lore. While Smith attempts to incorporate emergent research on animal pathology, Ware bases his book on the thirty years’ active personal experience with every kind of horse for every conceivable purpose—the experience that extends back to the plague and therefore precedes the emergence of bacteriology, a science he willfully ignores. Ware categorically dismisses stables with “the most expert and newly approved patterns” designed by architects and scientists in favor of those produced by the experience of “practical men,” arguing that “in equine pathology all treatment must be speculative” and that physically isolating a sick horse will only exacerbate its illness due to “his homesickness for familiar scenes.”

Smith, for his part, recommends immediately isolating a visibly sick horse, quarantining all remaining horses at a minimum 15-foot distance, and inspecting each horse daily. However, in an unfortunate conflation of emergent research with obsolete science, Smith substantiates his astute spatialization of germ theory with the defunct claims of miasma theory: he praises and republishes the dubious findings of an 1866 paper, which argues that stable managers can monitor the toxicity of horse stables simply by smelling the air. Gay, whose book was used as a high school and college textbook, republishes Smith’s republication of the spurious 1866 paper, thus re-legitimizing the claims of a nineteenth-century pseudoscience and deeply embedding them within twentieth-century academia. Clearly, like the presence of horse labor in the age of superior steam power, outdated and disproven nineteenth-century science also found a way to persist within twentieth-century studies and spatializations of animal pathology. The cramped quarters of Gay’s “model stables” (fig. 7) made it impossible for horses to be appropriately distanced from one another, clarifying how the epizootic could spread so rapidly among New York’s horse populations decades earlier, just as it also left the city vulnerable to future outbreaks.

As horses increasingly fell ill, nearly all industries that depended upon the exploitation of horse labor greatly slowed or ceased operations altogether. Without a means to pull boats through the Erie Canal or transport goods from shipyards, domestic and international trade networks along the east coast ground to a halt. Newspapers issued warnings about the approaching economic paralysis and financial panic. Industries tied to the production and distribution networks of perishable food items swiftly collapsed as their wares spoiled in gridlock. Unable to mobilize raw materials, New York’s construction industry ceased operations. Other enterprises were forced to hire human laborers at exorbitant cost, as “horse transportation was not to be had at any price.”

With the city at a standstill and with little understanding of how long the Horse Plague would last, the mayor’s office became desperate for solutions and passed a resolution that,
Dependence on horse labor was not restricted to mass transportation and industry alone. Funerals, weddings, ambulances, mail delivery, small business, fire departments, police were all suddenly without a means to effectively operate and mobilize. For example, of the 144 horses owned by the New York Fire Department, only two managed to escape the epizootic. The absence of fire department horses proved particularly disastrous in Boston, which, as a result of the epizootic, had far fewer resources to combat the horrific fire that struck the city on November 9th, 1872, decimating more than sixty-four acres and 700 buildings in the city. Firefighters were forced to handcart water and other resources to combat the conflagration, a far slower process than if horses and steam engines had been available.

In The Autobiography of an Idea, the celebrated American architect, Louis Sullivan, who was then a student at MIT, vividly recounts the effects of the Horse Plague in the spread of “the great conflagration” of Boston as he writes, “More excitement: Came the great conflagration of 9 and 10 November, 1872...No fire engine came. Horses were sick, “epizootic” was raging...The city seemed doomed.” “The Afflicted Horses: An Alarming General Dependence on horse labor was not restricted to mass transportation and industry alone. Funerals, weddings, ambulances, mail delivery, small business, fire departments, police were all suddenly without a means to effectively operate and mobilize. For example, of the 144 horses owned by the New York Fire Department, only two managed to escape the epizootic. The absence of fire department horses proved particularly disastrous in Boston, which, as a result of the epizootic, had far fewer resources to combat the horrific fire that struck the city on November 9th, 1872, decimating more than sixty-four acres and 700 buildings in the city. Firefighters were forced to handcart water and other resources to combat the conflagration, a far slower process than if horses and steam engines had been available.

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viability of steam-powered public transit: They were small and relatively noiseless; they could move as quickly as a horsecar; and they did not frighten horses. But, as one reporter notes, the Bleeker-Street experiment did little to ensure pedestrian safety. Unsatisfied by this marginal progress, the public and the media continued to press for alternative transit that did not simply adapt to the city’s existing and outdated street-surface infrastructure.

By mid-November 1872, roughly three weeks after confirming its first case of the Horse Plague, New York City began returning to normal operations. While streetcar and stagecoach lines were not yet operating at full capacity, services were partially restored after the city, as a stopgap measure, purchased hundreds of horses from the countryside that had avoided contracting the disease. All told, when the Horse Plague finally dissipated throughout North America—approximately one year after the Toronto outbreak—the US Department of Agriculture estimated that between 80% to 99% of horses located in areas affected by the Horse Plague contracted the disease. In the plague’s brutal aftermath in New York, “dead horses were piled up by the thousand” with carcasses “lying in the gutter” of “nearly every street uptown.” But, while the shocking scenes of the Horse Plague as it ravaged North America dominated the headlines, the inescapably filthy conditions of New York City continued to degrade the health of its human residents. For instance, in the week in which thousands of horses first contracted this plague, newspapers also reported that one hundred and forty-six New Yorkers had died from various zymotic diseases. Clearly, the city still had much work to do on many fronts.

In the spring of 1873, amid occasional resurgences of a milder form of the epizootic, design and construction of steam-powered, elevated railway systems proceeded apace. On March 28th, 1873, it was announced that an elevated rail would be constructed along Sixth Avenue as part of R.H. Gilbert’s original 1872 plan, with the exception that it would be powered by steam, not condensed air, and constructed by means and materials more economical than decorated iron. That same year, The New York Elevated Railroad Company, in addition to its existing Ninth Avenue line, opened another elevated line over Third Avenue. This was soon followed by the Second Avenue line, opened by The Metropolitan Elevated Railway Company. By 1879, New York had four elevated and steam-powered rapid transit systems in operation, which were consolidated as The Manhattan Railway Company in May of that year (fig. 8). Long considered machines themselves, horses had finally begun to be replaced by them.

The Horse Plague was surely not the only incitement to realize New York’s first unified and mechanically-powered public transportation system. Nor did the elevated system solve the city’s now centuries-old issues surrounding public transportation and natural disaster, as evidenced by the near total absence of elevated railways in present-day Manhattan. Rather, a key and demonstrable outcome of the Horse Plague was a diversification in the means by which New York supplied its power, decreasing the city’s singular dependence on horse labor as it progressively moved towards steam engine locomotion. This shift from animal to machine labor raises a critical question: when a crisis unassailably reveals deep-seated vulnerabilities and harmful misperceptions, what is required to empower transformation and new world-making? Conversely, what countermeasures can be taken against archaic and regressive ideas that persist long after their expiration date has passed? While this essay does not claim to have answered these questions, the effects of the Horse Plague on New York City show how an institutional authority weighed the pros and cons of available technologies and science against the realities of public pressure, media pressure, and inimitable disaster, if only to accelerate the dissolution of old and harmful structures in concert with the realization and normalization of alternative ideas.