The decline of the urban horse in American cities

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As American cities experienced massive economic growth in the nineteenth century, expanding requirements for local transport led to increased demand for horses. Every pound of freight that travelled on the nation's new railroad network required local delivery, and that was usually by horse. As *The Nation* observed on 31 October 1872, human 'dependence on horses has grown, *pari passu*, with our dependence on steam'.[1] The symbiotic relationship between the two species dated back six millennia: as Jared Diamond notes, horses were perfect domesticable animals with dominance hierarchies, a tolerance for other species and herding instincts.[2]

In an age of rapid urbanisation, horses flourished. Census and city records suggest that horses were urbanised more rapidly than people in the third quarter of the nineteenth century, a measure of their indispensability. Boston, not an especially horse-dependent city, but one for which there are good records, reflects this pattern. Between 1742, when horses were taxed for the first time, and 1841 there were roughly forty humans for each horse. By 1880 the ratio had dropped to twenty-five, although it was back up to forty in 1900 after the electrification of street railways. Over the next ten years the number of horses grew slightly, but did not come close to keeping up with the slow growth rate of the human population. Then it dropped dramatically and by 1920 Boston had fewer horses than in 1820.[3]

Large nineteenth-century cities in the United States averaged roughly one horse for every nineteen people, although the ratio of humans to horses varied widely, as reflected in the examples of numbers of humans per horse by urban county in 1900 shown in Table 1.[4] Even where the ratio was high, the total number of horses could be quite large. For example, 130,000 horses worked in Manhattan in 1900, while Chicago had 74,000 horses and Philadelphia 51,000.[5] These figures do not count animals working in the city but stabled on cheap suburban land or the farm animals that trekked cityward every day, carrying fresh produce for urban consumers.

Cities depended almost totally on horses for internal freight movement, for public transport, for private travel and for emergency services. Horseback riding, it should be noted, was very uncommon and limited to the odd leisure rider on the bridle paths of parks, the racetrack or the police. Commuting by

Table 1 Humans per horse in American cities in 1900

City	*Humans*	*Horses*
Kansas City	7	4
Minneapolis–St Paul	9	3
Los Angeles	12	7
Denver	14	7
Memphis	17	0
St Louis	17	5
Buffalo	18	5
San Francisco	20	1
Columbus	20	8
Chicago	22	9
Pittsburgh	23	0
Cincinnati	23	3
Philadelphia	25	3
New York	26	4

carriage was exceedingly rare. Horses provided an important source of stationary power for construction, hoisting, and dock and harbour work.[6] According to one estimate, until 1850 animals provided more energy than machines in the United States and urban animals were more important than rural.[7] Another source claims that animal sources of power prevailed until 1880.[8] Urbanites continued to rely upon horses for power long after the steam engine became available.[9]

Engineering theory and stationary applications

Nineteenth-century business owners valued horses for the profits that they produced; to them horses were mostly machines. Robert Bakewell, the eighteenth-century English pioneer of modern breeding, for instance, 'sought to discover the animal which was the best machine for turning food into money'.[10] The *Journal of the Franklin Institute* noted in 1833 that 'the name of horse power has become technical, and is applied to any apparatus by means of which a horse is made to exert his power in propelling machinery'.[11] One important book on animal husbandry, with a chapter entitled 'The horse as a machine', argued that the best horses were those that produced the most work for the least food.[12] As one unsentimental English author put it, 'the horse is looked on as a machine, for sentiment pays no dividend'.[13] In the 'rational' world of the nineteenth century, people increasingly viewed horses as property, subject to management, and not as moral beings. Horse-using societies unleashed their scientists and engineers to study equine machines and the horse became a form of technology.

Anson Rabinbach has traced the evolution of the science of animal power in the nineteenth century, focusing on what he calls 'the Human Motor', but much of what he writes also applies to the equine motor. This process involved the emergence of thermodynamics and consequent understanding

that the body (whether human or animal) was a site for energy conversion, the key insight of modern physiology. By 1806 the dynamometer had been applied to measure animal strength. Later, Julius Liebig compared nutrition to a furnace. Etienne-Jules Morey began to study animal mechanics in the 1870s, viewing muscle as a tool. And Edward Muybridge added another tool to the scientific analysis of the work potential of animals in 1871 when he began to photograph moving horses to analyse their gait.[14]

As early as 1839 engineer Elwood Morris conducted controlled experiments on the Chesapeake & Ohio Canal. Individual horses lifted between 9.5 million lb and 17.2 million lb per shift. While size was important, it did not explain most of the variation from horse to horse. He believed that such factors as wind, lameness and even 'will' explained much of the variation. After eight hours at 4 km hr most horses were fatigued.[15]

How much power horses could supply was a matter of constant investigation. Robert Thurston, first president of the American Society of Mechanical Engineers, wrote as late as 1895 that all vertebrate animals, such as the horse or a human, were 'prime motor[s] . . . the engineer regards the animal system with peculiar interest, as a machine of singularly complicated structure. Apart from intelligence and will . . . it is a self-contained prime mover.'[16] For Thurston the 'efficiency of the animal, considered as a machine', depended upon the amount of 'stored energy' supplied. He and others wrote about the 'horse power' machine which converted the 'linear, ambulatory, slightly rhythmic gait of the animal – horse or ox – to the rotary motion required by most machinery', usually by gears. Drawing largely on European advances in physiology, but also on a number of experiments in the United States, Thurston compared oxen, horses, human beings and steam engines, guiding his readers to the best power source for their purpose.[17] For light and sporadic duty, horses were best. Putting matters of power into comparative perspective, he constructed an elaborate table of species, type of work and time. For a four-hour shift he concluded that humans could move 4,420 horse lb per minute, mules 16,530, oxen 22,044 and horses themselves 24,780. Humans tired more than horses if the work shift was eight hours but less than oxen.[18] He also noted, 'In the selection and employment of men and animals the engineer is compelled to regard them as machines.' The *Street Railway Gazette* regularly reported on similar tests about horse size and strength in its columns.[19]

William Youatt, who wrote the most important stable management manual of the mid-nineteenth century, noted that an unloaded horse could travel 14.75 m.p.h. for one hour, 8.5 m.p.h. for three hours, 6 m.p.h. for six and 4.67 m.p.h. for ten to attain peak efficiency. He argued that one horse could pull more with a two-wheel, rather than four-wheel, vehicle, since there was less friction with the pavement and the wheel was larger, but carthorses were more easily fatigued and worn out. Thus for short distances over good roads carts were better than wagons. Youatt put the analysis purely in cost terms.[20] An American commentator pointed out that the study left out a major variable, namely that two carts required two drivers. One pair of heavy draught

animals with a heavy truck could pull as much as four one-horse drays. This cut feeding costs and reduced stabling costs by 50 per cent, although the real saving was in the elimination of three drivers.[21]

In 1874 the civil engineer John Trautwine calculated that a 'good average trained horse, weighing not less than ½ a ton, well fed and treated [and] . . . walking for 10 hours a day, at the rate of 2½ miles per hour, on a good level road . . . can exert a continuous pull, draught, power or traction of 100 lbs'. He calculated that this approximated 22,000 ft lb per minute, or enough force to lift 13,200,000 lb one foot high in a day. Trautwine noted that Boulton & Watt had calculated the 'nominal horse-power' as 33,000 ft lb per minute, using a 'very strong horse' rather than an 'average horse' as the basis of the assumption. Since no horse, he added, could 'work day and night for months without stopping', like a steam engine, it was apparent that a 'one-horse engine could do much more work than any one such horse'.[22] Pumping machines and factories that ran machinery, which required lots of horse power for long periods of time, switched to steam first, substituting mechanical horse power for the real thing. However, such applications were uncommon. Nor does Trautwine discuss the possibility of using horses in shifts.

There are many examples of the horse applied 'as a machine' in industrial contexts and it is important to examine these applications before looking at transport *per se*. Horses in America powered machinery in factories, pumped water, hoisted construction materials and even dredged harbours and canals.[23] While steam powered dredges in large-scale projects, on small operations horses often provided the power.[24] Horses were used at several major American engineering sites, including the building of the Alexandria aqueduct from 1833 to 1835 and the construction of the Brooklyn naval dry dock in 1845.[25] Horses drove dragging and scraping machinery (for example, mechanical rotary brooms for street cleaning) and pulled ice-cutting ploughs that cut ice across ponds, afterwards carrying the blocks of ice to the nearest shed.[26] The US Patent Office issued 333 patents for horse-powered machinery up to 1873.[27] Catalogues of agricultural and industrial machinery illustrate the variety of horse-powered tools that an interested customer might buy, including capstans (or whims), turntables and treadmills.[28] Hoisting machinery seemed an especially popular application.[29] In 1864 the Ohio State Fair gave prizes to 107 different types of horse-powered machines, many with non-farm applications.[30] As late as 1875 *Scientific American* noted that 'no [steam] engine adapted to the needs of the workshop was available', and this was 100 years after James Watt.

Nathan Rosenberg and Dolores Greenberg have noted that US mechanisation did not involve a 'massive shift to new power sources', but rather relied upon a range of traditional sources, especially water power, horse power and human power.[31] A study of manufacturing in Philadelphia between 1850 and 1880 reinforces this conclusion, emphasising the limited number of firms with steam or water power and the extent to which older manufacturing processes persisted over time, especially in low-power industries such as wool carding, bagging and rope making.[32] In 1859, for example, *Scientific*

American observed that the horse power as a 'prime mover for driving subordinate machinery . . . [occupied] the same place on a farm or in a small factory that a steam-engine or water-wheel does in other cases'. The periodical also noted that many improvements had been made in the ancient technology, adapting it to new applications.[33]

Horse power had low costs and flexibility that served the needs of the machine shops that began to appear in American cities and towns during the first half of the nineteenth century. These small shops usually specialised in repair work and constructing tools or small steam engines on special order.[34] One of the first examples of such a machine shop was in Pittsburgh, a centre of early machine building, where Benjamin Latrobe built a shop in 1814 to construct steamboat engines. His power, ironically enough, came from two blind horses which drove 'a perpendicular shaft, wheels, and drums to turn the lathes and drills'.[35]

In 1860 the American Institute held a discussion in New York City about 'motive power', debating the relative costs of steam power versus horse power. Advocates of horses argued that the costs of steam power were too high: $300 for a one horse-power steam engine, 25c a day for coal and $1.50 a day for a skilled operator, compared with low initial costs, 40c a day for food (20c in the country) and a working life of six to fifteen years for horses.[36] Horses provided small manufacturers with flexibility because they could be added or subtracted as needed; owners could also unhitch them from machines and hitch them to a wagon to deliver the finished product. Horses offered low capital costs for entry-level entrepreneurs.[37]

Robert Vogel has observed that the construction field 'probably was the last major technological-industrial area in the world to employ steam power widely and consistently'.[38] Horses were preferred in situations calling for limited and inexpensive power and they did not require skilled labour like a licensed boiler operator.[39] Even in large-scale construction operations horses were vital, and the builders of the New York subway loaded mules into their tunnels in 1900 when they started construction. The mules never saw the light of day and continued working underground until the subway was finished four years later, even though many of them went blind.[40] One ingenious deployment of horses and, arguably, their first application to urban mass transport was to use them as prime movers turning paddle wheels on ferryboats, paddle wheels that had been developed for steam-powered ferries, but retro-fitted to equine power. American inter-city railroads before 1832 also relied on horse power, in at least one case using a horse on a treadmill that was connected to a driving wheel by a belt.[41]

Thus, although horse power was theoretically obsolescent as soon as Watt invented the high-pressure steam engine, horses actually became increasingly common in the early nineteenth century. As late as 1895 thirty-four horses operated machinery in Suffolk County (Boston), in food preparation, quarrying, brick making, distilling and cement making.[42] The American economy was growing so rapidly that the number of horse-operated machines grew at the same time as their proportion of stationary power shrunk. Industrial

catalogues suggest that even as late as the 1920s some stationary applications of horses still existed.[43]

Urban transport

Horses may have made their greatest contribution in urban transport. On 1 January 1887 there were 4,864 miles of street railways with 20,392 cars and 98,659 horses in the United States.[44] Over twenty urban firms owned more than a thousand horses. The impact of horse-drawn cars in changing the shape of cities, fostering suburbanisation and the central business district has been noted by numerous scholars.[45]

The first horse-powered common carriers operating on American city streets were omnibuses. Abraham Brower operated the first line in New York City in 1831, and imitation followed rapidly.[46] The fares, typically 10c or 25c, were too high for lower-income groups.[47] Compared with European omnibuses, they used smaller horses and vehicles, and operated on rougher pavements.

There were attempts to adapt steam engines for street applications. At first railways tried to penetrate downtown and lay rails on top of city streets, but the authorities banned these, fearing high speeds and boiler explosions, as well as steam and smoke in the streets. The New York Central Railroad overcame many of these objections by switching from steam to horse power at Forty-second Street, before travelling on to its Fourteenth Street terminus. However this innovation had no imitators, since its rails rose above street-level, blocking cross-traffic. The streetcar concept did not really spread until 1852, when a French engineer working in New York, Alphonse Loubat, invented a side-bearing rail that could be laid flush with the street surface, allowing the first independent horse-drawn streetcar lines.

The streetcars' key advantage over the omnibus was smooth rails, a technology borrowed from steam railroads, just as horse boats adopted the paddle wheels of steamboats.[48] As the *American Railroad Journal* pointed out in 1853, 'the power of a horse on the rail is four times as great as on the pavement'.[49] Moreover horse cars only charged a nickel, which was much less than omnibuses.

Attempts to use steam power, however, failed. In 1863 one technical journal discussed the relative costs of horse and steam power in the context of urban transit.[50] And two years later the *American Railroad Journal* reported on six installations. Eventually a New York court ruled that 'the running of the cars may be regarded as a public nuisance'.[51] Cities always banned steamers, except on isolated rights of way to new suburbs, having allowed railroads to use a few downtown streets in mid-century, with disastrous results. They feared repeating the experience of blocked streets, noise and smoke in the nascent suburbs. Even though the light steam engines, called 'dummies' (because they were designed to avoid the appearance of locomotives), might accelerate suburbanisation, cities nonetheless banned them. Boston adopted some steam-driven fire engines after horse-drawn ones fell victim to an

influenza outbreak in 1872, and New York's aldermen authorised steam 'dummies' for thirty days for the same reason.[52]

Regulation alone, however, cannot explain the failure of steam power on American city streets. It is hard to believe that the entrepreneurs who had the political influence to obtain street railway franchises did not also have the clout to overcome 'environmental' regulations; therefore it seems that the higher cost of light steamers may have been the reason for their failure. At least eight street railway companies in New York in 1866, for instance, were experimenting with light steam-powered vehicles.[53] All of them had given up by 1870, the biological machine having triumphed over the mechanical. One study made before the Civil War claimed that a steam engine cost 42 per cent more a day to operate.[54] Thus the streetcar industry tried steam power, but rejected it as too costly.

The superiority of horse cars created a revolution, in both the travelling and residential patterns of American cities.[55] New York's mayor described the new service as 'the greatest invention in the history of man'.[56] By 1860 Common Councils in New York and Brooklyn had already franchised 143 miles of horse-car lines and the idea had spread to every large US city. In Boston the proportion of people who commuted, as listed in the City Directory, increased from 6 per cent in 1846 to 18 per cent in 1860. In 1870 a one-day traffic count on Boston's busy Tremont Street showed 56,400 pedestrians and 26,227 horse-car patrons, which suggests that horses were already meeting one-third of the city's downtown travel needs.[57] Horse railways also made downtown more accessible to suburban women, who had been reluctant to walk long distances on public streets.

The horse car was also a technology capable of enormous improvement. In 1860 it was easy to visualise lighter cars and better stock. For example, between 1855 and 1865 streetcar builder John Stephenson of New York cut the weight of the average street car from 6,200 lb to 3,500 lb without losing any of its twenty-passenger capacity. This represented a major saving in horse power, since two horses could now pull the same number of passengers that had previously required four.[58]

Since huge draught animals, suited to the heavy loads and constant stops and starts of street railway service, existed in Europe, it was merely a matter of identifying the best types and encouraging American farmers to import and breed them – an easy matter, given the premium prices that street railways were willing to pay for appropriate horses.[59] The weight (and, therefore, hauling ability) of street railway horses increased by roughly 50 per cent between 1860 and 1880. While French Percherons had weighed 1,200 lb to 1,300 lb in 1873, the winner at the Ohio State Fair in 1878 weighed no less than 2,015 lb.[60] And it may not even have been the heaviest horse, since the Fair judged by conformation and gait, not by weight or pulling contests.[61] *Harper's Monthly* (16 March 1912) has a photo of a horse belonging to a firm of New York truckmen that 'is said to be the largest horse in the world', weighing 2,430 lb, 20½ hands (6 ft 10 in.) at the withers. Eventually streetcars required only one horse on light runs, which was a huge saving.[62] Of

course, companies added extra horses for snow, steep hills and heavy rush-hour loads. (There are accounts of over a hundred passengers cramming themselves into and atop streetcars.)[63]

Other business costs also fell. The annual reports of the Metropolitan Street Railway of Boston for the 1870s and 1880s show reductions in the price of streetcars, feed and horses, while the *Statistical Abstract of the United States* shows the price of oats declining from 43c to 20c a bushel between 1870 and 1889, and hay falling from $14.65 to $8.11 a ton.[64] These prices were subject to wild fluctuation, as were all commodity prices in the nineteenth century. The price of oats, for example, rose from 22c per bushel in 1889 to 41c in 1890, then dropped back to nearly the original price, while the price of horses fluctuated 35 per cent, according to the annual reports of the Chicago Board of Trade. The decline in car prices is a little deceptive, since companies added open cars and small, ten-seat 'bobtail' cars (invented by John Slawson of New Orleans in 1860) for lighter travel times. More than half the streetcars in the United States were 'bobtails' by 1880. These required only a man and a horse to operate, but brought about an overall increase in the amount of rolling stock.[65] By 1890 nearly half of the Metropolitan Street Railway's cars were one-horse open cars, suitable only for summer.[66]

By 1885 operators of horse-drawn streetcars were less optimistic about the future. The enormous improvements in breeding techniques had probably achieved all that they could in terms of getting horses to their maximum size and speed. There is little specific information, but in the matter of speed there are good data showing that, while the record for trotting a mile dropped from 2.59 minutes to 2.00 minutes between 1806 and 1903,[67] almost all of the improvement came between the years 1840 and 1880.[68]

While incremental reductions in vehicle weight also seemed likely, no revolution of the kind created by John Stephenson and John Slawson could be visualised for the future. Nor did a continued decline in the price of horses and grain seem likely at a time when the supply of untilled arable land in the United States was running out. In a few cases, maximum rush-hour headway had been reached and it was physically impossible to add more peak-hour service. For example, in 1887 the Third Avenue Street Railway in New York City reported that it was operating on one-minute headways during the rush hour, a pace that could be maintained only by adding extra horses on hills.[69]

The decline in horse and fuel costs was offset by an increase in stabling costs. Growth required more horses and larger stables, at a time when land costs were rising. Moreover cheap wooden stables were no longer an option. Business practice which improved the health of horses and reduced the risk of fire demanded stables built from materials more durable than wood. Neighbourhoods were increasingly intolerant of stables, an intolerance that found its way into regulations, which limited locations or banned wood construction.

The economics of manure, once a valuable by-product of street railway stables, changed also. The volumes were considerable: a Brooklyn stable had horses which passed an average of 29 lb a day, so Manhattan's horses would have produced around 17.4 tons of manure every day.[70] The Second Avenue

Street Railway reported a decline in the value of manure produced per horse from $3.90 in 1870 to $1.10 in 1885, no small sum for a company that owned over 1,600 horses. Earlier, farmers had been willing to buy stable manure, but the increasing adoption of low-priced phosphate fertilisers, a superior product, made stable manure less valuable. Moreover, urban residents were less willing to allow stable owners to 'rot' their manure in a pit or pile, which enhanced its value. The law of nuisance also evolved. Before 1900 manure piles were only a 'nuisance' if they could be seen or smelt, but when it was demonstrated that they served as a breeding ground for insects that carried a variety of diseases the piles became a 'nuisance' over whatever range the insects could fly.[71]

The characteristics of ridership also changed. On average, each horse was pulling 27 per cent more passengers in 1890 than in 1880 and the average length of each passenger trip was longer, according to the US census.[72] The combination of downtown traffic jams and longer routes increased travel times, and heavier loads, sometimes over 100 passengers, stressed horses. The Metropolitan Street Railway in Boston averaged thirty-five passengers per trip in 1880 and forty-eight in 1890.[73] This increased wear and tear on horses and also slowed travelling because of the additional time needed to load and unload riders. The increase in ridership required larger, healthier horses, which were more expensive, both in initial cost and in depreciation, and stronger rolling stock, as well. The Second Avenue Street Railway in New York depreciated its horses at 7 per cent in 1880 and 16 per cent in 1885, suggesting a heavier work load.[74]

The influenza epidemic of 1872 showed another limitation. It stopped every street railway company in the United States, usually for weeks at a time, before full service resumed. After New York's devastating 1888 blizzard, an epidemic of a paralysing disease known as 'Azoturia', the result of being stabled too long without exercise, affected many horses. It took over a week to resume a regular schedule, and the American Society for the Prevention of Cruelty to Animals (ASPCA) had to shoot 100 ailing horses.[75] New York's Belt Line Street Railway was the victim of the worst stable fire ever in 1887, losing 1,185 horses in a matter of minutes.[76] Replacing them took weeks, and a new stable of brick, instead of wood, and including a sprinkler system, was much more expensive to build.

Other issues arose. The ASPCA was founded in 1866, and almost all cities soon had humane societies with police powers, which kept a close eye on street railways.[77] The latter, however, found ways to manipulate these groups, for example by having officials serve on their boards and getting them to lobby for municipal regulations which required cars to stop only at corners, instead of wherever flagged down. This made the horses' lives easier, since fewer stops meant less wear and tear on their legs, and also increased route speed. Street railway owners also hoped that these societies would restrain driver cruelty, since they feared that their employees would damage their stock. However, the actions of such organisations were hardly predictable.

Gradually well kept statistics demonstrated that horses were not as safe as people had once thought; for example, per vehicle, horse transport killed more people than internal combustion engine travel would do later. (Machines do not bite or kick, or take fright at pieces of flying paper.[78]) While harnessed tame animals had once symbolised human progress, they now seemed atavistic in an age which was increasingly proud of its mechanisation. As street railways looked to the future they saw unlimited growth in ridership if they could just meet demand. Urban residents were taking more trips per person as incomes rose, and travel distances increased in expanding cities. The number of rides per year, *per capita*, that residents of New York and Brooklyn took on horse cars had more than quadrupled between 1860 and 1885, even though steam-powered elevated railroads had taken over traffic on the main north–south streets of Manhattan.[79] Residents of other cities had not yet reached the same levels of horse car ridership as New Yorkers, but they were clearly moving in that direction.[80]

Ridership outpaced population growth, since cities were growing at their outskirts, requiring longer trips. Suburban living in detached, balloon-frame homes was becoming the 'American dream' and the new suburbanites depended on urban transit to reach their work. As Joel Tarr has demonstrated, they defined their housing taste in moral terms: suburbs were healthier, safer and purer than congested downtown areas.[81] Municipal governments reflected the desire for suburban living by pursuing a wide variety of pro-growth policies in taxation, in annexation and in the provision of services to new subdivisions. Horse-operated transit systems, apparently at their limit, now presented a bottleneck on the road to suburbanisation.

American transport entrepreneurs invariably speculated in suburban real estate; however, suburban extensions in the age of the horse were increasingly unprofitable. Even if horse-car operators did not speculate in real estate themselves, city governments pursued positive and negative policies (easy franchise terms, enfranchising competitors) to encourage expansion. Horse-car firms actively sought alternatives to the horse, no easy task, as cities put many obstacles in the way of steam power. This led first to elevated railroads in New York City in the 1870s, built by entrepreneurs who were already active in horse cars. However 'els' cost too much to provide profitable service on any but the most heavily travelled routes. Steam-powered elevated trains also blighted the streets on which they operated, so even Manhattan banned them after 1883.[82]

The other technological alternative was to employ a central steam engine to pull a cable in a conduit under the street, a system first employed by San Francisco realtor Alexander Hallidie in 1872. Cars moved by hooking on to the constantly moving cable or releasing it when they wanted to stop. Still, cable systems polluted at the central power source, did not travel very fast (the cable usually moved at less than 10 m.p.h.) and were expensive: $223,000 a mile, or four times the price of a horse-car line, according to the 1890 US census. Thus the system was deployed only in areas where travel was too heavy for horses to handle or in cities with terrain so rugged that

street railways had to employ extra teams of horses on hills.[83] Horses still trumped 'els' and cable cars in most places.

Electric trolleys, which received their power from an overhead wire and returned it through the rails, provided the system that finally made the horse obsolete. Frank Sprague installed the first technically successful system in Richmond in 1887, but its commercial viability became established only a year later when Henry Whitney, a Boston land speculator, and Charles Francis Adams, Jr (scion of the famous Adams family) built a trolley line to connect their suburban landholdings in Brookline with downtown Boston. Reports on the windfall profits that Whitney made on his property led to the rapid adoption of electric trolleys in other cities. The 1890 census estimated that trolley operation cost only $38,000 per mile, compared with $50,000 for horse cars.[84]

Typically, real estate interests argued for mechanisation, and inventors had little trouble finding investors for even the most harebrained schemes. The annual conventions of the American Street Railway Association ran sessions on alternatives to the horse which paid special attention to cost considerations. Most big-city horse-car firms began conversion within two years of the Boston installation, and in 1890 mechanised street railways, almost entirely electric trolleys, but also cable cars and a few light steamers or 'els', were hauling about 20 per cent of urban passengers.[85] Most big-city firms had phased out their horses entirely by 1893, and in 1902 only 8,902 horses remained, pulling a mere 6 per cent of the passengers that horses had carried twelve years earlier. Almost half the horse traffic was on one New York line, which evidently lacked the political strength to get the conversion to electricity approved. Most of the remaining horses worked on small lines with fewer than ten animals in southern or western towns.[86]

City governments put almost no obstacles in the way of companies seeking to convert, despite the possible dangers of electric power and high speeds. Some urbanites complained about the visual pollution of overhead wires, but most were in a rush to get horses off their streets. The danger of a relatively fast mode of transit on city streets seemed less than in the past and street railways confined their first electric operations to commercial streets which already had heavy traffic. The speed of the early trolley cars also seemed reassuringly low and until the late 1890s they rarely exceeded 12 m.p.h.[87]

The rapidity of this capital-intensive transformation, a mere five years from 1888 to 1893, is startling, especially given the slow pace at which *stationary* engines had converted. Horse cars seemed old-fashioned for cities that prided themselves on their modernity. Once street railway owners saw the possibilities of a low-cost form of mechanical power that was acceptable to the public, they switched immediately. If local firms did not convert, public pressure, in the form of grants to electrified competitors, forced them to do so rapidly. Trolleys allowed increases in route lengths, creating windfall real estate gains for corporate insiders, and owners, riders and regulators alike were all anxious to get rid of the horse.

Where horse use did persist was for elite vehicles, for common carriers and for certain kinds of freight. A separate set of social, economic and cultural circumstances were required to completely 'de-horse' the American city.

Private vehicles, cabs and omnibuses

It would hardly do to describe private carriages as a form of transport. Rather they were leisure vehicles whose primary function, as Thorstein Veblen noted, was the conspicuous consumption of wealth through public display on fashionable streets.[88] Carriage styles changed every few years, and most were open-top, the better to display their occupants.[89] James Garland, perhaps the best known writer on private stables, estimated in 1899 that a fashionable carriage cost between $1,300 and an astonishing $27,000. Annual operating costs, mostly for servants to maintain them, ran between $3,200 and $7,200 a year, which was clearly out of reach of all but the very wealthy.[90] The merely well-to-do might rent them for weddings, funerals or perhaps an adventurous spring drive in the country. Here displacement also took a while. Internal combustion and electric cars became commonplace after 1900 and the wealthy switched to the new adventure machines in much the same way that they had switched carriage styles every few years. Central Park, the premier display ground for carriages, allowed cars in 1899, a sure sign of acceptance by the wealthy.[91] In 1905 John Jacob Astor, the leader of Manhattan high society, and a former owner of a string of trotting horses, told the press, 'A stable of cars is coming to be recognized as the proper thing

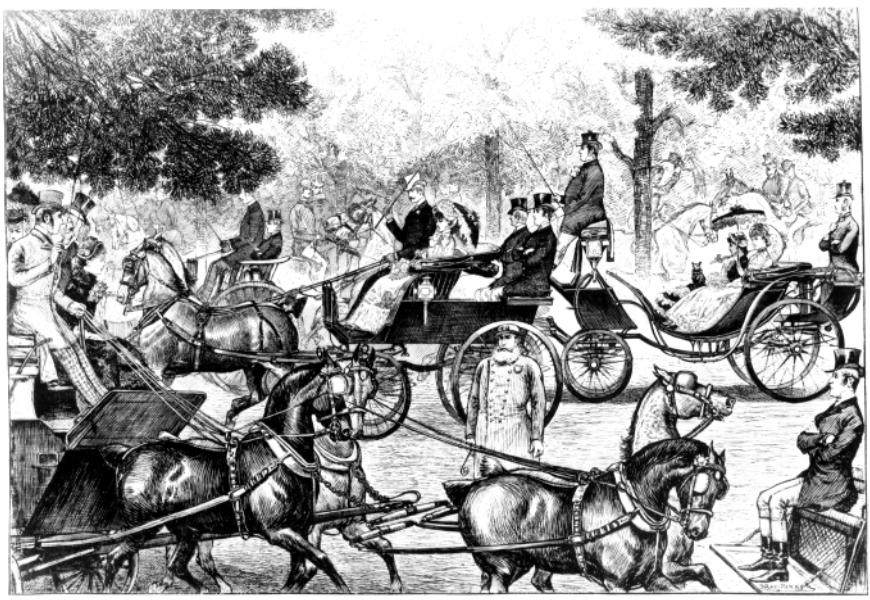

Figure 1 'The Drive, Central Park, four o'clock' during New York's fashionable season. *Source Harper's Weekly*, 19 May 1883

for a man of wealth.'[92] Still, as late as 1914 New York and Boston maintained speedways for private carriages.[93]

Before Henry Ford began producing his Model Ts in 1908, cars offered little advantage in price or reliability over carriages. As with other forms of displacement, there was some attempt by older technology to borrow from the new. One carriage maker offered battery-powered electric lights in 1894.[94] Another advertised vehicles with 'automobile seats' in 1913.[95] A third tried to rig the reins to a steering wheel.[96] But they missed the point: this was not just a change in fashion but the beginning of the twentieth century's massive growth in automobile traffic and an entirely new form of vehicular travel.

A few horse omnibuses remained after street railways eliminated them from regular commuters' routes. These included vehicles that hotels operated as shuttles to railroad termini.[97] There were also regular omnibus operations on Sixteenth Street in Washington and Fifth Avenue in New York, elite streets whose residents had enough political influence to get trolleys banned. Mechanisation came rapidly, however, since their owners wanted the most advanced technology for advertising purposes. The switch began with the adoption of De Dion Bouton buses on Fifth Avenue in 1906.[98] But numbers remained small and no American city had more than thirty buses in 1920.[99]

New York City licensed the first American hack (a four-wheel ancestor of today's taxicab) in 1697 and all large American cities had them by 1850.[100] The arrival of the horse car did not drive hacks out of business, as their drivers had feared, since they served a separate luxury business. By 1862 the number of horse-car drivers and hack drivers in New York City was roughly equal, at just over 500 each.[101] With considerable resistance from the hack owners, a few large east-coast American cities also adopted lighter, cheaper two-wheel cabs after New York City licensed the first one in 1886.[102] New York's ordinance allowed hacks to charge $1.25 a ride and cabs 75c.[103] Boston's allowed cabs to charge 25c to $2 on a zone fare system and hacks twice as much.[104] Cabs cost less than hacks, since they required only one horse, but both forms of service tended to buy the cheapest, oldest and most run-down animals.[105]

One of the first attempts at mass-producing cars in the United States was the Electric Vehicle Company's doomed attempt at manufacturing electric cabs for New York and other cities in 1899. This firm decided to seek a luxury hire market, instead of the mass popular ownership that Henry Ford sought a decade later. The company failed, not just because it judged the market wrongly but also because it could not build cars that worked, even in competition with horses.[106] While horses fought off this clumsy opponent, however, other motor vehicles slowly penetrated the market. In 1906 the entrepreneur Harry Allen imported sixty-five Darracq taxicabs into New York City, although his operation failed within two years.[107] In 1909 the Teamsters' Union was urging its 'locals' to organise the drivers of motor cabs because of their potential to break strikes by traditional hackmen.[108] The final blow to the horse-operated cab came during the 'jitney' craze of 1914–15 when owners of Model T Fords began to organise unlicensed 'gypsy' cab services in virtually every American city.[109]

Freight transport

There was a huge increase in urban freight movement in nineteenth-century America and the value of urban draught horses for intra-city freight doubled between 1830 and 1860.[110] At least one large horse-powered inter-city freight mode survived the coming of the railroad, namely canals. On the Erie Canal, as late as 1890, relays of horses pulled 1,763 towboats over 381 miles, moving 3.67 million tons of freight.[111] New York City relied so heavily on horse-operated canals for its coal and produce that there were fears of starvation, and fuel prices rose dramatically during the influenza epizootic of 1872.[112]

Although precise data on urban freight movement are hard to come by, we know that there were no freight operations as large as the giant street railways and, while the census counted the total number of horses in cities, those counts can be viewed only as approximations, with the split between passenger and freight modes unknown. The increase in teamsters was rapid, as Table 2 shows. However, peddlers, undertakers and street sweepers, to mention only a few trades, also drove teams, so the growth in traffic was likely to have been heavier than this table suggests.[113]

Table 2 Teamsters in the United States

1850	29,288
1860	55,695
1870	120,756
1880	177,586
1890	368,455[a]
1900	504,321
1910	408,469

Note *a* Including 234 women.
Sources See note 113.

In 1862 the *New York Coach-maker's Magazine* listed only five different kinds of freight vehicles in New York City: 418 wood wagons, 1,036 fish or vegetable wagons, 5,374 carts, 669 'dirt' (privy cleaners') carts and 278 junk carts.[114] Clearly horses were indispensable. In 1796 Boston had just twenty carriages and eighty carts, in 1860 it had over 4,000 horses and twenty years later 14,000. In 1840 370 Bostonians earned their living driving horses, in 1860 it was 4,501 and in 1900, 11,321.[115] After that, growth was slower, peaking at around 15,000 in 1910.[116] Meanwhile, in Chicago, in 1875 the *Chicago Tribune* estimated that 3,700 horses in the city pulled passengers, mostly on street railways and hacks, and 21,300 pulled freight.[117]

Fire engines were the largest and most important freight vehicles. To the modern eye it is strange to see horses pulling machines, especially machines vital to public safety. American cities began to switch from human-pulled to horse-pulled fire engines in the 1840s, usually over the objections of firemen, who took masculine pride in dragging their engines to fires. However, as cities grew, something faster was needed and much heavier steam pumps had to replace hand pumps. Eventually, fire engines weighed up to 9,000 lb. Firemen

harnessed three horses, side by side, an unusual arrangement that eased movement in traffic by reducing the turning radius and also stabilised a top-heavy load.[118] In fact the engines could have propelled themselves, and it is striking that fire departments chose horses; part of the equine advantage was the ability to start quickly whilst engines took a while to build up a head of steam.

Specialised horse-drawn freight vehicles also appeared. For example, the Studebaker Company offered 115 variations of its buggy style, and its catalogue also included street flushers, sprinklers, sweepers and dumpers.[119] New York carriage maker Ezra Stratton began selling panelled delivery wagons in 1844 (his first customer was a soda water shipper) and the first glassed-in hearse also appeared about this time.[120] What is impressive about these vehicles is not so much their weight-carrying capacity as their ability to carry glass without breaking it, a sign that better springs were available. The 1900 census showed wagon makers were producing seventy-eight types, mostly a variety of peddlers' and delivery vehicles, including insulated milk and ice trucks, furniture vans, laundry wagons and lunch vans. By that date Sears Roebuck had reduced the cost of its cheapest delivery wagon to $43.95.[121] Painting and exterior decoration for advertising took a large number of fancy forms.[122]

The increase in freight traffic derived not only from the increase in horses' size and strength, but also from improvements in wagons. Refinements in metallurgy allowed the use of light metal parts at spots where wood wore out and advances in springs, ball bearings and wheel construction meant less effort was required to pull wagons, so that only one or two horses were required – an important advantage. In 1848 *American Agriculturist* praised new wagons light enough to be pulled by only two horses.[123] By the 1860s one-horse wagons were available. Using fewer horses not only reduced costs, it facilitated operations in cities like Boston that banned four-horse teams.[124] There was some resistance from the operators of traditional carts. A British technical study claimed that two one-horse carts could pull more than a wagon with two horses,[125] but even in Britain the number of four-wheelers doubled between 1844 and 1854, the key period of growth.[126] By 1880 the superiority of four-wheelers was clear; the *National Livestock Journal* confirmed their superiority, noting that two Percherons with a heavy truck could pull more than four one-horse drays.[127]

There were also changes within the teaming industry. Before 1840 municipal ordinances limited horse-drawn freight to a relatively small number of licensed carters whose prices were fixed by law. The licensing system broke down in mid-century as express companies entered the field, starting with William Herndon's firm in 1839. By 1880 express companies had thousands of horses in American cities and their deliveries were indispensable for urban life, especially in the suburbs.[128] Other firms entered the field as well. As railroads and urban merchants did not want the lucrative delivery business in the hands of express companies or independent team owners, they entered the field themselves.[129] Teamsters, who had once seen themselves as independent craftsmen, owning their own horses and rigs, increasingly found themselves to be corporate employees, a status they did not like.[130] By 1890 they were

organising themselves into labour unions.[131] That year, the US Census reported that there were eighteen companies in interstate commerce, including American Express and Wells Fargo, and together they owned 8,291 horses, 6,008 wagons and 1,429 sleds.[132] Clearly this kind of competition reduced prices, although precise data are hard to come by.

One sign that horse power was reaching its limit in the 1890s was the huge *size* of some wagons. More than a fifth of urban wagons weighed over three tons, with heavier weights requiring long, hard-to-manage multiple-horse teams. In 1894 a New York manufacturer built a 32 ft long seven-ton vehicle to move heavy machinery. This vehicle had 9 in. wide wheels, carrying a frame of 14 in. by 16 in. wood beams with steel cross-braces. Not surprisingly, it required seven horses to move even when it was empty, and when it was full the whole rig was 62 ft long and needed fifty animals, occupying 140 ft of street space, to move it. It is hard to imagine it turning a street corner, let alone manoeuvring in traffic![133] In 1887 forty horses were required to pull a twelve-and-a-half-ton cable in Chicago. An observer described the scene: 'Forty whips were raised in mid-air; forty drivers uttered oaths of colossal proportions; forty horses felt the lash, and the North Side cable began to be threaded.'[134]

By the 1890s wagon makers were making all-steel garbage trucks, tank trucks, and even tree transplanters, capable of carrying up to fourteen tons, all requiring huge horse teams.[135] But technical refinements could not keep up with demand, and by the mid-1890s freight rates in big cities were increasing more rapidly than inter-city costs as the efficiency of steam railways increased. As with horse cars ten years earlier, horse-towed freight had reached its maximum effectiveness.

Horses persisted longest in freight applications, despite the early onset of machines. Macy's Department Store in New York City attracted considerable attention by using an imported Benz to deliver goods as early as 1895.[136] *Expressmen's Monthly* reported on it, saying, 'The day of the horse is doomed.'[137] That forecast was premature, even though Robert Thurston had advocated motor trucks as early as 1900.[138] Light motor vehicles did gain a lot of urban business by the beginning of the First World War, and here too the appearance of the Model T Ford was probably decisive. Despite a recommendation by the American Society of Mechanical Engineers in 1913 that motor trucks be used for loads of over two and a half tons,[139] motors did not really carry heavy freight until the Liberty truck, developed under government contract in 1917, pioneered the heavy-duty chassis. By 1930 almost no horses were pulling heavy freight in American cities.

All that remained were urban peddlers and individuals with delivery routes for lightweight products who continued to pull their wagons with horses into the 1950s and as recently as 1989 in Baltimore.[140] In such service horses offered one remaining advantage over light trucks: a well trained horse which knew, for example, a milkman's route, would go unprompted from the house of one customer to the next, freeing the driver to carry his goods from the street to the front step. Horses are smarter than motor cars.

Notes

1 'The Position of the Horse in Modern Society' (1872), pp. 277–8.
2 Jared Diamond, *Guns, Germs and Steel: the fates of human societies* (New York, 1887), pp. 76–92, 173. It is easy to see how humans exploited horses, but horses also benefited. Most large terrestrial mammals in the world became extinct and it is highly improbable that the horse would have survived as a species without human manipulation. See Roger A. Caras, *A Perfect Harmony: the intertwining lives of animals and humans throughout history* (New York, 1996).
3 Lemuel Shattuck, *Report to the Committee of the City Council appointed to obtain the Census of Boston for the Year 1845* (Boston MA, 1846), p. 42; Commonwealth of Massachusetts, Aggregate of Polls, Property and Taxes (Boston MA, 1941). These figures are probably an undercount, since owners tried to hide horses from the tax collector.
4 US Bureau of the Census, *Abstract of the Fourteenth Census of the United States, 1920* (Washington DC, 1923), p. 123. The data were collected by county, hence the use of that level of analysis. The figures for Kansas City may reflect the fact that it was a major transhipment centre.
5 US Census Office, *Twelfth Census of the United States, taken in the Year 1900* (Washington DC, 1907), pp. 428–79.
6 Joel Tarr, 'A note on the horse as an urban power source', *Journal of Urban History* 25 (March, 1999), pp. 434–48.
7 J. Frederic Dewhurst and associates, *America's Needs and Resources: a new survey* (New York, 1955), pp. 908–9, 1108–9.
8 Dolores Greenberg, 'Energy flow in a changing economy, 1810–80', in John R. Frese and Jacob Judd (eds), *An Emerging Independent American Economy, 1815–1875* (Tarrytown NY, 1980), p. 5.
9 Louis C. Hunter and Lynwood Bryant, *A History of Industrial Power in the United States, 1780–1930* III, *The Transmission of Power* (Cambridge MA, 1991), pp. 28–9; Jennifer Tann, 'Horse power, 1780–1880', in F. M. L. Thompson (ed.), *Horses in European Economic History: a preliminary canter* (Reading, 1983), pp. 21–30; Sigvard Strandh, *A History of the Machine* (New York, 1979), pp. 91–5; Dolores Greenberg, 'Reassessing the power patterns of the industrial revolution: an Anglo-American comparison', *American Historical Review* 87 (December 1982), pp. 1237–61.
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13 W. J. Gordon, *The Horse World of London* (1871), p. 16. Gordon's book and other nineteenth-century European works cited in the text were widely available in American libraries.
14 Anson Rabinbach, *The Human Motor: energy, fatigue and the origins of modernity* (Berkeley CA, 1990), pp. 3, 30, 72, 126.
15 Ellwood Morris, 'On the tractive power of the horse', *Journal of the Franklin Institute* (August 1839), p. 28.
16 Robert Thurston, *The Animal as a Machine and a Prime Mover* (New York, 1894), p. 37.
17 *Ibid*., pp. 53–78.
18 R. H. Thurston, 'The animal as a prime mover' I, 'The human animal as a vital prime mover and a thought-machine; the energetics of the vital machine; its transformation'; II, 'Energy supplied; power and efficiency; internal work of the vital machine', *Journal of the Franklin Institute* 139 (January–February 1895), pp. 1–20, 100–21.
19 For example, see Augustine Wright, *American Street Railways: their construction, equipment and maintenance* (Chicago, 1888), a compilation of his articles reviewing tests both in Chicago and in Europe.
20 William Youatt, *The Horse, with a Treatise on Draught and a Copious Index* (1861), p. 415.
21 J. H. Klippert, 'Size of domestic animals', *Annual Report of the State Board of Agriculture of Ohio* 29 (1863), pp. 223–43; A. B. Allen, 'Advantage of increased power and greater size in the horse for city work', *National Livestock Journal* 12 (November 1881), pp. 79–87.
22 John C. Trautwine, *Civil Engineer's Pocket Book* (revised edition, Philadelphia, 1874), pp. 605–6. Watt's definition of 'horse power' would have been more accurate for the larger horse pounds of the late nineteenth century.

23 Perhaps the best modern technical description of those machines is to be found in J. K. Major, 'The horse engine in the nineteenth century', *Transactions of the Newcomen Society* 60 (1988–89), pp. 31–48.
24 Trautwine, *The Civil Engineer's Pocket-Book*, p. 330; Hunter and Bryant, *A History of Industrial Power*, pp. 23–26.
25 Hunter and Bryant, *A History of Industrial Power*, p. 14.
26 Brooke Hindle, *Technology in Early America: needs and opportunities for study* (Chapel Hill NC, 1966), pp. 120–1.
27 US Patent Office, *Subject-matter Index of Patents for Inventions issued by the United States Patent Office from 1790 to 1873* (Washington DC, 1874), pp. 371–4.
28 For examples see *Annual Catalogue of the Agricultural Warehouse, and New England Seed Store* (Boston MA, 1836); L. Allen & Co., *Agricultural and Horticultural Implements* (New York, 1853); J. B. Pitts & Co., *The Dayton Threshing Machine Works* (Zanesville OH, 1866); Catalog of the Allied Machinery Co. of America; Hoisting Machines: Belt hoists, Horse Power Hoistings, Electric Hoists, Gasoline Hoistings; for Use in Factories, Warehouses, Docks, Quarries and Mine (New York, 1920); *Moseman's Illustrated Guide for Purchasers of Horse Furnishing Goods* (New York, 1892).
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31 Nathan Rosenberg, *Technology and American Economic Growth* (New York, 1972), pp. 63–4, 158; Greenberg, 'Reassessing the power patterns of the industrial revolution', pp. 1237–61, and *id*., 'Energy flow in a changing economy', p. 11.
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49 'The way to wealth for our city is on the railways within the city', *American Railroad Journal* 26 (15 May 1853), p. 296.
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51 'The Buffalo and Niagara Falls Railroad Co. *v*. the City of Buffalo', 50 Hill 211–12 (1843).
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53 Annual Report of the New York State Engineer, 1866, *passim*. There were also light steam lines elsewhere, often operated by real estate developers seeking to bring their subdivisions within reach of downtown. See Clay McShane, *Down the Asphalt Path: the automobile and the American city* (New York, 1995), chapter 5.
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55 George Rogers Taylor, 'Beginnings of mass transportation in urban America' II, *Smithsonian Journal of History* (fall 1966), pp. 39–51.
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57 *Proceedings of the Board of Aldermen, City of Boston* (16 January 1871), p. 14.
58 *Annual Report of the New York State Engineer, 1855*, pp. 659, 1865, 224. Data on vehicle weight were rarely indicated.
59 The increase in weight may have come from better nutrition as well, since completion of the American railroad network allowed the horse raising industry to be localised on the calcium-rich grasses of the Midwest. This would explain why the United States became a net exporter of draught animals so soon after importing the larger European animals.
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62 A. B. Allen, 'Advantage of increased power and greater size in the horse for city work' *National Livestock Journal* 12 (November 1881), pp. 79–87.
63 For examples see Scott, *Trolley Wars*, p. 95; ASPCA Clipping File (ASPCA Archives, New York City), Vol. 3; 'How horsecars are run', *The Stable: a monthly magazine published for the livery stable, the private stable, and the harness*, 2 (March 1887), pp. 28–9.
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66 Allen, 'Advantage of increased power'.
67 Edward L. Anderson and Price Collier, *Riding and Driving* (New York, 1905), p. 240.
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71 Henry Bixby Hemenway, *Essentials of Veterinary Law* (Chicago, 1916), p. 33. Shibasaru Kitasato demonstrated the adverse impact on human health in a series of experiments in

1899. See Haas, 'The trouble with horse manure', p. 37.
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74 As reported in the *Annual Reports of the New York State Engineer*, 1880, 1885.
75 *Street Railway Journal* 4 (April 1888), p. 49.
76 *New York Times*, 28 May – 3 June 1887.
77 Tim Gilfoyle, 'The moral origins of political surveillance: the preventative society in New York City, 1867–1918', *American Quarterly* (fall 1986), pp. 637–52.
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85 *Ibid*., pp. 681–5.
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89 Maureen E. Montgomery, *Spectacles of Leisure in Edith Wharton's New York* (New York and London, 1998), pp. 10–13.
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91 'The legal status of automobiles', *Horseless Age* 6 (9 May 1900), p. 1612.
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95 Sears Roebuck & Co., *Solid Comfort Vehicles* (Chicago, 1913), p. 31.
96 Paul Pinkerton Foster, 'Helping the work horses', *Outing* 53 (May 1919), p. 178.
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98 McShane, *The Automobile*, p. 34.
99 McShane, *Down the Asphalt Path*, p. 195. By that date they were all mechanised.
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113 J. B. DeBow, *Seventh Census of the United States, 1850* (Washington DC, 1853), pp. cxvii–lxxix; Joseph C. G. Kennedy, *Census of the United States in 1860* (Washington DC, 1864); Francis A. Walker, *Statistics of Population at the Ninth Census, 1870*, Part 1 (Washington DC, 1873); *Statistics of Population at the Tenth Census, June 1, 1880* (Washington DC, 1887); *Report on the Population of the United States at the Eleventh Census, 1890* (Washington DC, 1897), Part 2, pp. 34–5; *Twelfth Census of the United States, taken in the Year 1900, Population,* Part II (Washington DC, 1902), p. clxiv; *Thirteenth Census of the United States, taken in the Year 1910* IV, *Population: Occupation Statistics* (Washington DC, 1912), p. 92. Includes carters.
114 *The New York Coach-maker's Magazine* (May 1862), p. 150.
115 See note 109. This includes the specialised categories of carters, draymen, drivers, hackmen, teamsters and expressmen.
116 Clay McShane, 'Gelded Age Boston', *New England Quarterly* 74 (August 2001), p. 278.
117 As reported in 'Number and value of horses in Chicago', *National Livestock Journal* 4 (January 1873), p. 8.
118 Don H. Berkebile (ed.), *Horse-drawn Commercial Vehicles: 255 illustrations of nineteenth century stagecoaches, delivery wagons, fire engines, etc.* (New York, 1989), p. 54. The best professional account of these fire engines is Amy Greenberg, *The Volunteer Fire Company in the Nineteenth Century* (Princeton NJ, 1998).
119 Gannon, 'Carriage, Coach and Wagon, p. 116.
120 Stratton, *The World on Wheels*, p. 442; Gannon, 'Carriage, Coach and Wagon', p. 71.
121 Sears Roebuck, *Solid Comfort Vehicles,* p. 20.
122 Because of their ornamentation, hearses were the most expensive of light vehicles, and one 1876 hearse sold for $3,500, a fortune for the time (Gannon, 'Carriage, Coach and Wagon, p. 478). By the mid-1850s ice trucks featured paintings of 'Washington crossing the Delaware' or, more commonly, polar bears. Firms ordered vans in the shape of shoes, trunks, or even a tomato, and a New York veterinary surgeon owned a hospital wagon shaped like a dog. (Gannon, 'Carriage, Coach and Wagon', pp. 195–8; Museums at Stony Brook, *Nineteenth Century Carriages*, p. 56.)
123 As quoted in Gannon, 'Carriage, Coach and Wagon', p. 112.
124 E.g. *The Charter and Ordinances of the City of Boston* (1856), p. 101.
125 William Youatt's widely read *The Horse*, pp. 443–4, probably gave such ideas their greatest American circulation.
126 G. A. Trupp, *The History of Coaches* (New York and London, 1877), p. 95.
127 Allen, 'Advantage of increased power', p. 487. Prices went down also. David Hounshell's *From the American System of Mass Production, 1800–1932* (Baltimore MD, 1984), pp. 146–51, also notes the reductions in price made possible by the 'American System' of mass production, especially as applied by the Studebaker Company's factory, which turned out a wagon every seven minutes by 1880.
128 Stimson, *History of the Express Business*, p. 32.
129 Kruse, 'Teamsters in the Gilded Age', p. 82; *New York Times*, 10 January 1997.
130 Isaac Lyon, *Recollections of an old Cartman* (New York, 1872, reprinted 1984), pp. viii, 3–8, 43–9. In 1883 New York City teamster Thomas McGuire testified to a US Senate

committee about the proletarianisation of teamsters. 'Relations between labor and capital', *Hearings of the Senate Committee on Education and Labor* (Washington DC, 1883), p. 771.

131 The best history of early teamster organisation is still John R. Commons, 'Types of American labor organizations: the Teamsters of Chicago', *Quarterly Journal of Economics* 19 (1905), pp. 400–33.

132 'Transportation by express companies', *Eleventh Census, Transportation*, XXII (Washington DC, 1890), p. 496.

133 Berkebile, *Horse-drawn Commercial Vehicles*, p. 11.

134 'Forty horses unwinding a cable rope', *Street Railway Journal* 3 (December 1887), p. 1040.

135 Berkebile, *Horse-drawn Commercial Vehicles*, pp. 54, 93, 96.

136 Macy's also sold imported cars at that date. See James J. Flink, *America adopts the Automobile* (Cambridge MA, 1970), p. 21.

137 XX (15 September 1895), p. 211.

138 Robert H. Thurston, 'The automobile in traction', *Review of Reviews* 21 (February 1900), p. 225.

139 W. R. Metz, 'Cost of upkeep of horse-drawn vehicles against electric vehicles', *American Society of Mechanical Engineers' Proceedings* (1913), pp. 129–38.

140 Roland L. Freeman, *The Arabbers of Baltimore* (Centreville MD, 1989).

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