Dead Ends in the History of Technology: The Case of Steam Cars

By Haris Kitsikopoulos
Founder and Academic Director, Unbound Prometheus Program of Advanced Seminars
Former Clinical Professor (retired), Department of Economics, NYU

Abstract

This paper starts with a historical outline of the main events which defined the technological development of steam cars, a transportation mode which aspired to imitate railroads by taking passenger traffic away from coaches. A fair number of inventors are mentioned but greater emphasis is placed on the two main figures, Gurney and Hancock. The narrative conveys the impression of something akin to fireworks in that this innovation burst into the scene in the 1820s but practically came to an end by the late 1830s to be followed from the 1840s on by far more successful efforts to use such vehicles in transporting goods relating to agriculture and extractive industries. The author uses some incomplete information stemming from a service ran in the Cheltenham-Gloucester road using Gurney's vehicles complemented by information from two contemporary authors to calculate the operating cost of steam vehicles. The figure is contrasted to the respective cost of stage coaches with the former standing at two-thirds of the latter.

Following this analysis, the controversial impact of discriminatory tolls on steam cars by turnpike trusts is brought into the calculations concluding that if such tolls were up to three times as high in the case of steam cars the latter's operating cost would have been the same or lower compared to coaches. Tolls above that level would have driven them out of competition.

The paper ends with a critical review of the explanations advanced by the limited number of authors who have dealt with this subject. The author dismisses the argument made by Evans that the main culprit for the failure of steam cars were the technical imperfections which plagued them through the 1830s making the point that it was a matter of time before such issues were satisfactorily resolved. At the same time, he finds partial another theory by Nicholson which emphasized the role of the discriminatory tolls. The author argues, instead, that while the tolls played a major role, another factor that has not been stressed by the literature were managerial and entrepreneurial failures on the part of steam car inventors. Managerial failures are reflected on the mismanagement of the Cheltenham-Gloucester service which ran on an unnecessarily excessive operating cost. Entrepreneurial failures, on the other hand, manifested on the insistence of these inventors to capture the market for passenger traffic from the start as opposed to focusing on the conveyance of agricultural goods and useful materials which were exempted from the imposition of tolls. The latter tactic would have allowed such vehicles to drive out of the market vehicles operated by horses, establish their superiority in the minds of the public and then attempt to reenter the market for passenger traffic.

One of the multiple trajectories the diffusion of steam power followed was the invention of steam cars. This innovation appeared in the early part of the 19th century reaching a crescendo of inventive activity in the 1820s and 1830s. It coincided with the dawn of the railway era and it was an effort to capture the market for the transportation of passengers by displacing coaches drawn by horses. But as impressive was the genesis of this phenomenon, equally spectacular was the failure of the endeavor. By the mid-1830s it was obvious that the obstacles which prevented the development of this technological trajectory were too complex to overcome. Steam cars failed to capture this market although they reappeared in the second half of the century in the form of vehicles used to convey agricultural goods and useful materials. Few historians delved into this subject but, despite the limited number of studies, some sophisticated explanations have been forwarded elaborating on the relative failure of this technology. This chapter reviews the relevant evidence and, in the end, offers a somewhat different perspective which stresses managerial and entrepreneurial failures on the part of inventors involved in this innovation as well as the adverse impact of the opposition raised by turnpike trusts.

Historical evolution: from Newton to Gurney

The idea of propelling vehicles with steam dates back to the early modern period.[1] Isaac Newton depicted in the early 1680s such vehicle but it was a mere expression of fanciful speculation. At almost the same time Verbiest, a missionary in China, described in a book published in 1687 how a few years earlier he propelled a vehicle through steam emanating from a cylinder and channeled through vanes fixed in the periphery of a wheel. Papin also pondered the same idea, revealing in a letter to Leibniz in 1698 that he came up with a model of a carriage driven by the power of steam sent to the ratchet-drive attached to the rear wheel. He felt, however, that the curves on the roads would make it very difficult to render it practicable. His contemporary Savery also gave some hints on the subject but never worked on the concept. The first successful steam-driven mechanical vehicle was conceived in 1763 by Nicholas Joseph Cugnot, a French military engineer, and an improved version of it was exhibited six years later. It was a heavy vehicle acquiring a speed of just 2.25 miles/hour and having a boiler not capable of supplying enough steam to make it operate for more than 15 minutes. Another French engineer, Charles Dallery, followed in 1780 with his own version.

On the other side of the English Channel, Watt considered the potential of steam cars and was urged to pursue it by Erasmus Darwin and Drs. Small and Robinson. He described the basic mechanism of a steam carriage in the fourth article of his 1769 patent as well as one he obtained in 1784. He specified that the boiler should be made of wooden staves joined together and kept in place by iron hoops, much like a cask, while the iron furnace ought to have been placed inside the boiler. The wheels of the carriage would be stirred from the piston whose reciprocating motion would be converted into a rotary one with toothed wheels. The steam would be exhausted into the atmosphere once it raised the piston. Stuart considered Watt’s concept too crude and impractical in light of the fact the water used for condensation had to be regularly replenished, that factor alone rendering not feasible the construction of such vehicle; additionally, he doubted its ability to generate sufficient power to move its own weight.[2]

Watt knew full well that steam cars could only operate with high pressure, at 25 p.s.i. he reckoned, which was well above practices with his own engines. Being against the use of high-pressure steam, he did not

[1] Davison, *History of steam road vehicles*, pp. 4-5; Fletcher, *The history and development of steam locomotion*, pp. 12-4; *Catalogue of the mechanical engineering collection*, p. 70.
[2] Stuart, *Historical and descriptive anecdotes*, pp. 361-2, 453-4.

ponder much on this concept. But he must have felt awkward in dealing with Murdoch, his talented engineer, when the latter showed a keen interest on the subject. Being fearful of losing him, Watt tried to achieve a fine balance by proposing to advance him £100 in order to continue with his experiments and, if successful within a year, he proposed to finance, along with Boulton, a venture aimed at producing steam cars. Murdoch did construct a model but nothing came out of it. When other engineers demonstrated that his fears with high pressure were unjustified, he became hostile towards them belittling their efforts. One of them was William Symington who engaged in experiments during the 1780s exhibiting a working model; however, his efforts eventually led to nowhere because of several practical difficulties he encountered. Almost simultaneously, in 1788, Robert Furness and James Ashworth took out a patent and constructed a 4-wheel steam vehicle at Halifax which was capable of running a short distance but its progress came to a halt due to the early death of Furness.[3]

Trevithick and Vivian came closer to success designing a steam carriage in 1802, a description of which is given by Stuart and Bird.[4] The design had some merits, especially relating to its geared transmission mechanism. But its high center of gravity, the uneven motion produced by the single cylinder, and the use of a cast-iron boiler were all caveats which rendered its use impracticable. After several trials which drew a fair amount of interest but also several mishaps due to defective parts, Trevithick decided to give up and focus his attention on railroads, especially since financial backing to cover the fair amount of money he spent on the concept was not forthcoming. But there were other technological advances during this time which paved the way for more successful outcomes later on. In 1805 Obadiah Elliot patented the laminated spring of semi-elliptic or elliptic form providing a superior means of suspension. This invention along with the use of the "artillery" wheel with iron tyres, patented by Samuel Miller the same year, and improvements of roads constructed under the supervision of Telford and McAdam provided a considerable boost to efforts relating to steam carriages.[5]

The efforts to come up with a functional steamer acquired a major momentum by the mid-1820s. Horse carriages may have provided some clues on the designing side but major mechanical challenges had to be resolved. One of them was the construction of a proper boiler.[6] It had to be small and light but, at the same time, efficient in that it ought to have had a small water content but a large heating surface as to raise steam quickly. Most importantly, both the boiler had to be strong to avoid bursting and, by implication, other components (cylinders, joints, pistons, pipes) needed to be able to take the pressure. The first steamers ran at pressures in the range of 70-250 p.s.i. at a time 25 p.s.i. was already considered high. Boilers were placed at the rear of vehicles to avoid inconveniencing the passengers with the effects of soot and smoke and to this objective coke was used. Most of them were of the butt-welded type with leakages being a constant irritant. Given the insufficient protection provided by the patent system at that time, many unsuccessful designs were often repeated. Most of the designs followed the working mechanism of stationary engines with the exhaust steam not being condensed but blown into a chimney

---

[3] Watt's views on the subject hardened reflected on the fact he prohibited steam cars from approaching the house he retired in. His speculative thinking on steam carriages is described in Burn, *The steam engine*, pp. 109-11. See also Bird, *Roads and vehicles*, p. 158-60; Copeland, *Roads and their traffic*, p. 164; Fletcher, *The history and development of steam locomotion*, pp. 15-7, 19; Davison, *History of steam road vehicles*, pp. 5-6.

[4] Stuart, *Historical and descriptive anecdotes*, pp. 458-60; Bird, *Roads and vehicles*, pp. 160-4. See also Evans, "Steam-road carriages," p. 6; Copeland, *Roads and their traffic*, pp. 164-5.

[5] Davison, *History of steam road vehicles*, p. 9.

[6] Davison, *History of steam road vehicles*, pp. 8-9; Porter, *The life and times of Sir Goldsworthy Gurney*, p. 114; Bird, *Roads and vehicles*, pp. 168, 170-1.

to create a draught. Vehicles had to refill every eight miles with the water often being dirty and hence leaving harmful impurities in the boilers. This points to another major problem, the lack of infrastructure relating to stations for coke and water supplies. The task of filling with water, up to 100 gallons, that could be found on the side of roads on stable pumps or horse troughs meant delays of 20 minutes or more and a slackening of the engine's performance for a mile or so. Even if steamers succeeded in having a lower capital and operating cost than coaches, their success would demand eventually the creation of an infrastructure for fuel and water supplies, something that was not the case for coaches which had their own already established.

The other major challenge was to come up with an effective transmission mechanism channeling power from the engine to the wheels while bouncing on top of springs and carrying a major weight including a hot and vibrating engine and boiler. Every design involved in such a project had to achieve major advancements in steering, suspension, transmission, boiler and engine. Different engineers experimented with various designs but the inferiority of metals and tools rendered the task a major challenge.[7] Another mechanical challenge which preoccupied the early pioneers was the issue of adhesion to the road. Despite the fact that railway engineers did try different methods driven by the belief that adhesion of regular wheels would not be satisfactory (e.g., Blenkinsop's rack-and-pinion locomotive), engineers engaged with steamers were slower abandoning the belief that "walking" engines were not necessary, a curious delay given the demonstration of Trevithick's engine and of others which followed.[8]

Finally, among the myriad mechanical issues that had to be addressed, particular attention had to be paid to well-designed brakes and change-speed gears to deal with uphill terrains and rough surfaces. Some steamers could achieve impressive speeds, up to 20 mph, but this was a figure that could not be kept up unless they wished to risk considerable damage and repair cost. The norm was speeds of 10 mph or less, not far from the speed that could be achieved by horses. The comparison with horses was not entirely at the latter's expense. Horse legs exerted good traction even on bad surfaces and the vehicle they carried did not face issues relating to transmission, complexities with suspension, steering and boiler.[9]

It becomes apparent that aspiring inventors were facing a Herculean task. An observer of these efforts, writing in 1837, pointed out that success could come only when an inventor combined the skills of a carriage builder and an engineer, they had to possess knowledge of details, they had to adjust the proportion of parts of stationary engines to the concussions such vehicles would encounter on rough roads, they had to combine lightness with strength, inventors had to have the financial resources to support repeated experiments or at least to convince a speculator to back them up, and they had to be able to persuade the public that this was an effort worth pursuing.[10]

The 1820s opened with the construction in Bramah's shop of a steamer designed by Julius Griffith. The vehicle was completed in 1821. It meant to operate with two steam cylinders which drove the rear wheels through change-speed gears, the first application of this mechanism in a road vehicle. However, despite

---

[7] A review of such efforts as well as those relating to steering mechanisms are described in Davison, *History of steam road vehicles*, pp. 10-2. See also Evans, "Roads, railways, and canals," p. 30.
[8] Such misconceptions started with Edgeworth's notion for a primitive track-laying vehicle, to similar efforts by David Gordon and Brunton and up to the feet or hinged plates attached by Boydell to his agricultural traction engines in the late 1840s. See Bird, *Roads and vehicles*, pp. 164-6.
[9] Evans, "Steam-road carriages," p. 21.
[10] Cited in ibid., pp. 6-7.

the admirable work done in the shop, the steamer never worked properly due to problems with the boiler. It was used only experimentally but no doubt provided useful information to other engineers. The next year David Gordon came up with his own version but his efforts were frustrated by having to deal with several design flaws. It was followed by Burstall and Hill's carriage of 1825 which was particularly innovative having 4-wheel drive. The two inventors, aspiring to operate passenger carriages in Scotland, exhibited considerable ingenuity in their construction. However, the vehicle was heavy at 8 tons, travelling at a speed of 3-4 mph. The effort was suspended due to fatal flaws with the design of the boiler which burst injuring a couple of its attendants. It reappeared, however, in the Rainhill trials, appropriately named *Perseverance*, having the boiler and furnace in a separate carriage attached to the main one in order to avoid injuries in the event of accidents. Another effort came to the fore by W. H. James who patented his own version in 1824 but came up with an actual model in 1829 which differed substantially; however, in the end, the vehicle failed due to its excessively complex design.[11]

As practical efforts across the country started multiplying, there was a publication in 1824 in the *Scotsman*, reprinted in the *Mechanics Magazine*, which played a decisive role in focusing work on steam carriages. The article began by noting that a horse possessed 10 times more draughting power in railroads and 30 times more in canals compared to roads. But this statement was correct only under the assumption of a 2 miles per hour speed. When an attempt is made to increase the speed when pulling on a water surface the power required increases multifold. The capacity of horses to pull weight on roads also decreases much faster as the speed increases. These conclusions were good news for railroads which did not face the same constraints and bad news for canals and road transportation using horses. The conclusion that was drawn regarding the use of steamers is that they could accomplish the carrying of a given weight almost as well as railroads. A macadam road had higher resistance than rails but the road infrastructure was already in place, unlike railroads whose respective cost was enormous, not to mention that the resistance could be lessened with hard paving of the roads.[12]

By the late 1820s there were at least a dozen inventors with promising designs and many others with vague or unrealistic patents. Goldsworthy Gurney, one of the most celebrated names in the field of steam cars, deserves special mention. He was a wealthy and well-educated man with a good understanding of mechanical developments, though not an engineer. When he started his work in 1824 there were still people who believed that the wheels could not get a sufficient traction on the ground to make a steam vehicle move forward. Gurney had to go through a long learning curve. He went to considerable personal expense, £30,000 over a period of 5 years according to his own claim, to improve various mechanical flaws he encountered such as the driving axle which often broke and the boiler tubes which leaked.[13] He patented a steam car in 1827, not his first one, and subsequently built one which ran successfully for two years in and around London carrying 18 passengers at a speed of 15 mph with an extra load of 60 gallons of water and 1.5 cwt of coke. His efforts right after this venture focused on providing the same power

[11] Evans, "Steam-road carriages, pp. 4, 7; Davison, *History of steam road vehicles*, pp. 32-4.

[12] Evans, "Steam-road carriages, pp. 4-5.

[13] Gurney estimated that his boiler, when well-maintained, could last for up to 3 years. It had to be checked every 3 weeks or so as long as the lime content was not very heavy. Regarding the driving axle, despite the problems with it, it was still more advanced compared to prevailing practice in locomotives, in fact, Robert Stephenson wrote to his father urging him to imitate Gurney. See Alderson, *An essay*, p. 89; Evans, "Steam-road carriages," pp. 8, 13. Also, Bird, *Roads and vehicles*, pp. 167, 173, 176-9; Davison, *History of road steam vehicles*, pp. 9, 34-5; Copeland, *Roads and their traffic*, pp. 165-8.

with less weight, a goal he achieved by reducing it from 70 down to 35 cwt. After 5 years of continuous efforts, he succeeded in putting on the road a fairly successful steamer although technical problems still remained, the price he had to pay for being one of the early pioneers and thus not having the benefit of learning from a substantial pool of other inventors.

By July 1829 Gurney had come up with a "drag" which towed a passenger carriage, a combination of tractor and trailer, which could carry 38 passengers. The concept had several advantages. First, by separating the boiler from the passengers it intended to calm fears about possible explosions. This idea was first applied by Trevithick in his trials with the *Catch Me Who Can* locomotive in 1808. A derived benefit was that the weight of passengers was spread on 8 wheels thereby addressing the accusations that steamers caused disproportionate damage to the roads. Another advantage was that if one of the two vehicles broke down on the road, it would be more economical to replace them than in the case of self-contained vehicles.[14]

On July 1829 Gurney undertook a very ambitious demonstration of his steamer by running it on the London-Bath road. It was part of the London-Bristol road, being the second in importance route nationally after the London-Holyhead route, serviced by dozens of coach trips weekly. The journey was not without unfortunate episodes which were very well documented because Charles Dance, one of the passengers, as well as another gentleman kept detailed records. There was an accident which damaged an axle shaft; there was also a lack of pre-arranged water and coke depots which meant that the vehicle had to be refueled with coal which caused the emission of excessive smoke and some sparks which could damage crops along the way; another frightening episode was the attack of the vehicle and its passengers by a mob of out-of-work handloom weavers it came across in the town of Melksham who expressed their hostility because it was a new technology such as the one that caused their unemployment. For the last leg of the trip to Bath the steamer was drawn by horses as well as for part of the return trip which was slow but less eventful. Gurney's ambition was to do the London-Bath trip with an average speed of 15 mph but while this figure was accomplished for some segments of the trip, the average speed was not even close to his desire. This was also the first steamer journey for which detailed information on fuel consumption was recorded. The steamer burned 104 bushels, c. 5,000 lbs, of fuel during the round trip of 168 miles. With a coal price of 6d/bushel in the London region, the fuel cost per mile came to a bit under 4d. This fuel rate was about the norm for other steamers. In Gurney's vehicle, in particular, better performance could have been achieved if there was valve-gear providing a variable cut-off as well as the lack of condensers, both issues causing wasteful use of fuel. Be that as it may, the trip was used in an expert way by Gurney for promotional purposes. It was subsequently exhibited at the Hounslow Barracks in the presence of the Duke of Wellington, prime minister and national hero, drawing his praise. During the exhibition it achieved a speed of 17 mph and right after it towed a wagon with 27 soldiers. Another fan of the vehicle was Sir James Willoughby Gordon, Quartermaster-General, who had his own expectations for using steamers for military purposes.[15]

Based on this record, Gurney was able to gather a considerable sum of money from franchises he sold to various prospectors allowing these individuals to use Gurney's design on specified routes; they included Major Dobbyn, William Hanning, Dr. Mackey, Colonel Viney, Thiselton, John Ward and, most important of all, Charles Dance. Gurney came to an agreement with Dance to have the latter organize the steamer

[14] Nicholson, *The birth of the British motor car*, p. 46.
[15] Ibid., pp. 46-51; Bird, *Roads and vehicles*, p. 155.

service in the Chelteham-Gloucester road. The service ran for 4 months, from February 21st to June 22nd, 1831. The vehicle was light and powerful enough to ascent acclivities thought impossible. The high-pressure engine was placed horizontally under the body of the carriage and gave motion to the two hind wheels by using a crank. The fuel the vehicle used was stated to have been 4 bushels of coke and 900 lbs of water for the c. 9 miles. A Worcester newspaper reported on March 3rd, 1831 that "all the passengers who have travelled by it seem much pleased and agree that the motion is remarkably smooth, regular and agreeable."[16] But Dance himself admitted that there were delays due to defective pipes in the boiler although there was never an injury to any party involved. Dance had the boiler in one of his vehicles replaced by one designed by Maudsley, although that one also proved unsatisfactory. Dance's problems also included the fact that the service drew fierce opposition from farmers who owned land because they were responsible for the maintenance of the roads. There was an accident due to large stones strewn over the road based on orders by the Turnpike trustees, according to Gurney, leading to breaking a crank axle. Gurney's suspicion, though never definitely proven, was not baseless given an entry in the minute book of the turnpike company which characterized as nuisance the steamer's service and threatened legal action if it failed to discontinue. The trust's wish was fulfilled. This mishap coincided with the renewal of the Cheltenham Road Bill which permitted the trust to impose prohibitory tolls to mechanical vehicles. These events provided the excuse for ceasing the service despite the fact the major reason may have been the economic configurations relating to Dance's service.[17]

Just about the time the Cheltenham-Gloucester service ceased, Gurney introduced a lightweight vehicle with a small steam engine designed to carry either 2-3 people or a load of parcels. It looked like a cross between a cart and a cabriolet. Its weight was 500 lbs and it was meant to run in 7-mile stages consuming 25 bushels of coke and 70 gallons of water for each stage. If this vehicle had been introduced at the end of the century it was most likely to be lauded as one of the pioneer designs of the car industry. At the time it appeared it looked more like a peculiar curiosity. Overall, Gurney constructed about a dozen vehicles for passenger traffic but we should also bear in mind one or two were built to carry loads such as one for the Cyfartha works proving that steamers had the capacity to carry much greater weight on rails than on roads.[18]

The suspension of Dance's service was a major blow to Gurney's efforts to spread the use of steam vehicles across the country. Viewing the imposition of discriminatory tolls as a major obstacle to his efforts, he summoned his considerable astuteness and network trying to convince the Parliament to initiate proceedings of a committee to look into the matter. The select committee's inquiry lasted from August 3rd to September 9th 1831 and it was exhaustive. The task facing the proponents of steam power on roads seemed particularly onerous given the very powerful position of the lobby associated with coaches.

---

[16] Cited in Copeland, *Roads and their traffic*, p. 171. See also Evans, "Steam-road carriages," p. 12; Alderson, *An essay*, pp. 79, 81-2; Bird, *Roads and vehicles*, p. 180; Lord Montagu and Bird, *Steam cars*, p. 49.

[17] The cessation of Dance's service was not the only unfortunate event. A steamer licensed by Gurney in 1831 to John Ward in order to initiate a similar service in Scotland was also damaged although it was repaired by Ward using unauthorized parts without Gurney's knowledge. But when an explosion took place when it was put into service, two local boys were killed and the adverse publicity was widespread. Porter, *The life and times of Sir Goldsworthy Gurney*, p. 102; Copeland, *Roads and their traffic*, p. 175.

[18] Ibid., p. 103.

But there were proponents on the side of steam with a celebrity status.[19] Colonel Torrens made the argument that steamers would reduce the cost of transportation, increase profitability for farmers who would use this mode for bringing to the market their produce and the cultivation of marginal pieces of land would become feasible. Regarding the argument that the elimination of horses used for transportation would damage farming, he responded that this would only be a temporary loss and that, overtime, the increase of population that would ensue due to boosting economic activity would also generate demand for agricultural products making up for the loss. Another major issue that came up during the sessions was the extent steamers caused damage to the roads. The argument made by proponents of steam power that there was no such damage underplayed the weight of steam vehicles which was in the range of 3-5 tons. This figure, coupled with speeds up to 20 mph did have the potential of causing damage. However, Gurney reminded the members of the committee that the speed of his steamers was 10 mph and added that the damage to the roads was less severe compared to horses due to the greater width of a steamer's tires. In fact, based on evidence provided by Telford and McAdam, in certain roads steamers improved the road surface acting much as heavy rollers. Despite the fact that such fears dissipated with time, opponents of steamers kept repeating them periodically as was the case with a book published by Henry Davies in 1843.

The members of the committee were not swayed by the overoptimism of witnesses such as Gurney and Ogle, another major figure in the field (see below). They were keenly aware of the technological imperfections of steamers and the fact they needed a long time to reach their maximum potential. But they also appreciated that the existing prejudices regarding, smoke, noise and, especially, the risk of explosions were largely unfounded. The committee also felt that accidents caused by steamers should not have been a major concern because steamers were better equipped to maintain speeds up to 10-20 mph. Most importantly, in light of the rapidly growing population, the encouragement of steam power was of paramount national importance. In the end, the committee came to the following conclusions after pondering on the evidence presented:[20]

1. Steamers could travel at an average speed of 10 miles/hour and at this rate they could convey up to 14 passengers.
2. Their weight could be under 3 tons including fuel, water, and attendants.
3. That they can ascend hills with considerable inclination easily and safely.
4. That they are not nuisances to the public if properly constructed.
5. That they can be a cheaper and faster mode of transportation than horses.
6. That they cause less damage to the roads compared to horses as their tires are wider (4-5 inches).
7. That the imposition of discriminatory tolls was detrimental to their wider use.

---

[19] Alderson, *An essay*, pp. 94-7; Bird, *Roads and vehicles*, pp. 172-3; *The roads and railroads*, p. 298; James, *Walter Hancock*, p. 46; Bagwell, *The transport revolution*, p. 150; Copeland, *Roads and their traffic*, pp. 175-6.

[20] Alderson, *An essay*, pp. 98-9. For extensive quotes from the report of the committee and the rationale of its conclusions see Cundy, *Inland transit*, pp. 80-3. See also Nicholson, *The birth of the British motor car*, p. 91; Davison, *History of steam road vehicles*, p. 13.

The findings of the committee were surprisingly fair and dispassionate as well as exhibiting an accurate and far-sighted approach about the potential of the new mode. The committee proposed the temporary suspension of all discriminatory tolls and the eventual imposition of a uniform and reasonable scale.[21]

Subsequently, the committee asked the House of Commons to pass a bill that was perceived as detrimental to the interests of some of its members having ties to the agricultural, horse-breeding, and trust groups, a bill that could lead to the insolvency of many coach masters. Moreover, it was a bill that would have the central government interfere with local authorities. Yet the Commons passed the bill without any fight to a large extent due to the respect held for the work of select committees. Another reason may have been Walter Hancock's ability to run successfully a service without being harassed by trusts through the imposition of discriminatory tolls (see below). Finally, they may have been influenced by Torrens's arguments which focused on economic factors and came at a time of high food prices. However, the bill was narrowly defeated in the House of Lords based on technicalities, a predictable outcome. In the latter body, landowners were stronger than in the House of Commons, conservative and eager to fight against an innovation they perceived as being clearly against their interests. The government intended to modify the bill and reintroduce it but other critical legislative matters and the railway mania which absorbed a good amount of the existing engineering talent killed the intention.[22]

The overall experience was certainly disappointing for the proponents of steam power on roads. According to Bird, the accusation that Parliament was short-sighted may be "less than just, as Parliament was not so much unreasonable as unwilling to breach the honored principle of interfering as little as possible with established local authorities."[23] But, in the author's view, this type of argument is unfair in that the proponents of the bill were requesting government's interference not to gain any advantage but to level the playing field.

The defeat of the bill brought a decisive blow to Gurney. He had put £18,000 of his own money into a large factory whose annual operating expenses were £16-17,000 during the years 1830-1, half of which covered the wage bill. If successful, he was set to gain a fortune from various revenues, far exceeding the factory's expenses. He had already collected £18,000 from licenses (mainly from Hanning, Dance, and Ward) and sold three steamers to Dance for £1,800. His contract with Ward alone provisioned for carriages worth £32,000 to be used on the London-Liverpool-Holyhead route while Ward promised another £15,000 for the Scottish rights. Hanning's financial backing was even more impressive. According to one estimate, Gurney' total annual revenues could have reached £150,000. However, the rejection of the bill by the House of Lords and Gurney's failure to deliver the steamers he had promised led to Hanning pulling out his support. Soon another investor, William Bulnois, as well as others followed despite Gurney's efforts to rally support for his project by publishing a pamphlet lauding the merits of his scheme.

---

[21] The proposal was to have steamers with a maximum of 6 passengers, in essence being private carriages, paying the same tolls as a 2-horse/4-wheel vehicle while the rest the same tolls as a 4-horse coach. See Nicholson, *The birth of the British motor car, p. 91*. Also, James, *Walter Hancock*, p. 40.

[22] Nicholson, *The birth of the British motor car*, pp. 92-3; Bird, *Roads and vehicles*, pp. 173-4. For a detailed account of the politics in the Commons and the House of Lords, see Porter, *The life and times of Sir Goldsworthy Gurney*, pp. 110-2.

[23] Bird, *Roads and vehicles*, p. 172.

It was obvious he could not go on without substantial backers and hence he decided to liquidate his assets at much reduced prices.[24]

The ending of Gurney's entrepreneurial efforts was anticlimactic in light of the fact he was the most astute of the individuals connected to steamers. He got the Army interested in the possibilities of the new invention and he even convinced Duke Wellington to ride in one of his cars. His efforts were widely reported in the press and, when something went wrong, he had the ability to engage in damage control by citing some minor malfunction or oversight. He was well-connected with members of the parliament, something he used in getting the select committee look into the matter and later on in requesting compensation from public funds for his losses. It should be borne in mind that other innovators, who may have come up with better steamers, lacked such connections. He was also adept in selling lucrative franchises to several investors. This was quite a formidable combination of entrepreneurial virtues. But the fact of the matter is that, despite his ability to underplay technical problems he encountered, he was not able to resolving them particularly the one relating to the boiler. It proved difficult to clear the steam from the small tubes resulting in water being leaking into the cylinder. His vehicles had a massive water consumption and hence the maximum distance they could work was 7 miles. But his boilers were not the only issue in light of crankshafts kept breaking on the rough roads. But, despite the technical shortcomings of his vehicles, Gurney inspired many imitators who learned from the numerous technological innovations he introduced. Many of his rivals failed to run steamers in regular routes but they were encouraged to keep going by the fact his patent was scheduled to expire in 1836.[25]

Historical evolution: from Hancock to defeat

The inquiry of the select committee and its sympathetic conclusions provided a strong sense of legitimacy to efforts towards the development of steam carriages, a seal of approval so to speak. With Gurney soon to abandon his endeavors, Walter Hancock, being just a couple of steps behind him, came out as the clearest winner. Hancock was particularly active during the period 1829-36, when he constructed 9 reliable vehicles, although he lingered until 1840 when he quit due to the lack of financial support and the existence of heavy tolls. One of the main challenges he faced was the construction of a boiler. After experimenting with several designs and suffering from multiple instances of bursting several of them, he came up in 1827 with his "chamber" version which went through gradual improvements, in the end being considered as one of the lightest and safest boilers used in steam carriages. Farey deemed Hancock's boiler as being decades ahead of his time and lavished it with much praise during his testimony at the select committee. Hancock's trademark was that he learned quickly from his mistakes. He went through a learning curve similar to that of Gurney, lasting several years, evident also in the technological evolution between his first experimental engine and his first functional vehicle, the *Infant*, constructed in 1829.[26] The *Infant* was a 10-seat bus, the first one Hancock used to run a service on the Stratford-London road in

---

[24] Porter, *The life and times of Sir Goldsworthy Gurney*, pp. 112-4; Nicholson, *The birth of the British motor car*, pp. 52, 78. Copeland's account on Gurney's losses cited more modest figures. He also points out that the committee recommended either a free extension of his patent or a compensation of £5,000, however, the Exchequer was not forthcoming in terms of the latter proposal. See Copeland, *Roads and their traffic*, p. 182.

[25] Evans, "Steam-road carriages", pp. 12-3; Porter, *The life and times of Sir Goldsworthy Gurney*, p. 114; James, *Walter Hancock*, p. 47.

[26] References to his vehicles can be found at Davison, *History of steam road vehicles*, pp. 35-6 and Alderson, *An essay*, pp. 82-4. See also Bird, *Roads and vehicles*, p. 168; Copeland, *Roads and their traffic*, p. 169; Evans, "Steam-road carriages," pp. 7-8; Nicholson, *The birth of the British motor car*, p. 82.

1831 but the service proved to be uneconomic and the vehicle was withdrawn and converted to a 14-seater. A rebuilt version of this steamer ran between London and Brighton in 1832 but it encountered some technical problems and, in the end, it was discontinued.[27]

The next year, 1833, was a milestone in Hancock's professional trajectory. He was deeply focused on various improvements, particularly the problem of clinkers blocking firebars and causing delays and loss of power, a problem plaguing all steamers. It was addressed by patenting a removable firebar which could be replaced by a new set. Another improvement, more of an adaptation, came in 1834 with the design of new wheels of composite construction, cast-iron naves and very strong spokes, which provided robustness without excessive weight. Such wheels were used in artillery but it was the first time adapted to steamers. These two years were marked by robust activity on the part of Hancock but also marred with a number of problems, including the death of one of his engineers by a boiler explosion and incidents with coaches on a service he ran.[28]

The latter service started in 1833 in the context of an agreement with the London and Paddington Steam Carriage Company (LPSCC) which involved building the *Enterprise*, a 14-seater omnibus, to run a service between Paddington and the Bank charging 1s per passenger. The understanding was that if the trials were successful the company would buy two more similar buses. The service ran twice or thrice a day for 16 days, the demand was great, the company expressed its satisfaction, and the vehicle was handed over. However, LPSCC did not fulfill its obligations and Dr. Redmund, the company's engineer, came up with an inferior copy of the vehicle. The company failed while Hancock ended up retrieving the vehicle after months of negotiations. His loss from this unfortunate event reached £1,000. A similar scenario unfolded with another of his vehicles, the *Era*, which was sent to a Greenwich company which also failed. The *Era* was renamed *Erin* and was sent to Ireland but was also met with failure. However, it was used with another steamer (the *Autopsy*) for service between the City, Moorgate, and Paddington. Each vehicle carried 12 passengers and took, on average, half hour to cover the 5-mile distance at a speed of 12 miles/hour allowing for stops. The service ran from August 18th to the end of November 1834 carrying over 4,000 passengers without any incident. Finally, the deal over a vehicle destined for Austria also fell through but it went through modifications and in its final form was named the *Automaton*. It was a 22-seater, Hancock considering it the best of his creations and also the most powerful, at times reaching 20 mph.[29] The *Automaton*, along with the *Erin*, the *Autopsy* and the old *Infant* as a spare were used in 1836, to run the Moorgate to Stratford, Paddington and Islington services. In total, 525 round-trip journeys were undertaken over a period of 5 months covering 4,200 miles from the City to Islington and back carrying 12,761 passengers while the total capacity of the vehicles was 20,420 passengers. Hancock claimed that there were only 4 mechanical breakdowns and a single accident during the entire duration of the service. The service on the Stratford-Paddington route succeeded in shaving off considerably the amount of time it would take coaches. The latter were forced to increase the speed to 8-9 mph while Hancock's steamer averaged 9-10 mph. Despite these successes, this was the last commercial enterprise by Hancock.

---

[27] Nicholson, *The birth of the British motor car*, p. 83. Bird, *Roads and vehicles*, p. 186.

[28] Nicholson, *The birth of the British motor car*, pp. 112-3, 115. For the technological features, evolution and problems encountered by his vehicles, see also Bird, *Roads and vehicles*, pp. 183-6; Copeland, *Roads and their traffic*, pp. 168-9.

[29] Its last recorded run was in 1840 when it took a cricket club to a game reaching a speed of 25 mph on the return journey. Bird, *Roads and vehicles*, pp. 186-8. See also Copeland, *Roads and their traffic*, p. 170; Evans, "Steam-road carriages," p. 19; Nicholson, *The birth of the British motor car*, p. 131; Hancock, *Narrative*, p. 72.

Ogle, another notable inventor (see below), stated that the reason behind Hancock's cessation of his services was because he ran short hauls with many halts. This is a valid point but it was applicable to all steamers. The fact of the matter is that we do not have enough information on the economics of his services, with the exception of fuel and tolls, to be able to tell whether his business was generating profits. One may also argue that he failed both because of the imposition of high tolls as well as his inability to attract investment capital unlike other inventors with inferior designs.[30]

There was a lull in Hancock's activities in the years 1837-9 with the exception of a vehicle he came up with in 1838 for his own private use accommodating 3 persons besides the one steering. It was a type of vehicle which could have been marketed to wealthy individuals if steamers proved to be successful. It was used for excursions in the streets of London at speeds of 10-12 miles/hour and drawing, according to him, the admiration and curiosity of the crowd which was impressed by the lack of noise and smoke.[31]

By the spring of 1839 he was seeking contracts from operators and was attempting to raise capital. In an effort to lure both types of investors, he had the *Automaton* engage in various demonstrations but the vehicle was plagued by several minor problems due to its long immobility. Its fuel consumption was a bushel per mile, not something to brag about. Some of its speed was also lost although in one of the runs it achieved over 10 mph while in another it even went up to 25 mph. His efforts were not successful and after 15-16 years of engagement with the subject and spending £12,000 of his own money he decided to desist. Hancock came the closest than any other inventor to render steamers a viable alternative to coaches. His vehicles had a rational and efficient design, they were reliable, economical, achieved high speeds, and he was astute enough to focus on roads with plentiful of passenger traffic and low tolls. He gained the admiration of his contemporaries, even a portion of his competitors although some of them extended it grudgingly. In the end, he was more of an engineer than a businessman. His efforts moved to new technological challenges but he was financially ruined by 1851 and died a year later.[32]

Hancock was just one, albeit the most preeminent, of engineers trying to make it during the 1830s. Another notable figure in this group was W. H. James.[33] His experiments dated back to 1823 at a time he patented a high-pressure water-tube boiler specifically designed for steamers. In 1829 he came up with a vehicle which was financed by Sir James Anderson. It weighted 3 tons, in one occasion it carried 20 passengers at 10 mph and it operated under a pressure of 250-300 p.s.i, way too high for the materials at the time. Another vehicle designed in 1832 aimed at hitting the road the next year failed to do so after Anderson withdrew his backing. It had the novel element of a 3-speed gear with the gear-changing function taking place while in motion. The driver was also provided with a foot-brake. Had this steamer being built, it would have been the most practicable of those which emerged prior to 1840. James' failure was due to the heavy expenses involved in his experiments stemming from the continuous trouble with the boilers and pipes. He went off to America to continue his work there while Anderson tried again in 1838-40 and he kept experimenting with steamers 20 years later.

The Heaton brothers of Birmingham, considered the Hancocks of the Midlands, came up with several complicated but efficient steamers during 1830-3 by creating a company aimed at producing steamers at

---

[30] Nicholson, *The birth of the British motor car*, pp. 131-2.
[31] Porter, *The life and times of Goldsworthy Gurney*, p. 117; Hancock, *Narrative*, p. 98.
[32] Nicholson, *The birth of the British motor car*, pp. 148-9; Porter, *The life and times of Goldsworthy Gurney*, p. 117.
[33] Bird, *Roads and vehicles*, pp. 189-91; Porter, *The life and times of Goldsworthy Gurney*, p. 117; Davison, *History of steam road vehicles*, pp. 32-3.

£500 apiece. One of them, used in experimental runs in the neighborhood of Birmingham had an advanced feature in its change-speed mechanism. It went on several runs between Birmingham and Wolverhampton in 1833, completing 3 round trips in a day between the two cities and covering the total distance of 84 miles in 14 hours carrying 34 passengers. In another occasion, running the round trip of 29 miles between Birmingham and Bromsgrove, it had a fuel consumption of 11 bushels of coke at the local price of 2.5-3d per bushel. The Heaton machine scored a fuel rate as good as Hancock's or even lower in monetary terms, 1d/mile, given the low price of coke locally. Equally important was the fact that the vehicle proved to be powerful and reliable as well as working with a boiler which John Farey, being their consultant on patent drawings and specifications, classified as one of the best in the business. However, they failed to attain an average speed of 10 mph stipulated by their financial backer and came to the conclusion that no commercial enterprise using steamers would be economical leading them to withdraw from the business. The *Mechanics Magazine* noted in a May 1834 article that the Heaton brothers "have been compelled to doubt the possibility of steam-locomotion on common roads at an average speed of ten miles an hour, the wear and tear of the machinery, with other expenses, being so great as to exceed any probable receipts."[34]

One of the steamers that found itself on the road in 1833 was by the Maceroni-Squire duo. Its range between water and fuel stops was 12 miles and had a recorded speed which at its maximum reached just under 10 mph. However, according to Alexander Gordon who became a Maceroni supporter after Gurney's withdrawal, it had a fuel consumption of 0.5-0.75 bushels per mile, a fairly high figure for the standards of the time. But Maceroni came up later on with a second steamer, to be sold to a buyer from Germany, which achieved 15 mph and had a fuel consumption of one bushel of coal per 3 miles. It was faster and its fuel rate compared with the best steamers at the time. Maceroni's vehicles drew considerable interest in the continent, two of them were exhibited in Belgium and France by an Italian named Asda who agreed to return them and pay £1,500 for the patent rights. The latter received £16,000 for manufacturing rights but Maceroni did not see a penny contributing to his financial hardships which led to the confiscation of his tools in his Paddington workshop. Things looked much brighter for him, after repeated efforts, in 1841 when he came to an agreement with the General Steam Carriage Company to supply it with a number of vehicles manufactured at a factory in East Greenwich. The shareholders of the company were given a demonstration which was proven utterly successful with the vehicle traversing the London streets at 16 mph having 17 passengers. The deal, however, soured when the manufacturer refused to build the extra vehicles at £800 apiece, instead demanding £1,100, and refused to hand over one that was completed. The deal collapsed leaving Maceroni utterly disappointed. By 1843, having failed to find any financial backers, he decided to give up. Maceroni was one of the most noticeable figures in this field, however, his vehicles did not exhibit any startling design novelties and they suffered the usual mishaps, especially with crank-axle breakages.[35]

Another notable effort was the one of the pair of Ogle and Summers whose experimentations seem to have gotten an impetus in 1830, right after the successes and publicity received by Gurney's efforts. Ogle was an amateur enthusiast and publicist prone to exaggeration while Summers provided the engineering expertise. The two of them made the incredible claim that their vehicle, weighing 3 tons, could achieve a

[34] Cited in Evans, "Roads, railways, and canals," p. 28. See also Porter, *The life and times of Sir Goldsworthy Gurney*, p. 117; Nicholson, *The birth of the British motor car*, pp. 112-3.

[35] Bird, *Roads and vehicles*, pp. 188-9; Davison, *History of steam road vehicles*, pp. 37-8; Nicholson, *The birth of the British motor car*, pp. 116, 119.

speed of 30-35 mph going down to 16.5 mph when encountering hills.[36] Ogle formed a company in 1834 issuing 4,000 shares but only one individual subscribed. The venture cost him £3,800 while he claimed he spent a total of £47,000 before giving up.

Another inventor, John Scott Russell, came much closer to success getting involved in a venture which provided service between Glasgow and Paisley. It operated by the Steam Carriage Company of Scotland using six 26-seater vehicles based on his designs.[37] Each vehicle managed with a crew of 3 (steersman, stoker, and the engineman) and used a boiler which was similar to Hancock's albeit inferior. The company came up with the clever idea of carrying enough fuel and water for each stage in a two-wheeled trailer which also provided comfortable seating for 6 more passengers. The trailer could be replaced with a new one when fuel and water supplies were exhausted, a practice that saved time. The service operated for 7 months in 1834 in the context of a daily service with multiple departures. It was fast and reliable, averaging 30-35 minutes for the journey of 7.5 miles. However, in the end, it suffered the same fate as Dance's Gloucester adventure. Russell provided the usual assurances about the safety of the vehicle but there was one accident on the road between Paisley and Glasgow caused by a vehicle trying to force itself over a heap of stones left on the road that led to the boiler exploding resulting in the death of 5 people while a dozen others were injured to one degree or another. The accident found its way to court and, in the end, the service was terminated.

The 1830s closed with an invention by Frank Hills, one of the most interesting figures in this field, who obtained a patent in 1839 and came up with a vehicle the next year. Aside of the fact it was aesthetically very attractive, it was technologically advanced. It had space for 6 passengers inside and 3 on the box. The machinery was entirely enclosed, it had a speed-change mechanism, and it used 10-12 gallons of water per mile, a quite excessive figure, which was probably due to its declared speed, reaching 25 mph with a cruising speed of 16 mph. The construction cost was £800, hence rendering it a toy for wealthy individuals.[38]

The 1830s proved to be a critical decade for the future of steam cars. Gurney claimed, while he was still active, that 20-40 steamers were in the process of development by various investors. Just a few years later the situation was radically different. The number of steam vehicle inventors and their backers declined from at least 9 in 1834, to 5 in 1835, to one in 1836 (Hancock), and to none by the fall of that year. The year 1834 was the last year for newcomers, by 1835 only bruised veterans had remained and, by next year, even they started exiting the scene. It was the same year the second edition of Alexander Gordon's *Treatise on Locomotion* came out in which the author claimed that there were about 20 inventors involved with steamers at that time, some hopeful, some hopeless. It seems that it was mostly the latter though some instances of optimism still survived. Such optimistic attitudes, for example, were still attributed to the directors of the London & Birmingham Steam Carriage Company based on a statement of theirs issued in May 1835. In September 1838 the *Birmingham Advertiser* adopted the same confident outlook.[39] It was about that time that Sir James Anderson announced that he intended to build

---

[36] For a description of the vehicle see Alderson, *An essay*, pp. 84-7. Also, *The roads and railroads*, p. 299; Nicholson, *The birth of the British motor car*, p. 52; Porter, *The life and times of Sir Goldsworthy Gurney*, p. 118.

[37] Bird, *Roads and vehicles*, pp. 181-2; Lord Montagu and Bird, *Steam cars*, pp. 49-50; Davison, *History of steam road vehicles*, pp. 36-7; Copeland, *Roads and their traffic*, pp. 172-3.

[38] Nicholson, *The birth of the British motor car*, p. 149; Davison, *History of steam road vehicles*, p. 38.

[39] "The subject of steam carriages on common roads is much spoken of at this time, and we understand that the bondholders on the turnpike roads, as well as the innkeepers and others whose property is threatened with

400 steam carriages for the Waggon Company of England, all of them to be drawn by his own steam carriage. According to a report by the *Southern Reporter*, which followed developments of his efforts, the cost of fuel for carrying 30 passengers and their luggage at a speed of 15 mph would be 4d/mile.

Notwithstanding these glimpses of optimism, it seems that by 1836 the development curve of steam cars had passed its zenith, in fact, by the end of the decade, at a time few individuals kept going on, one may be justified in talking about their failure. The accomplishments of inventors involved in steamers was quite remarkable by that time since they achieved major improvements within the span of a little over a decade.[40] Whatever technical imperfections were left to be addressed could have been resolved by a second generation of inventors. One may say their achievements surpassed those of railway engineers when we think of the constraints imposed by weights and bulk. But the timing was not to their favor. Steamers still faced major technical issues in contradistinction to railroads which already proved their technical viability. To make matters worse, Turnpike Trusts had accumulated a debt of £9 mil by 1838 which meant they were not able to invest in harder roads which could have lessened design problems faced by steamer inventors. But even without technical problems, there were some who believed that steamers could not compete, the Heaton brothers being in the pessimistic camp. The success of railways meant that not only engineering talent but also huge sums of capital were channeled towards this transportation mode starving steamers from essential financial resources. Another winner, at least temporarily so, were stage coaches. By having eliminated one competitor they kept going although they were also doomed to succumb to the might of railroads.

The disheartening developments of the 1830s were crystallized in a state of relative indifference towards the subject during the period 1840-60 coinciding with the railways' take-off. One may point to some isolated instances of lingering interest.[41] I. W. Boulton constructed a vehicle in 1848 which ran on the road between Manchester and Ashton-under-Lyme. Ten years later Lough and Messenger of Swindon built a light vehicle of only 8 cwt. which could reach a speed of 15 mph on a levelled road. Thomas Ricket also built two vehicles in the late 1850s which performed quite well.

But interestingly enough, while engineers had spent a fair amount of energy and treasure to develop steam vehicles for the transportation of passengers, the 1840s witnessed the beginning of efforts towards the development of heavy traction engines for agricultural tasks such as threshing and chaff-cutting. Such

---

destruction by the railway lines, are beginning to feel confident that, by levelling of turnpikes, laying down granite tracks, and adapting steam locomotive carriages and wagons, the traffic, both for passengers and merchandise, may well be preserved on the present lines of roads." Copeland, *Roads and their traffic*, pp. 177-8, quote from the former page. See also Porter, *The life and times of Sir Goldsworthy Gurney*, pp. 114-5. Evans, "Steam-road carriages," p. 18.

[40] Many of the technical ideas developed in the context of steam cars reappeared in the automobile industry towards the end of the century. See Lord Montagu and Bird, *Steam cars*, p. 51. See also Nicholson, The *Birth of the British motor car*, pp. 132-3; Copeland, *Roads and their traffic*, p. 183; Evans, "Steam-road carriages," p. 15-8, 22; Bird, *Roads and vehicles*, pp. 168-71. The technical evolution of steamers also contributed to scientists such as Carnot and Joule developing theoretical principles by the first half of the 19th century which proved very useful for the application of steam power in transportation. See Davison, *History of steam road vehicles*, p. 17. The role of science in the technological evolution of steamers was very limited as was the case with steam engines in general. Improvements materialized through experimentation and trial-and-error. Inventors, despite being secretive, learned from each other either by sharing information voluntarily or by stealing since they dealt with a select group of foundries, mechanics and patent draftsmen. See Porter, *The life and times of Sir Goldsworthy Gurney*, p. 115.

[41] Davison, *History of steam road vehicles*, pp. 15-6.

engines were also used for hauling heavy loads at a speed of 4 mph.[42] One of the first ones was designed by Boydell while a large number of them were constructed by Charles Burrell of Thetford. One of them made a journey from Thetford to London in 8 days taking a gross load of 29 tons although in terms of speed and cost of haulage the effort was a failure. Nevertheless, heavy traction engines proved to be a great success and found a lucrative market.

As this market was developing, Parliament stepped in engaging in some legislative activity that was anything short of schizophrenic. First, it passed an act in 1861 which reduced excessive tolls. At that point the turnpike system was under relentless threat by railroads and some thought that the steamers could accelerate the predicament of many unprofitable railway lines by acting as feeders to major lines by drawing 3-4 heavy tractors loaded with goods and traveling at speeds of 8 mph or lighter vehicles transporting passengers at speeds of 16-20 mph.[43] Inventors working on steamers aimed at passenger traffic viewed this legislation as offering a fresh opportunity. A number of such vehicles appeared in the early 1860s.[44] T. Cowan built a vehicle using the design of Yarrow and Hilditch which weighted 2.5 tons when loaded and attained a speed of 15-18 mph. The Cowan firm, however, stopped pursuing further construction despite the good performance of the vehicle because of the opposition to any vehicles but those drawn by horses. W. O. Garret of Leeds built a rather clumsy steam car in 1861-2 with 3 wheels carrying 7-8 passengers and, despite its weight reaching 5-6 tons, it achieved a speed of 20 mph although its ordinary rate was 12 mph. There was another one by Garrett in 1862 which performed very well although it was clumsy compared to its predecessors. It carried 7-8 passengers reaching a weight of 5 tons.

Four years later, in 1865, Parliament stepped in again passing the famous Red Flag Act which reversed its previously favorable attitude. The act imposed limits on the speed of steamers, 4 mph in the country and 2 mph in towns and villages; each steamer had to be accompanied by 3 individuals one of which was to precede the vehicle by no less than 60 yards and display a red flag warning others of the vehicle's presence; blowing steam or a whistle was prohibited and any person on horseback or a horse-drawn vehicle was given the right to stop a steamer; a penalty of no more than £10 was imposed for violating these rules; further provisions regulated the weight of steamers and gave authority to local parishes to impose limits and specify the hours they could travel. This act, along with another one passed in 1878, brought experimentation and use of steamers to a standstill. It was the last nail to the coffin of this phenomenon which was attracting a very limited group of enthusiasts at that point.[45]

Some inventors have had enough by that point. The firm of Tangye and Co. of Birmingham was in the process of following an expansion of its production plans but it overturned its decision when the unfavorable acts were passed. L. J. Todd of Scotland whose vehicle proved successful on the road decided to abandon his plan to start receiving orders. Others lingered in the hope the damaging provisions of the

---

[42] Head, *On the rise and progress of steam locomotion*, p. 22; *Catalogue of the mechanical engineering collection*, p. 71.

[43] "Had these services been established they would almost certainly have led on to the development of private horseless carriages." See Lord Montagu and Bird, *Steam cars*, p. 56.

[44] Davison, *History of steam road vehicles*, p. 39; Bird, *Roads and vehicles*, pp. 191-3.

[45] Davison, *History of steam road vehicles*, p. 19; Fletcher, *The history and development of steam locomotion*, pp. 279-80, 285.

acts would be reversed or looked at foreign markets.[46] H. P. Holt of Leeds built a vehicle in 1867 for 8 passengers, including the steersman and engineman, weighing 30 cwt and developing speeds up to 15-20 mph on a flat road. It could carry sufficient coke for 40 miles, having a fuel rate of 5 lbs/mile, and water for 20 miles. He was joined by some others: R. W. Thomson who worked on an omnibus capable of carrying 60 passengers, R.E.B. Crompton, Catley and Ayres of York whose vehicle ran for about 3 years developing speeds up to 20 mph, J. H. Knight of Farnham, and Andrew Nairn of Scotland who constructed a 3-wheel omnibus to carry 50 passengers and was used for a time in Edinburgh. Others followed in the post-1870 period.[47]

By the last quarter of the century steam carriages for passengers were rarely built, their most notable applications being in agriculture for ploughing purposes. There was also a setback in terms of the mechanical principles they were constructed. During the first part of the 1860s most of the steam cars that were built were heavy embodying technology from railroads and traction-engines. Boilers and cylinders occupied much of the space with comfortable seating for passengers being a secondary consideration. The work of Gurney, Hancock and others who aimed to coming up with small boilers was not followed up. The boilers inspired by railways had thick plates and were made to carry large quantities of water. The vehicles of those years were mechanically sound but failed to attract much attention due to high initial and operating costs while their slight superiority over horses for short distances was not considered to be a major benefit.[48]

The development of steam vehicles had a fairly brief history. It is sad to admit that later developments relating to the car industry borrowed little from the achievements of the early pioneers in the 1820s and 1830s. It was like almost everything had to be rediscovered. When the steamer reappeared on the scene later in the century, the emphasis was on power for agriculture, goods haulage, and towards the development of private vehicles, a very important development; they were still few but they were built in much larger numbers than steamers.[49]

Nevertheless, the development of steamers resulted in a multiplicity of vehicles which can be classified into four distinct categories.[50] First, there was the group that aimed at connecting London with major provincial towns, a category that includes efforts by Gurney and the Heatons. Second, there was another group that aimed to providing service within major urban centers which were growing spatially. Hancock belonged to this group. A third group was private steamers for the wealthy. However, little effort was put

---

[46] Davison, *History of steam road vehicles*, pp. 20, 39-44; Head, *On the rise and progress of steam locomotion*, pp. 17-8, 20-1; Wallis-Tayler, *Motor cars*, pp. 30-2.

[47] For instance, an engine designed by Head and Thompson named “Sunderland” and being equipped with india-rubber wheels was tested in 1871 in a run from Wolverhampton to Stafford, a distance of 16 miles. It had a speed rate of 4 miles per hour with a net load of 12 tons behind it. The fuel rate was 3.75 lbs of coal per ton of load per mile and of water 2.05 gallons per ton of load per mile. This vehicle managed to go up an incline with 38 tons. See Head, *On the rise and progress of steam locomotion*, pp. 24-5. Another engine designed based on Thompson’s patent and used by John White of Aberdeen was of 10 hp and was used to carry wheat and flour. It was observed during 1871 coming to the conclusion that the cost per ton per mile was 5d which included heavy outlays for repairs and alterations as well as “deduction for deterioration of plant.” It is stated that “barring repairs, the work should be done considerably cheaper.” See Head, *On the rise and progress of steam locomotion*, p. 42.

[48] Davison, *History of steam road vehicles*, p. 18; Thurston, *A history of the growth of the steam engine*, pp. 357-9.

[49] Nicholson, *The birth of the British motor car*, p. 156.

[50] Evans, “Steam-road carriages,” p. 11.

by inventors in making progress in this category. The last group was developed for the haulage of heavy goods, Gurney's steamer at Cyfartha being an example of this.

The economics of steam cars

There were many factors that came into play in deciding the fate of steam cars, from the technical problems encountered by virtually every inventor to the opposition by the public, stage coach companies, and turnpike trusts. But the most critical determinant of their long-term viability hinged on whether they had the ability of offering services at a lower cost than railroads and, especially, stage coaches. The long list of individuals who got engaged in such projects seems to indicate that *ex ante* expectations were driven by optimism based on factors such as that steam carriages would run faster than horses, the road infrastructure was already in place or the advantage they had over railways by requiring less power to ascend hilly terrains.[51] Such optimistic attitudes were crystallized in statements, to name just one, by Sir James Anderson according to whom the savings that could be effected with steam carriages would allow passengers to travel with less than a quarter of the charges on railways.[52]

The data we need to reconstruct the cost configurations of various steam cars is adequate although one has to tread carefully because they include purposely deceitful statements by inventors, ignorance by others writing on the subject, and occasional calculation errors.[53] The data presented here will ignore at this stage toll charges in order to avoid the distorting element of discriminatory tolls. The first account, published in 1839, comes from Adcock who engaged in a cost comparison of coaches and steamers relying on information provided by the proprietors of coach companies servicing the road between Manchester and Liverpool and some adjacent places in the context of a petition to the Parliament in May 1830.[54] Adcock engages in a hypothetical exercise calculating the cost of transporting the passengers and their luggage for 39 miles, a trip that would take half day to complete. He assumes that the purchasing cost of a steamer would amount to £700 and he adds one-fifth of that amount, for a total of £840, for a spare steamer making the assumption of one spare per 5 working steamers, the former replacing one of the latter when undergoing repairs. On the basis of the capital cost figure, he calculates the interest charges for half day (1s 2d) and the same when it comes to depreciation (7s 5d) assuming that steamers costing £840 will sell two years later for £300 at a loss of £540.[55] Then he adds the cost of fuel (9s 6d) for the 20 hp steamer, assuming the same fuel rate and cost as incurred by a locomotive in the Liverpool-Manchester line, as well as the cost of repairs. The latter is estimated by assuming that each steamer covered 78 miles/day, one round trip, or 28,470 miles per year. He also assumes that the cost of repairs was the same as one locomotive which covered a similar distance (26,000 miles). Taking into account data from the Manchester-Liverpool locomotives, the figure referring to one of the latter (£800) is augmented by one-fifth for the spare steamer (£160) giving a figure of £1 6s 4d for the cost of the 39-mile trip. Two more items are taken into account: rent and interest for carriage houses, sheds, pumps, water stations, etc.

---

[51] Macadam roads had a higher resistance than rails but this issue could be addressed by hard paving. Ibid., p. 5.
[52] "A person could be conveyed for two shillings and sixpence, affording a larger profit than can be effected for ten shillings on an iron locomotive." Cited in Copeland, *Roads and their traffic*, p. 179.
[53] For instance, references to steamers in many newspaper articles display a fair amount of ignorance on the part of writers regarding the mechanics of the subject while the pamphlets published by some of these inventors aimed at not informing but in providing enthusiastic accounts of their designs or vilification of their opponents as well as underplaying the gravity of technical problems. See Bird, *Roads and vehicles*, pp. 156-7.
[54] Adcock, *Rules and data for the steam engine*, pp. 83-8.
[55] Adcock's figure for depreciation per half day is double the one stated by the author because he makes an error by dividing the total figure by one year as opposed to two per his own statement.

coming to 3s 6d as well as the wage of the engineer for half day at 3s. Without counting turnpike tolls, the total cost of the trip comes to £2.54 or 15.6d per mile.

The author concludes that, mainly due to the high level of the repair cost, the use of steam power on roads was not feasible contrary to the evidence submitted to Parliament in previous years. Adcock's account, however, should be treated with a mild amount of skepticism in light of his reliance on data from locomotives, as opposed to the performance of operating steamers, and the ambivalence regarding the derivation of figures such as rental charges.

A more reliable account is provided by Dance's Gloucester-Cheltenham 9.25-mile service since cost figures are derived from actual performance. This was one of three licenses Dance had acquired from Gurney, the other two being on the London-Birmingham and London-Holyhead roads, by paying a royalty of 6d per mile ran. The particular service was chosen to run first because there was a smooth surface road and no tolls. Dance's expectation was that the service would absorb the entire clientele of stage coaches and then create some additional traffic based on the novelty of the vehicles, in a fashion that echoed the triumph of the Liverpool-Manchester railway which succeeded in nearly wiping out the local stage coach services from the very start and generating enormous profits. The vehicle used by Dance was composed of a tractor and a trailer with the considerable capacity of 38 passengers per journey. There were two round trips daily except Sundays. Curiously enough, Dance utilized 3 steamers despite the fact that the daily distance to be travelled, 37 miles, could be accommodated by just one steamer and a spare one as was the case in Adcock's hypothetical account which involved an almost identical distance.

The calculation of the steamers' operating cost relies on figures provided by Gurney or, when there are omissions, by consulting other sources. The cost of a single steamer was specified by Gurney at c. £600, below the actual cost of steamers by other inventors which could reach as high as £1,100. Taking the stated figure at its face value, annual interest charges, an expense Gurney ignored, would amount to £30 for the 4 months of the service. The annual depreciation cost, also ignored, of the 3 steamers will be calculated at 20%, a lower rate than in Adcock's estimates, due to the lighter working load of Dance's steamers amounting to £360 for the year or £120 for the 4 months. The cost of repairs is not stated by either Gurney or Dance with some historians speculating that there was a conscious effort on their part to underreport this expense. Of the 396 trips that did take place, there was a one major delay with the trip taking 160 minutes but otherwise minor ones with the rest of the trips never exceeding 82 minutes. These delays were probably due to the inexperience of a new stoker. But there was also a fair number of cancelled trips. The service was supposed to involve 4 trips daily which would have implied a total figure approaching 490 trips over the 4-month period. The fact that only 396 took place translates to nearly 19% of them being cancelled. The factors contributing to these cancellations are unclear. Bird speculated that the most common source of technical problems would have been burst boiler tubes, a statement rejected by Nicholson who noted that boiler tubes burned only 5-6 times over a 3-month period or once every 66 journeys. There may have been other types of breakdowns but we lack both precise information and how much they added to the operating cost.[56]

On the other hand, there are two types of cost on which we have precise figures, the wage and fuel bills.[57] The former involved wages for 4 engineers, Thomas Bailey (the senior one), Thomas Harris along with two

[56] Nicholson, *The birth of the British motor car*, pp. 52, 70-1; Alderson, *An essay*, pp. 87-9; Gordon, *Historical and practical treatise*, pp. 19-20; Bird, *Roads and vehicles*, p. 180.
[57] Nicholson, *The birth of the British motor car*, pp. 70-2; Bird, *Roads and vehicles*, p. 180; Lord Montagu and Bird, *Steam cars*, p. 48; Copeland, *Roads and their traffic*, p. 171; Cundy, *Inland transit*, pp. 77-8.

other individuals. Each of these four men drew a salary of £3/week.[58] James Stone, the manager, drew an even more impressive compensation, £1 per working day. The total wage bill for the 18 weeks of the service reached £324. The fuel bill reached a far more modest figure. Each steamer used 10 gallons of water and 20 lbs of coke per mile travelled coming to a fuel bill of £78 during the 4 months. From the latter figure, however, Gurney deducted one-third for coke used during trials thereby reducing the fuel bill involving just the trips down to £52 (3.4d per mile). Finally, we need to add 6d per mile ran, or c. £92 for the entire duration of the service, for the royalty paid by Dance to Gurney.

The total operating cost of the service came to £618 or 40.4d per mile ran. However, the true cost was higher in light of the fact we could not include the cost of repairs and maintenance nor did we take into account potential costs such as the rental of premises or the construction of infrastructure such as water and fuel stations. To appreciate the extent of underestimation, if we take Adcock's figure for repairs and maintenance and adjust it for the number of miles ran by Dance's service, the cost of this item alone would increase the operating cost by £123 and would bring the operating cost per mile at 48.5d. It is clear that Dance should have done a better job in controlling cost by not overextending himself regarding the number of steamers he utilized and, especially, when it comes to the wage bill he incurred which reached over half of the known expenses.

Nevertheless, Dance seems to have been overly optimistic before the service commenced due to several perceived advantages.[59] One related to speed with his steamers completing a trip, in most cases, in 40-50 minutes as opposed to 50-70 minutes needed by stage coaches. The latter could attempt to match a steamer's speed but it would have to incur a higher cost in contrast to Dance's steamers whose cost was not affected by speed. A second advantage was the fact a steam carriage could better be controlled when dealing with dangerous bends and uphill terrains compared to a team of spirited horses. Dealing with a potential decline in demand also worked in favor of steamers, as John Farey pointed out to the 1831 select committee, because they could be withdrawn from service while coach companies still had to bear the maintenance cost of their horses. Other virtues included the greater seating capacity of steamers and their ability to cover much longer distances than a team of horses. Dance must have figured out that all he had to do was to price the service at a level similar to railroads, thereby undercutting the prices of stage coaches, in order to wipe them out. His price, he decided, was going to be 1s per passenger (1.3d per mile).[60] It is this overconfidence, one may speculate, that may have led him to purchase three steamers from Gurney as opposed to two, one to be used as a spare, and then increase his seating capacity based on the level of the anticipated higher demand.

Table 9.1: *Expenses, revenues and break-even point in Dance's service*

	Expenses	*Revenues from parcels*	*Revenues from passengers*	*Combined revenues*	*Loss*	*Passengers needed to break even*
Total (£)	740.6	68.9	133.3	202.2	538.4	13,434
Per mile ran (d)	48.5			13.2	35.3	

[58] Such weekly salaries would translate to £156 annually, well above the range of salaries (c. £80-130) paid to managing engineers of steam engines a decade later, in the 1840s. See chapter 9.
[59] Copeland, *Roads and their traffic*, p. 180.
[60] Porter cites the specification of three different prices depending on the seating of a passenger in the steamer but he is wrong on this issue. See Porter, *The life and times of Sir Goldsworthy Gurney*, p. 102.

Source: see text

The way the economics of the service turned out is summarized in Table 9.1. Dance managed to attract 2,666 paying passengers in the 396 journeys that took place or 6.73 passengers per trip corresponding to 17.7% of a steamer's seating capacity. Some of these journeys ran with 3-4 passengers, occasionally with none while there was not a single trip in which the number of passengers approached full capacity. Strangely enough, Dance compounded the problem by allowing a large number of passengers to ride without paying, a decision that can only be explained on the basis of creating publicity. At 1s per passenger, this source of revenue generated £133.3 accounting for nearly two-thirds of the total revenues which stood at £202 4s 6d with the remainder being collected from the delivery of parcels.[61] Expressed differently, Dance was collecting 13.2d per mile ran while his cost stood at 48.5d, in the end coming up with a loss of £538.4 during the entire duration of the service.

How many passengers Dance's service would need just to break even? The answer is 13,434 passengers who would generate a revenue of £671.7 and, along with the existing proceeds from the delivery of parcels, would have gotten him to the break-even point. In other words, he had to have 33.9 passengers per trip operating at nearly 90% of a steamer's seating capacity. Did he ever approach this break-even point? Records kept by Dance show that looking at the 30 days leading up to June 1st, during the first 10 days of this segment there were 169 passengers (5.2/trip), rising to 357 in the following 10 days (11/trip), and reaching 463 in the final 10 days (14.2/trip).[62] Dance passenger traffic was improving but he was still a long way from just breaking even right before he decided to discontinue the service, a choice that became clear in light of the imminent discriminatory tolls. Simply put, passenger traffic in this particular route was neither robust enough nor Dance's market share was rising fast enough to justify his initial excessive optimism that led him to purchase 3 steamers with a total seating capacity of 114. The magnitude of the gap between reality and his *ex ante* expectations is shown by the fact that his break-even point could have been accommodated by a single steamer with a second one being spare.

Table 9.2: *Annual operating cost of a hypothetical steamer service in the London-Birmingham route (all figures in £)*

Interest	*Depreciation*	*Repairs and maintenance*	*Wages*	*Fuel bill*	*Total*
2,350	4,350	39,420	13,140	34,492.5	93,752.5

Source: Cort, *Railroad impositions*, n.p (but the relevant table is labelled "No. 5"). *Note*: Cort allows £5,000 in his capital bill and another £8,000 in his operating cost account for "contingencies" which have not be taken into account and the same applies for the payment of tolls, an expense whose effect will be discussed below.

Did a service relying on steamers was bound to be unfeasible? On the contrary, assuming the management of such a service was based on a tighter handling of cost factors. R. Cort published an account in 1834 looking at the economics of 61 stage coaches operating between London and Birmingham, a 108-mile distance, and provided a hypothetical estimate of cost and revenues if the same service was provided by

[61] Nicholson, *The birth of the British motor car*, p. 72; Gurney, *Observations*, pp. 36-40.

[62] Nicholson, *The birth of the British motor car*, pp. 72-3. The assumption is made that the daily number of trips during the month in question was the same as in the entire duration of the service, i.e., 3.25 trips (number of days the service ran divided by the number of trips), as opposed to four trips per day as the company intended, a goal that failed to achieve due to technical problems.

steamers which meant to run every day of the year. Cort's account lacks analytical detail that would allow us to justify some of his figures, it includes unnecessary expenses and omits others which were indispensable. However, a modified version of his account worked by the author, summarized in Table 9.2, provides a useful insight.

Cort specifies that the service would need a total of 60 steamers, 20 of which were spare, with each steamer costing £700 or £42,000 for all of them. To this figure he adds £5,000 for the purchase of offices in London and Birmingham as well as the cost of water and fuel depots. Interest charges in Table 9.2 are based on a 5% rate while the depreciation figure relies on a 10% rate for the engines specified by Cort, which may be a bit low, and a 3% rate for the buildings, a charge he ignores (see chapter 9). The repairs and maintenance figure relies on Cort's assumption of being 6d per mile, a bit lower than Adcock's 8.1d/mile, with the total number of miles ran by the steamers during a year reaching 1,576,800. The wage bill is based on a team attending each steamer comprised of an engineer, assistant engineer, and a fireman getting paid 18s per day, a figure much more reasonable when compared with Dance's spending on this item. Finally, the specified fuel bill is based on the assumption of a 5.25d/mile rate being higher than Dance's actual consumption per mile ran. Cort's expense account is not ideal because he does not take into account items such as interest charges and depreciation of buildings, as the author does, or the salaries of managerial and clerical staff. The last item probably would have brought the annual operating cost closer to £100,000. If the latter figure is taken into account, operating cost per mile was 15.2d. The operating cost figure is contrasted with a projected annual income of £189,252.5 generated by an average of 550 passengers per day (13.75 passengers/trip) and revenues from parcels which accounted for c. 19% of the total. It should be noted that the number of passengers travelling the route with coaches daily was also 550 which means that Cort envisioned a complete wiping out of coach services.[63]

Table 9.3: ***Annual operating cost of a projected steamer service in the London-Birmingham route (all figures in £)***

Interest	*Depreciation*	*Repairs and maintenance*	*Wages*	*Fuel*	*Total*
17,500	72 + 4,260	3,240 + 39,420	9,855 +3,650	25,869	103,866

Source: Cort, *Railroad impositions*, n.p (but the relevant material is labelled "No. 7")

A second, equally optimistic, account is reproduced by Cort regarding the profitability of a service with steamers on the London-Birmingham route but this time the figures are projections of the *London, Holyhead, and Liverpool Steam and Road Company*. The company's intended range of operations was wider but its initial service was meant to be limited between the two cities. The interesting part of this case is that the company proposed the reconstruction of the road surface and hence it needed to apply for parliamentary approval as well as to come up with an expense-revenue account to accompany a prospectus issued for raising capital. The company's estimates do present some minor caveats and differ regarding some expense and revenue items, presented on a daily basis, when contrasted to Cort's own account. The figures, modified by the author, are presented in Table 9.3.

The capital cost of the project included parliamentary and other preliminary expenses (£5,000), road-making expenses (£300,000), and the construction of depots and water stations (£2,400). In addition, it provisions the purchase of 30 steamers at a total cost of £31,500 (£1,050/unit) but, oddly enough, it makes

[63] Referring to all 40 running steamers, Cort assumes 122 daily passengers travelling inside and paying 23s each along with 428 passengers travelling outside and paying 13s each.

no mention of spare steamers. To remedy this omission, another £11,100 provided in the capital account for "contingencies" will be accounted as a fund for such spare engines capable of purchasing another 10-11 of them. No mention is made on spending regarding office space.

Interest charges are based on a 5% rate on the capital cost while the depreciation rate applied to depots was 3% and another 10% to engines, active and spares. On repairs and maintenance, the company provisioned £30 per mile per annum for the maintenance of the road while the company's figure for the same expense regarding the engines, supplemented by the cost of repairs, was modified to include the spare steamers thereby reaching £39,420. The wage bill for the 3-member team per working steamer relies on the same compensation as in the previous account while £10 per day or £3,650 annually is added for the "establishment at London, Birmingham, and the depots" presumably referring to salaries of personnel. Finally, the fuel bill added another £25,869. The total operating cost, which somewhat exceeded £100,000, ought to be considered as a slight underestimate since it excludes interest charges and depreciation of buildings.

On the revenues side, the company's projections envision the new service absorbing almost all passengers serviced daily by coaches (500 out of 550) and provides estimates for three types of annual revenues: £62,962.5 from 150 daily passengers travelling inside and paying 23s each; £83,037.5 from 350 daily passengers travelling outside and paying 13s each; and £29,200 from the conveyance of parcels. Once again, the total annual revenues of £175,200 allows for a very generous return. It should be noted that Cort's account of the company's projections does not extend into any discussion regarding demand factors although the presumed rate of 16.66 passengers per trip seems fairly reasonable.

Aside of the aforementioned estimates and the data on Dance's service, there is no other material that could be utilized in getting a glimpse on the economics of passenger-carrying steamers. The unfortunate element when it comes to the existing evidence is that we lack information on Hancock's record regarding cost and revenues.[64] This is a pity because he achieved progress more than anyone else relating to some supply and demand factors. On the former, he achieved the higher fuel efficiency than any of his competitors. For instance, the *Infant* which was used in the service between Stratford and the City ran in stages of 8 miles carrying 90 gallons of water and used a quarter of a bushel of coke per stage. Hancock himself claimed that the fuel consumption of his vehicles came to 2.5d per mile, at a time other operators calculated the cost of fuel at 4-4.5d/mile, but added that this figure could be lower in long journeys since there would be a lower frequency in raising and lowering the fire.[65] On the demand side, Hancock's

---

[64] Instead of providing to the public data on the economics of the services he ran, Hancock provided estimates regarding the cost, revenues and profits under two hypothetical scenarios, one running two carriages for a day or 100 miles and, second, running a fleet of steam vehicles on a distance of 1,000 miles, each steamer costing £1,500. The brief references to these two scenarios seem to be ill-thought in light of the fact Hancock assigns two steamers to the former scenario but 80 in the latter! However, some interesting cost figures to note from the former scenario, referring to daily charges, is the assignment of £4 10s for repairs and maintenance of the steamers, £2 for the wages of engineers, steersmen, and stokers (two of each) as well as one 1 guard, £3 for rent of stations, offices, and wages of attendants, £1 10s for tolls, and £4 daily regarding a fund for the renewal of the two carriages. Regarding revenues, he cites a charge of 1.5d per mile per passenger. See Copeland, *Roads and their traffic*, pp. 178-9; Hancock, *Narrative*, pp. 85-6.

[65] This fuel rate was the norm but, to state the obvious, the *Infant* occasionally recorded higher fuel rates. According to an account by Alexander Gordon referring to a trip undertaken on October 31st, 1832, the expectation was that its fuel consumption ought to have been no more than half bushel per mile when running on a good road. However, on this particular trip it exceeded considerably the half bushel mark, perhaps by 25%. See Alderson, *An essay*, p. 84; Hancock, *Narrative*, pp. 48, 56, 79; Nicholson, *The birth of the British motor car*, p. 82.

capacity utilization rate was equally impressive.[66] The service he initiated in May 1836 involving the *Automaton* covered 4,200 miles carrying 12,761 passengers, over 62% of the vehicle's capacity during those trips (20,420 miles). Even the *Pioneer*, another one of his vehicles, achieved a 42% capacity utilization rate over 952 runs, still higher than the rate Dance achieved towards the later stage of his service when his numbers were improving.[67]

The economics of stage coaches

The evidence on the economic configurations of running a coach service tends to be more complete in light of the long history of using this mode of transportation. We will begin by going back to Adcock's comparative account which relies on data provided to Parliament in 1830 by a Lancashire coach company. The figures are adjusted by Adcock to present an account on the cost of a 39-miles hypothetical trip performed by a 4-horse coach in three relays, i.e., each relay covering 13 miles.[68] The Lancashire company employed 709 horses carrying passengers and luggage by 33 coaches, with each horse having a purchase price of £30 and a resale value of £15 when replaced three years later.[69] Table 9.4 summarizes the relevant cost data.[70]

Table 9.4: *Annual expense of a Lancashire coach company and of a hypothetical 39-mile trip*

	Total annual cost, Lancashire coach company, in £	Daily cost of hypothetical 39-mile trip, in £, s, and d
Harness for 709 horses at £4 each per year	2,836	
Shoeing, iron, and blacksmith labor, £3 per horse per year	2,127	
87 hostlers at £1 each per week	4,536	
Rent of stables and coach offices	1,418	
Hay and corn, at 15s per week	27,725	
Straw at 2s 6d per week each	4,621	
Keep of 709 horses	43,263	
Minus value of manure, calculated at the price of straw	4,615	
Net keep of 709 horses	38,648	£1 16s

[66] Hancock, *Narrative*, pp. 74-7; Head, *On the rise and progress of steam locomotion*, p. 18.
[67] His vehicles' carrying capacity exclusive of the steersman, engineer, and fireman were as follows: Experimental carriage: 4 outside; *Infant*: 10 outside, *Infant* (enlarged with fixed engines): 14 outside; *Era*: 16 inside, 2 out; *Enterprise*: 14 inside; *Autopsy*: 9 inside, 5 out; *Erin*: 8 inside, 6 out; *German Drag*: 6 outside, exclusive of those accommodated in the separate carriages behind; *Automaton*: 22 outside. See Hancock, *Narrative*, p. 82.
[68] Adcock, *Rules and data for the steam engine*, pp. 81-3. See also Wood, *A practical treatise*, pp. 438-9, 732. The same account is also given by Gordon, *An historical and practical treatise*, pp. 183-4.
[69] The cost of horses varied by quality and location. According to evidence gathered from different coach companies, horses operating 50 miles from London cost £30 each c. 1825 and lasted for 4 years while those working outside this radius cost £15 each and lasted for 6 years due to a lighter workload and better feed. Prices of horses could reach as high as £100 but the norm was towards the lower end of the range. These statements, however, are generalizations. It seems that the Lancashire coach company opted for good quality horses and had to replace them every three years due to the intense work schedule it subjected them at 13 miles per day. See Gray, *Observations*, pp. 15, 53-4, 60; Dyos and Aldcroft, *British transport*, pp. 75-6.
[70] Other contemporary publications provide estimates on particular components of cost but, seemingly, less reliable. In the *Probably effects*, pp. 16-7, for example, the author cites an annual figure of £30 for feeding the horses but considers it "an extremely low one, even at the present price of agricultural produce" (quote from the latter page).

Replacement cost of horses	3,545	3s 3d
Interest charges	Not counted	1s
Hire or expenses of stage coaches (Adcock assumes the latter at 1.5d per mile)	Not counted	4s 11d
Total cost	42,193	£2 5s 2d

Sources: Adcock, *Rules and data for the steam engine*, pp. 81-3. See also Wood, *A practical treatise*, p. 732; Gordon, *An historical and practical treatise*, pp. 183-4. *Note*: some of the figures are slightly different than those stated in the sources due to calculating errors made by the authors. It should also be noted that the coach companies paid duty to the government which the author ignores as he does with steamers.

Adcock's account is informative albeit not complete since it ignores expenses such as wages for coach servants and clerical staff as well as the cost of spare horses.[71] Notwithstanding these caveats, his figures imply that the cost per mile in the case of stage coaches was 13.9d, in contrast to his 15.6d estimate for steamers, hence he concluded that the latter was not as economical, the main culprit being the high cost of repairs.

If Adcock's account on the comparative cost is incomplete, Gurney's references on the same subject are grossly so, tend to be biased towards steamers, and are not quite consistent with his own figures. Referring to a hypothetical journey of 100 miles, he deems that a round trip would necessitate the purchase of 100 horses for the coach service compared to only three steamers, an underestimate to a certain degree given that Dance purchased from him the same number of steamers for his 37-mile per day Cheltenham-Gloucester service. According to his account, the capital and labor costs as well as the wear and tear involved in the two modes would be about the same.[72] It follows that the judgment on which mode was preferable boiled down to mainly one issue, the cost of power. Regarding the maintenance cost of horses, he stated that the expense for shoeing, keep, provision, attendance, and harness would be 3s per day for each or £15 for all of them amounting to a cost of 18d per mile. In contrast, he ignores the repairs and maintenance cost of steamers focusing, instead, exclusively on their fuel cost which he stated at half bushel per mile. Given a price of 6d/bushel, the cost per mile for steamers would be 3d falling about midway within a wider range of as low as 1d in coal districts and as high as 6d in districts away from coalfields. Extrapolating from this hypothetical example, albeit not being quite consistent with his figures, he concluded that the 18 horses needed for the Cheltenham-Gloucester service would bear a maintenance cost of 45s per day, this time at the more conservative daily rate of 2s 6d per horse, contrasted with 9s 3d for the fuel cost of steamers. Despite these figures forming a 1:5 ratio, he concluded, very generously one may add, that steamers can carry the public at half the cost of coaches and "with perfect safety, in one half the time."[73]

[71] The author also ignores the cost of turnpike tolls because the impact of this factor will be discussed in the next section. In Adcock's account it is assumed that the tolls were 2d/mile or 6s 6d in the case of the 39-mile hypothetical trip.

[72] Steamers, according to Gurney, would involve a total capital cost of £1,500 while horses £2,500 (£25/horse). Steamers would also compare favorably in terms of depreciation cost losing one-fifth of their value annually, i.e., £100 each or £300 for the three of them while each horse would depreciate £5 annually or £500 for all of them. On the other hand, he did not take into account the expense of stables which could be very considerable compared to the cost of sheds for coke and water. See Alderson, *An essay*, pp. 87-9; Gordon, *Historical and practical treatise*, pp. 19-20.

[73] Gurney, *Observations*, p. 42. The reference to the duration of the trip with the two modes, needless to say, also violates the facts as mentioned earlier. See also Copeland, *Roads and their traffic*, p. 178; Gordon, *Historical and practical treatise*, p. 19; Porter, *The life and times of Sir Goldsworthy Gurney*, p. 100; Nicholson, *The birth of the British motor car*, p. 70.

The final piece of evidence on the economics of stage coaches comes from Cort's 1834 account which is based on information from the aforementioned 61 stage coaches, each having a carrying capacity of 9 passengers, operating between London and Birmingham, a distance of 108 miles. The company he considers employed 3,050 horses with an average purchase price of £30 each. Table 11.5 summarizes the results.

Table 9.5: ***Annual operating cost of a coach service in the London-Birmingham route (all figures in £)***

Interest	*Depreciation*	*Coach hire and rental cost of offices/stables*	*Wages (coach servants and managers)*	*Horse expenses*	*Total*
4,575	22,875	12,524 + 8,000	7,930 + 6,000	152,500	214,404

Source: Cort, *Railroad impositions*, n.p (but the relevant information is labelled No. 4).

The interest charges on the capital cost of horses are based on a 5% rate while the respective rate for annual depreciation is taken at 25%. The cost of hiring coaches is based on a total distance travelled per year amounting to 2,404,620 miles at a rate of 1.25d per mile while rental charges for offices and stables added another £8,000. Labor cost included the salaries of both coach servants and managerial staff while the expenses of horses encompassed the cost of their upkeep, harness, farriers, and attendance coming to an annual cost of £50 per horse. The total operating cost of £214,404 translated to a rate of 21.4d per mile.[74] On the side of revenues, Cort projects 550 passengers daily, 122 inside and 428 outside, the former paying a fare of 40s, the latter of 20s. Annual passenger revenues would reach £245,280 while parcels and other miscellaneous sources (bookings and porterage) would bring the total to £292,810.

To summarize the evidence of the present and the previous section, Adcock's and Cort's accounts on the operating cost per mile relating to steamers are close enough, at 15.6d and 15.2d respectively, to inspire confidence on their reliability since the mild defects in their calculations were addressed by the author. It is also remarkable, and this is a finding entirely missed by the existing literature, how incompetently Dance's service was managed by having an operating cost of 48.5d per mile, a figure which could have been higher if the potential cost of offices and the one relating to the infrastructure of depots were added. On the side of coaches, Adcock's estimate of 13.9d regarding the operating cost per mile is seriously defective since he failed to take into account the wage bill for coach servants, clerical, and managerial staff as well as the cost of spare horses. On the other hand, Cort's figure of an operating cost per mile at 21.4d seems complete and hence far more reliable. The essential point to retain from this summary of the evidence is that steamers may not have quite reached half the cost of coaches as some inventors argued but, when both modes of transportation were competently managed, the conveyance of passengers by steamers stood at about two-thirds of the cost of coaches.

Hostile attitudes and discriminatory tolls

[74] Some minor modifications were made on Cort's figures such as not taking into account his references for expenses relating to "contingencies." It should also be noted that, at this stage, neither taxes nor turnpike tolls were factored into the calculations.

It was important to leave the impact of tolls on the viability of steam cars out of the discussion in order to establish the economic competitiveness of each transportation mode assuming a levelled playing field. But before getting into a quantitative assessment of the impact of tolls it is useful to outline the emotional framework and attitudes which brought this factor into play.

Horses used in stage coaches had a very punishing work schedule covering 8-10 miles at a time and occasionally above these figures thereby reducing their useful working lives down to 2-3 years. Covering a distance of 100 miles involved, assuming a 4-horse stage coach, at least 50 horses and, in the fastest and most punishing routes, up to double this figure. It follows that a very large number of horses was needed to cover the country's transportation needs reaching, according to one account, 150,000 of them having a value of over £3 mil, including the value of stabling and harness. The figure reached nearly £4mil when counting the value of the 700 mail coaches and 3,300 stage coaches, each one of them costing £200. In plain terms, this was a very important industry with an enormous wealth-creating potential. The most extravagant illustration of such wealth was William James Chaplin who, standing at the peak of the pecking order, had amassed a fortune of £1.5 mil. But there were another 30,000 individuals who depended on this industry for their livelihoods. The stakes were high for a very diverse group of people which included owners, employees, farmers, stable proprietors, coach-building businesses, harness makers, horse breeders and traders, as well as owners and servants of inns and coffee houses which functioned as coaching establishments. If the stage coach business was damaged the domino effect would be large and devastating.[75]

Turnpike trusts were part of this potential domino effect. The hostility they developed towards steam carriages was fed by the fact their trustees came from the ranks of country gentlemen, large farmers, corn-merchants, and small-town attorneys, all professions whose fortunes benefitted from transportation undertaken by horses.[76] Hostile attitudes started developing early on, well before celebrated figures such as Gurney made a splash on the scene. A 1827 newspaper article expressed the opinion that the prices of horse feed and of horses themselves would become "dog cheap in a short time" if steamers came to replace coaches.[77] Similar attitudes were hosted in another newspaper article published in October 1828 by the *Sieckle* repeating the same fears as well as the prospect of increased unemployment for numerous poor workers. James Stone, Dance's manager, pointed to Gurney in a letter sent in June 1830 the opposition forthcoming from agriculturalists, coach proprietors and their workers, even from "the old ladies of Cheltenham." Hancock had similar experiences expressing his frustration not only because of the refusal of services and exorbitant charges but also because, when detained on a road for lack of water, "he was assaulted with yellings, hootings, hissings and sometimes even with the grossest abuse" by a segment of the public he characterized as "the rabble." One such "gross abuse" was reported in an article published in the *Morning Advertiser* in April 1833 referring to the aggression on the part of the driver of an omnibus who charged and damaged Hancock's vehicles drawing a fine of £5.[78]

The hostility that was developed clearly had at its foundation competing economic interests. It quickly spilled into the realm of propaganda attempting to intensify hostile attitudes by shifting public perceptions. One of the accusations addressed against Gurney was that his steamer caused fright to horses. As a matter of fact, it did. But the same was the case in the event of any strange sight and sound

[75] Nicholson, *The birth of the motor car*, p. 56.
[76] Lord Montagu and Bird, *Steam cars*, p. 51; Bird, *Roads and vehicles*, p. 173.
[77] Quoted in Davison, *History of steam road vehicles*, p. 13.
[78] Copeland, *Roads and their traffic*, p. 173-5, quotes from page 174.

and, in the end, the potential of accident hinged on the temperament of specific animals.[79] However, in all fairness, not all accusations were biased propaganda. One minor factor which contributed to hostile attitudes were the reckless practices on the part of a few inventors which rendered their steamers prone to accidents. One of the perceived advantages of steamers over coaches was their ability to run faster than coaches.[80] The problem lied in that some inventors attempted to push this advantage to its limit by running their vehicles at dangerous speeds. Ogle and Summers ran a service in 1830 reaching regularly speeds of 15-16 mph thereby placing, according to some accounts, the passengers at risk of injury. Such speeds, and occasionally higher ones, were a mistake from a technical point of view. Operating a 3- or 4-ton vehicle running on iron tires at 15-20 mph over the type of roads in the 1830s was an accident waiting to happen. Coaches could not compete based on this factor but they attempted to close the speed gap as much as possible. Speeds of 10 mph were becoming commonplace and in a few cases the figures reached 13.75 mph, an absolute limit when it comes to horses; when drunkenness or momentary negligence were involved the results could be disastrous. There is no precise record of accidents in coaches but there was a large number of fatalities and countless injuries during the 1830s.

In the context of this growing animosity, tolls specific to steam cars appeared fairly early on, for the first time in 1828 at a time Gurney's efforts came into public view.[81] The coverage he received was instantaneous and extensive, not only in London but throughout the country through the circulation of London newspapers distributed by stage coaches. Of the 62 Turnpike Road Acts of 1828, 4 of them made mention of tolls on steam cars and only one discriminated against them, and that only marginally, the one at the Mildenhall-Littleport road. A practically identical situation was recorded in 1829 with 6 of the 62 new acts mentioning tolls for steam carriages and only one discriminating. Trusts felt up to that point that there was little ground to pay serious attention to the new invention. However, the second half of 1829 proved to be the turning point between calm and the impending storm. This point coincided with intense activity on the part of Gurney drawing widespread publicity (both positive and negative), the support of the army and the Prime Minister as well as potential funders.

The anxiety imposed by Gurney's activities have to be appreciated in the context of the intense financial pressures trusts were facing or about to face by accumulating increasing debts to which government policies contributed by allowing free passage to agricultural commodities, useful materials (e.g., lime and chalk), and mail coaches. The exemption of agricultural products split the attitudes of agriculturalists who benefited in their role as producers but lost in their capacity as turnpike trustees. But the resentment was unambiguous when it comes to mail coaches. Financial pressures were particularly intense in areas which drew the interest of railway schemes creating the prospect of seeing their revenues plummeting, something that materialized in years to come. An increasing number of turnpike trusts started forming the opinion that war against steam cars was warranted because there was a real prospect they were going to replace horse-drawn carriages, their main remaining source of revenue, without generating themselves enough toll revenue to make up for the loss thereby compromising even more their shrinking revenue base. Stage coaches were, by far, the biggest source of toll revenue for turnpikes. One gate in the very busy road London-Brighton collected £2,400 in tolls in 1828, two-thirds of which came from coaches. In

---

[79] Even a prejudiced London coachman admitted that his horses were prone to fright due to various reasons. See Nicholson, *The birth of the British motor car*, p. 47.

[80] Gurney testified during the parliamentary proceedings that running steamers below a speed of 5 mph was not economical, a statement based on a false premise. See Lord Montagu and Bird, *Steam cars*, p. 51. Also, Nicholson, *The birth of the British motor car*, p. 57; Copeland, *Roads and their traffic*, p. 171.

[81] The entire review on the timeline of toll impositions in the next several paragraphs relies heavily on Nicholson, *The birth of the British motor car*, pp. 64-8, 73-5, 78-80, 112, 133.

the country as a whole coaches covered 1 mil miles per week, most of them on trust roads and hence subject to the payment of tolls.

By the end of 1829 turnpike trusts started becoming really aggressive towards steam cars figuring out that raising tolls would either drive them out of competition or would raise revenues high enough to make up for the business loss relating to stage coaches and to pay for potential damages caused on roads by them. The growing hostile attitudes materialized in 1830. Of the 67 turnpike acts, 23 imposed tolls on steam carriages, 14 of which were discriminatory to one degree or another. The fact that about two-thirds of turnpike trusts did not impose any tolls even on roads which serviced very heavily stage coaches (e.g., in Bedfordshire which lay on the main road to London) and that in a couple of cases the imposed tolls actually favored steam explains the lack of serious complaints by promoters of steam vehicles prior to 1831. However, some of the latter played a pivotal role in intensifying the hostility between the two sides. Despite the fact that at that point there were no provisions for the of payment of tolls by steam cars in most roads, toll keepers either expected payment informally agreed upon or arbitrarily imposed. The most agreeable steam car operators would pay a toll equal to that for a 4-horse stage coach. But others were not cooperating. Gurney would agree to only paying half the toll while Nathaniel Ogle had an even more cavalier attitude by throwing to the gate keeper a shilling in one instance or two in another claiming he was too preoccupied to pay attention to the matter. Maceroni behaved in a similar fashion.

During the period December 1830-August 1831, 76 turnpike bills became law. Of those, 47 took cognizance of steamers, and of those 47 all but 5 discriminated against them, a threefold increase compared to 1830. The criteria used to discriminate varied. In some “exotic” cases, such as the Liverpool-Prescott trust, the charge was based on horsepower while in other cases it was up to the discretion of the gatekeeper. In more conventional cases tolls were based on weight or on the number of wheels while in other cases trusts forced steamers to pay both ways (going and returning) as opposed to only one way which was the norm for other traffic. In Nicholson’s view, the discriminatory tolls of 1831 did not aim at raising revenues but to excluding steamers. The particular case of Dance’s service is indicative of the prevailing mood. The local trust was unhappy with Dance taking advantage of the absence of tolls. Following the termination of the service, on June 25th, the trustees threatened legal proceedings citing excessive noise which frightened animals, shedding hot coals and thus posing risk for fires and, in one occasion, due to the overturning of a steamer. Shortly after there was the incident of gravel-laying on the road. According to Dance, it was not this incident which led him to suspend the service but the prospect of facing discriminatory tolls. When the act passed in July 1831, his fears were confirmed although the imposed tolls were not nearly as discriminatory as in other cases.[82]

In the 1832 House session 52 turnpike acts became law, 39 of which took notice of steamers with all but 7 discriminating against them. Of the 32 discriminatory acts 23 of them charged steam vehicles 2 to 8 times higher tolls than stage coaches.[83] By 1834, at a time Gurney was defeated and Hancock was still striving to prove himself, there was a dramatic drop in new Acts passed by Parliament. Of those, 11 mentioned steam and 10 discriminated against it. In 1836 a bill was introduced in Parliament which aimed at finding a balance between the interests of both sides by eliminating discriminatory tolls and at the same

---

[82] Gurney in his evidence to the parliamentary committee stated that he was willing to accept tolls at the same level paid by stage coaches as long as a steamer was the same weight as a coach, i.e., 3 tons or a higher toll if the weight of a steamer exceeded that weight. Alderson, *An essay*, pp. 79-80.

[83] At that point, with the decision of the House of Lords not yet known, Gurney’s business fell apart, including the support of Hanning. The same year Gurney was forced to auction all of his business assets. Nicholson, *The birth of the British motor car*, p. 93.

time providing compensation to trusts in the event of road damage by very heavy steamers. It provisioned the same toll for a small steamer up to 1.5 tons as for a 2-horse carriage while steamers up to 3 tons would pay the same amount as a 4-horse coach; for steamers having above the latter weight or if the tyres were less than 3.5 inches wide the toll doubled. This legislation came at the heels of intense financial pressures faced by turnpike trusts, particularly from about 1840 onwards. This pressure intensified due to the loss of considerable amount of traffic which shifted to railroads. Some trusts failed to pay the interest on their loans and, in several cases, creditors seized the tolls thereby having the upkeep of the roads reverting back to local parish councils.[84]

The 1861 Locomotive Act which passed Parliament reiterated the principle of equal tolls when steam carriages and coaches carried the same weight but with steam carriages used for agricultural purposes being exempt from tolls. But this Act also moved towards a refinement of the legal framework applied to steamers. It regulated the weight and size of steam carriages, imposed a speed limit of 10 mph in rural areas (5 in towns and villages), the wheels were to have smooth cylindrical rims and widths regulated by the weight imposed on each wheel, it specified that two persons should be responsible for a steam vehicle as well as a third one if the steam carriage pulled two or more vehicles behind it, lights had to be installed during the dark hours of the day and all steam vehicles had to consume their own smoke, a provision that was not technically feasible at that time especially when starting or refiring the boiler. But there were also potential loopholes and caveats. The Act left opened the window for prohibiting steam carriages operating on roads if they posed danger to the public, a provision which was open to interpretation.[85] The 1861 Act was followed by the infamous Red Flag Act of 1865 (see above) which marked the epitaph of the steam car movement.

The crucial question is the extent to which tolls imposed on steamers dealt a decisive blow leading to their failure. The answer to this question regarding Dance's service is straightforward. Assuming the service had to pay the toll of 5s 6d imposed by the trust after its termination, the expense bill during the time it operated would have augmented by £108 18s (7.13d per mile) bringing the total bill to £849 10s (55.6d per mile). To the number of passengers necessary to achieve the break-even point specified in Table 11.1, he would have to add another 2,178 bringing the total to 15,612, somewhat above the full seating capacity of a single vehicle.[86] In other words, the imposition of tolls would have pushed him over the brink albeit his financial grave was already dug by his gross mismanagement.

An even more interesting question to pose is how the imposition of tolls would recalibrate the competitive position of well-managed companies in both modes of transportation. On the side of stages coaches, Bird came up with a table of the tolls charged during the first quarter of the 19th century by the Bruton Trust in Somerset which he considered representative for the country as a whole. According to his calculations, tolls imposed a surcharge on a 4-horse coach amounting to approximately 2.25d per mile. By the 1830s, when the battle between the two modes reached a crescendo, the figure may have gone up a bit, at 2.75d, considering the 1834 data provided by Cort from the 61 stage coaches operating between London and

---

[84] Davison, *History of the steam road vehicles*, p. 17.
[85] Ibid.
[86] Nicholson pointed out that in order for Dance to cover the expense of toll imposition he would have to find 72 passengers per day, instead of 28, or treble his fares something that would have been suicidal to the delight of coach masters. In the author's view, these figures are very conservative because Nicholson underestimated Dance's total expenses. See Nicholson, *The birth of the British motor car*, p. 80.

Birmingham.[87] Taking into account Cort's figure of an operating cost per mile at 21.4d and adding tolls as well as duties and taxes, the final figure would be c. 27d per mile. On the side of steamers, and in light of Adcock's and Cort's estimates on their operating cost per mile at 15.6d and 15.2d respectively, a toll equal to that of stage coaches would preserve the considerable advantage they had over the latter. Tolls would have to be three times the average figure for stage coaches, and including also the same duties and taxes, in order to bring the costs of the two modes near each other. It is difficult to generalize on the multiplier imposed on steamers' tolls over those of coaches since no author, including the present one, has put the effort to provide a comprehensive account by gathering all relevant data. A sample put together by this author shows a very wide variation between the two types of tolls, from steamer's tolls being only marginally higher all the way to being 22 times higher.[88]

This information has to be assessed in the context of pricing policies and profit margins. The business of running a coach in the early part of the 19th century accommodated a wide spectrum regarding the size of companies, from single driver-owner firms to Chaplin & Company of London which used 1,500 horses to operate 64 coaches and having an annual turnover of half a million pounds in the 1830s. Fares per mile varied depending on the company with the most likely causes of variation being the degree of competition from rival coaches and the state of the roads, with those in poor condition demanding more horses. The two categories of fares reached 2-3d for outside passengers, with somewhat cheaper fares for slower coaches, while for inside passengers they could reach as low as 2.5d in some routes all the way to 4-5d in fast coaches, when competition was weak or when facilities were exceptional as was the case with the mail coaches. We should bear in mind, however, that tips and meals could raise the cost of a journey by more than one third. It follows that traveling by coach was expensive and hence affordable to only a tiny fraction of the population.[89]

In cases of intense competition fares reached a cutthroat level, 16s for inside and 8s for outside passengers in the 180-mile journey from London to Manchester in 1831. Fare reductions, however, were the last resort with speed, safety, and convenience often emphasized instead of low fares. There was a herculean effort to cut down on the time it would take to service two towns by using relays of horses, each covering c. 10 miles, and scheduling overnight trips to cut down on the number of stops. The amount of time it would take to run a coach between London and Manchester was reduced from 4 ½ days in the early 1750s to 18 hours by the 1830s. Similar reductions took place in all routes with times between major towns being five times faster in 1830 compared to 1750 while for lesser towns speed was at least twice as fast. Improved speeds, however, increased the risk of accidents and hence the payment of legal

---

[87] Bird, *Roads and vehicles*, p. 226; Cort, *Railroad impositions*, n.p (but the relevant figures are on table no. 4). In the case of the 61 stage coach companies, another 3d and 0.06d per mile were added due to the payment of duties and taxes respectively.

[88] Steamers' tolls which were up to 3 times higher were imposed on the following roads: Gloucester-Cheltenham, Mildenhall-Littleport, in the Derby and Mansfield area, Bolton-le-Moors to Blackburn, a segment of the London-Liverpool road, Norwich-Yarmouth, in Lampeter, and in Cheadle. On the other hand, the ratio was higher in the following roads: Ashburton-Totnes, in the vicinity of Glasgow, in the Tiverton area, Liverpool-Prescott, Teignmouth-Dawlish, Bathgate road, a segment of the Edinburgh-Glasgow road, and Coventry-Over Whitacre. See Nicholson, *The birth of the British motor car*, pp. 64, 67, 75, 77-8; Copeland, *Roads and their traffic*, p. 176; Davison, *History of steam road vehicles*, p. 13; Bird, *Roads and vehicles*, p. 173. It should be noted that occasionally figures on tolls cited by different authors do differ.

[89] Dyos and Aldcroft, *British transport*, pp. 75-6; Jackman, *The development of transportation*, p. 605; Copeland, *Roads and their traffic*, p. 93; Wood, *A practical treatise*, pp. 649-50.

damages.[90] Profit margins were fairly modest especially when railroads arrived. Coach operators concentrated on acting as feeders to them but, ultimately, they had to withdraw by servicing regions not covered by railroads.[91]

The potential impact of steamers being introduced to routes serviced by coaches can be illustrated through a couple of examples. The 4-horse coach operating in the Cheltenham-Gloucester route charged 2s 6d per passenger or 3.24d per mile. If its operating cost was close to the general estimate of 27d, it would need between 8-9 passengers per trip just to break-even but without counting revenues from parcels. Based on evidence cited by Alan Bates, a contemporary observer, the majority of coaches at that time accommodated either 15 passengers (4 inside, 11 outside) or 12 (4 inside, 8 outside).[92] It follows that a coach at that route had to fill either 56% or 69% of its capacity in order to defray its cost, both being realistic goals. However, when Dance's service appeared the local coach company was forced to reduce its fare down to the same figure Dance charged, 1s or 1.3d per mile, which translated to the break-even point being raised to 21 passengers, i.e., well beyond a coach's capacity. Even if we factor in revenues from parcels, financial failure was all but guaranteed hence creating the basis for the intense animosity exhibited by all those involved with the coach business, including the local trust.

A second example comes from the financial statements of the 61 stage coaches servicing the London-Birmingham route reproduced by Cort.[93] The average daily number of passengers per trip was 9, 2 inside and 7 outside, the former paying a fare of 4.44d per mile while the latter half that. The combined revenue per mile from passenger traffic would be 24.42d to which another 4.74d per mile was added through the delivery of parcels and some other miscellaneous sources. The total revenue of 29.16d, given a cost per mile at 27d, generated the very modest profit of 8%. Looking at Cort's speculative account of having a steamer servicing this route, his suggested fares of 2.55d and 1.44d per mile for inside and outside passengers respectively would surely wipe out coaches from the particular route.

A critical assessment of the literature

The historical misadventure of British steam cars has not drawn an extensive literature on the subject. However, those who dealt with it did provide quite analytical accounts and some of them delved into the causes of their failure. There are two types of explanations one may discern. The first one simply provided a list of factors which played a detrimental role but without attempting to attribute different degrees of significance. Copeland, being an example of such an approach, noted the mechanical difficulties which were present even as late as the late 1840s. Another operational difficulty, about which Hancock was particularly vocal, was the lack of a sufficient infrastructure in the form of stations in order to provide him

[90] In 1760 a coach company running the London to Manchester route charged £2 5s for inside passengers, half that price for those outside. But such fares could only be offered for limited periods given the high operating cost of coaches. See Barker and Savage, *An economic history of transport*, pp. 48, 51; Baines, *Lancashire and Cheshire, vol. II*, p. 221. See also Dyos and Aldcroft, *British transport*, p. 75.

[91] Bagwell provides an analytical account of a stage-coach company running the route London to Edinburgh which charged fares of 4d a mile for inside and 2d for outside customers, the total capacity of the coach being 15 seats. Total expenses were £32 with average revenues reaching £50 per trip. See Bagwell, *The transport revolution*, pp. 51-2, 68; for an illustration of such competition see Copeland, *Roads and their traffic*, pp. 92, 184. See also Dyos and Aldcroft, *British transport*, pp. 75-6.

[92] On Bates' figures, see http://www.friern-barnethistory.org.uk/userfiles/file/The_Area/Transport/Stage-Coach-Routes.pdf. On the charged fares, see Nicholson, *The birth of the British motor car*, p. 70.

[93] Cort, *Railroad impositions*, n.p (but the relevant figures are labelled No. 4 and No. 5).

with coke and water. It was a problem which would eventually have been resolved but it was still a major issue during the main wave of steamers' appearance.[94] The discriminatory tolls and the need to find financial backers were other issues pointed out by Copeland.

A second type of approach is one that does acknowledge the multiplicity of factors which impeded the development and diffusion of steamers but singled out one of them as being the predominant factor. According to Evans' discussion, the imposition of high tolls certainly delayed their diffusion but it was an obstacle which could ultimately have been removed by dealing effectively with the opposition forthcoming from interests associated with coaches. He pointed out that railways also faced stiff opposition but they were ultimately able to overcome it. Lack of adequate finance also impeded the progress of steamers but, according to his judgement, it was not the biggest problem. In the end, the factor that played the most decisive role was that these inventors were not good enough in resolving the technical flaws that still remained although he acknowledged that, time allowing, very reliable steamers could emerge if a synthesis of several variants was achieved. The experience of inventors in other countries point to the fundamental role played by this factor at that particular juncture. Dietz in France, inventors in Prussia and Denmark, Fisher in New York, all were plagued by mechanical problems proving that the failure based on technological factors was universal as opposed to social and economic factors. When inventors such as Serpollet and others succeeded in building steamers at the end of the century they had more commonalities with their contemporary liquid-gas counterparts than with their 1830 predecessors by relying on advanced technologies, including machine tools which were unknown earlier.[95]

Another variant in this type of explanations, the most sophisticated one, was offered by Nicholson.[96] He also points to a multiplicity of factors which played an impeding role. On the side of those which he considers minor ones, and in contrast to Evans, he included the continuous presence of technical and logistical problems. The former stemmed from the experimental stage steamers were going through attempting to address issues such as the much heavier weight on the wheels of a steamer compared to a stage coach and the lack of experience in dealing with jolting caused by rough road surfaces and power stresses. In addition, steamers were not able to sustain speeds rivaling railways and they were just a bit faster, if at all, compared to stage coaches. This created the need for a logistical infrastructure regarding fuel and water supplies which, however, was lacking thereby leading to the loss of steam and time when refueling. Another infrastructural problem related to the very challenging road surfaces which included gravel, mud, and hills. The presence of technical and logistical challenges inflated bills for fuel, maintenance and repair expenses necessitating infusion of investment capital which, however, was not forthcoming to the extent it needed to.[97]

---

[94] While making trial runs with the Infant in 1832, Hancock discovered that the speed of the carriage had to retard periodically due to inadequate supplies of coke. He did attempt to hook fuel tenders to the carriages but the effort proved unsuccessful. An equally frustrating problem was the supply of water. Carriages had to stop at a frequency rate of every 10-12 miles, even as often as every 5-6 miles in the case of Macerone, for 14-18 minutes to fill the water tank from pumps using buckets or even longer if a stream or pond were used. During the time the carriage was stationary its fire subsided and, because of it, it required about two miles to recover its previous speed. See Copeland, *Roads and their traffic*, pp. 180-1.

[95] Evans, "Steam-road carriages," pp. 21-2, 32. For a review of some of the technical problems encountered by steamers and the ways they were addressed, or failed to do so, see Evans, "Roads, railways, and canals," pp. 30-2.

[96] Nicholson, *The birth of the British motor car*, pp. 152-5.

[97] These were much more difficult terrains than the surfaces used by railroads. Despite the excellent power-to-weight ratios of many steamers, such surfaces prevented them from developing speeds comparable to railroads. Furthermore, a railway did not need a steering mechanism since it could haul much heavier weights with the same

Another issue Nicholson brought to the fore, which fed into the delay in dealing with technical problems, related to the personalities of the inventors involved with steamers. He felt that many of them were unwilling to share information in order to learn from their failures. Part of it had to do with their reasonable wish to protect their patents. But it also extended to borderline paranoia in some cases, a preeminent example being Maceroni with Ogle and Gurney being somewhat less extreme examples while Hancock exhibited only occasional lapses of judgment. Some of these individuals were also not the best businessmen and very poor in public relations behaving in an arrogant way towards the trusts as if they sought to create antagonism. Perhaps the source of this type of behavior was the fact that some of the people involved in this business did not have any training either as engineers or as businessmen and hence they tended to exaggerate the merits of their invention while underplaying the existing mechanical defects. The least these personality flaws were evident, the longer was the life of their steamers, Hancock being a good example. If Hancock failed, having to deal with high running costs and lack of capital, those with more pronounced personality flaws were even more doomed to have the same fate.

But out of all the factors which played a role in the demise of steamers, Nicholson considers the opposition of trusts, particularly during the critical years 1831-2, and the hostility they succeeded in transmitting to the public as being the preeminent factors in the sense that, if they were missing, steam cars would have gone on. The reasons behind the existing hostility were sometimes warranted such as the reduction of the traffic serviced by stage coaches, the noise and smoke when operating in urban environments or the real risk of fire to roadside crops; in other cases, accusations were subject to debate such as that steamers were a danger to horses and the public; in most cases they were based on plain and simple conservatism. A crucial factor was that trusts could always rely on the House of Lords, the ultimate arbiter on the subject, whose members shared the same prejudice. If it was not for the translation of this hostility to discriminatory tolls, Nicholson argued, multiple steamer services would have been developed c. 1831 and shortly thereafter, including from Gurney who could deliver more vehicles. The opposition of trusts impacted steamers both on the supply side by raising their operating cost through the imposition of often exorbitant tolls but also revenues because a segment of the public was swayed by the intense hostility thereby depriving steamers from valuable revenues.[98]

The present analysis offered a yet another interpretation which differs in subtle but important ways from previous explanations. The role of persisting technical problems has to be acknowledged because it impacted adversely the financial bottom line of inventors who had to deal with fairly high depreciation rates and very high expenses for repairs and maintenance, these two items reaching or, more often, well exceeding half of their annual operating cost. But some progress was recorded by the 1830s and, most importantly, this factor would have become less of an issue overtime. The entire history of steam power, punctuated by periods of spectacular improvements during the Watt years and with the appearance of high-pressure engines, is a testament to this statement. The same applies to the lack of infrastructure which, if inventors were not impeded in their efforts, would have eventually come into place as was the

---

power and it did not need to alter its power frequently as with stopping and starting or climbing gradients. On the other hand, steamers required a much simpler mechanism to deal with stresses.

[98] The early 1830s, Nicholson points out, was a critical juncture because railways were not spread enough and hence there was still opportunity to attract capital and engineering talent. Without capital inflows, particular entrepreneurs were faced with almost the same cost as that of railways when it comes to rolling stock but with much less revenue potential. The problem compounded when the diffusion of railways started taking off several years later because such investment promised higher returns despite the enormous initial cost of the investment. In that sense, there was a passive role of the railways contributing to the demise of steamers.

case with railroads. The presence of railroads did indeed siphon capital and engineering talent away from steamers but the latter could still find its niche within the overall transportation network by acting as feeders to railroads.

What were then the crucial factors that dealt the fatal blow to this promising technology? In the author's view, two of them were of overarching importance. The first one was entrepreneurial and managerial failures. Having access to a couple of, fairly elaborate, financial estimates allow us to conclude that steamers could have been a profitable enterprise if managed competently. In contradistinction to these estimates, the evidence from Dance's Gloucester-Cheltenham route revealed an overextension of the service's transportation capacity and, as a result, a ballooning of its operational cost to an extent that a meager profit could have been made only if the steamer operated at the full extent of its capacity in every single trip. It is a pity that, out of all the services established by various inventors, this is the only one we are allowed to glimpse into its financials. The lack of evidence is particularly problematic in the case of Hancock who seems to have come the closest to success. Narrow as the evidence may be, especially when viewed in conjunction with other irrational actions on the part of inventors, seems to suggest that this may have been a major factor that doomed steamers. The second one has certainly to do with the opposition of the trusts. The hostility they instilled to a segment of the public penalized steamers on the side of revenues; and the tolls they imposed, at a time the finances of steamers were still fragile, in some cases either wiped out the economic advantage steamers had over coaches or even reached the point of rendering them the more expensive of the two transportation options.

But if one first of these two factors is poorly documented as it relates to the financial management of these ventures, the evidence is more robust when it comes to an aspect which points to the lack of vision on the part of the various inventors. Lord Montagu and Bird eluded to such lack of vision in a brief reference though they did not pursue analytically their astute remark: "One of the mistakes the steam coach promoters made was to try to compete with the stage coaches … Had the steam-carriage men gone in for goods haulage at rather less ambitious speeds their success might have been the greater."[99] This is a very intriguing statement indeed. It raises the question of why inventors involved in the steam vehicles business did not try to circumvent the burden of tolls by engaging in the haulage of agricultural products or other useful materials which were exempted from tolls, prove their worth and eliminate fears among the public and then try to enter, or more accurately re-enter, the business of passenger transportation? Instead, inventors followed the reverse route shifting their attention to hauling goods after mid-century and once they gave up their effort to capture part of the market for passenger traffic.

To answer this question, one has to establish that steamers were competitive in hauling goods *vis a vis* other transportation modes. The earliest evidence refers to one of Gurney's vehicles which he designed for the Cyfartha ironworks when he moved to South Wales in March 1830. In a letter from William Crawshay jun., the ironmaster, to Charles Dance dated February 1832, the writer refers with much praise to Gurney's boiler but he also provided evidence regarding the steamer's performance during the 12 months of 1831. Specifically, he revealed that it conveyed a net weight of 42,300 tons of coal, iron-stone and iron. Each journey covered 2.5 miles and the typical load was 20-30 tons, however, it could pull up to 33 tons with ease. The fuel consumption for all the journeys was 299 tons which, at a price of 3s/ton, amounted to £44 17s. The wage bill came to under a farthing per ton-mile. The total operating cost was £112 9s or less than a fourth of a penny per ton mile. Crawshay was so impressed that he ordered to have Gurney's boiler be adopted to all of his locomotives. However, the family gave up the business following a number of strikes in Welsh mines depriving Gurney from one of his warmest supporters. But as

[99] Lord Montagu and Bird, *Steam cars*, p. 51.

impressive as the cost figure is, it is very incomplete and, furthermore, the particular vehicle operated on rails and hence it was not a typical steamer using the road system.[100]

Much better evidence is available c. 40 years later, at a time steam-driven agricultural engines had established themselves. Table 9.6 summarizes the evidence drawing figures from Head's work on the subject.

Table 9.6: *Costs per ton mile of three agricultural engines (all figures in d)*

	Aveling and Porter engine used by a Kent farmer	Fowler & Co. engine near Bradford	Fowler and Co. engine used at the Farnley Iron Company
Cost per ton mile	3.17	4.41	6

Source: Head, *On the rise and progress of steam locomotion*, pp. 22, 25, 27-8, 43-5. See also Fletcher, *The history and development of steam locomotion*, pp. 234-5 on the fuel rate of a fourth engine.

The first case refers to the report compiled by a farmer in Kent using an Aveling and Porter agricultural engine interested in comparing the cost of horses vs. steam with his account on the former having been cited in the previous chapter. The engine was tasked to cart a useful load of 12 tons of material for 10 miles with its wagons returning empty. The account, being fairly complete with the exception of omitting the cost of repairs, concluded that the cost per ton mile was 3.17d. The second account is very complete and refers to an 8-hp engine made by the Leeds-based Fowler & Co. used to carry a useful load of 9.5 tons of coal for 2.5 miles near Bradford, also returning empty, and making 850 trips per year. The account concludes that the cost per ton mile reached 4.4d. The final account also refers to a Fowler and Co. engine, belonging to the Farnley Iron Company. The work of the engine consisted in traveling empty from the ironworks to a depot 3.5 miles away and returning loaded with 9 tons of iron-stone making two journeys per day. The account lacks specificity that would have allowed us to assess whether it was complete but the latter was probably the case. The figure it comes up with was 6d per ton mile.

The conclusion is that, at 3-6d per ton mile, the use of steamers for the conveyance of goods was considerably more expensive compared to railways and a bit more so compared to fly boats which had comparable speeds at c. 10 mph. But there were certainly more competitive compared to the cost of conveying goods overland through the use of horses, specifically standing at c. two-thirds of the latter cost, an almost identical cost ratio between the two modes as with the conveyance of passengers. As stated earlier, the fact that inventors associated with various steamer schemes pursued this option with a quarter century delay and once their efforts to capture the market of conveying passengers failed seems to support the argument of entrepreneurial failure.

Bibliography

Adcock, Henry, *Rules and data for the steam-engine, both stationary and locomotive; and for railways, canals, and turnpike roads* (London: J. Weale, 1839)

[100] Marshall, *A history of railway locomotives*, p. 220; Porter, *The life and times of Goldsworthy Gurney*, pp. 100-1; Evans, "Steam-road carriages," p. 11.

Alderson, M. A., *An essay on the nature and application of steam* (London: Sherwood, Gilbert, and Piper, 1834)

Bagwell, Philip S., *The transport revolution from 1770* (London: B. T. Batsford, 1974)

Baines, Thomas, *Lancashire and Cheshire, past and present. With an account of the rise and progress of manufactures and commerce …* 2 vols. (London: William McKenzie, undated)

Barker, T. C., and C. I. Savage, *An economic history of transport in Britain* (London: Hutchinson & Co., third rev. ed. 1974)

Bates, Alan, http://www.friern-barnethistory.org.uk/userfiles/file/The_Area/Transport/Stage-Coach-Routes.pdf

Bird, A., *Roads and vehicles* (London and Harlow: Longman, 1969)

Burn, Robert Scott, *The steam-engine, its history and mechanism: being descriptions and illustrations of the stationary, locomotive, and marine engine, for the use of schools and students*, sixth ed. (London: Ward, Lock, and Tyler, 1854?)

Copeland, J., *Roads and their traffic, 1750-1850* (Newton Abbot: David & Charles, 1968)

Cort, R., *Railroad impositions detected* (London: Printed and published by W. Lake, 1834)

Cundy, N. W., *Inland transit, the practicability, utility, and benefit of railroads*, 2nd ed. (London: G. Hebert, T. Egerton, and J. Ridgway, 1834)

Davison, C. St C. B., *History of steam road vehicles* (London: H.M.S.O., 1953)

Dyos, H. J., and D. H. Aldcroft, *British transport, an economic survey from the seventeenth century to the twentieth* (Leicester: Leicester University Press, 1969)

Evans, F. T., "Steam road carriages of the 1830s: why did they fail?", *Transactions of the Newcomen Society*, 70 (1998-9), pp. 1-25

Evans, Francis T., "Roads, railways, and canals: technical choices in nineteenth century Britain", *Technology and Culture*, 22 (1981), pp. 1-34

Fletcher, William, *The history and development of steam locomotion on common roads* (London: E. & F.N. Spon 1891)

Gordon, A., *An historical and practical treatise upon elemental locomotion by means of steam carriages on common roads* (London: Printed for B. Steuart and W. Blackwood, Edinburgh, 1832)

Gray, Thomas, *Observations on a general iron rail-way, or land steam conveyance, to supersede the necessity of horses in all public vehicles*, fifth ed. (London: Baldwin, Cradock, and Joy, 1825)

Gurney, Sir Goldsworthy, *Observations on steam carriages on turnpike roads, etc*., 2nd ed. (London: ?, 1832)

Hancock, W., *Narrative of twelve years' experiments, 1824-36* (London: John Weale and J. Mann, 1838)

Head, John, *Rise and progress of steam locomotion on common roads* (London: Printed by William Clowes and Sons, 1873)

Jackman, W. T., *The development of transportation in modern England* (New York: August M. Kelley, 1965)

James, Francis, *Walter Hancock and his common road steam carriages* (Alresford, Hampshire: Laurence Oxley, 1975)

Lord Montagu of Beaulieu and Anthony Bird, *Steam cars, 1770-1970* (New York: St. Martin's Press, 1971)

Marshall, C. F. Dendy, *A history of railway locomotives down to the end of the year 1831* (London: Locomotive Publ. Co, 1953)

Nicholson, T. R., *The birth of the British motor car, vol. I, A new machine, 1769-1842* (London and Basingstoke: MacMillan, 1982)

Porter, Dale H., *The life and times of sir Goldsworthy Gurney, gentleman scientist and inventor 1793-1875* (Bethlehem: Lehigh University Press and London: Associated University Presses, 1998)

Science Museum, *Catalogue of the mechanical engineering collection in the Science Museum, South Kensington, with descriptive and historical notes*, 6th ed. (London, 1919-)

Stuart (Meikleham), R., *Historical and descriptive anecdotes of steam engines* (London: Wightman and Cramp, 1829/or London: John Knight and Henry Lacey, 1829)

The probable effects of the proposed railway from Birmingham to London considered (London, 1831)

The roads and railroads, vehicles, and modes of traveling, of ancient and modern countries (London: John W. Parker, 1839)

Thurston, A., *A history of the growth of the steam engine* (New York: D. Appleton and Company, 1897)

Wallis-Tayler, A. J., *Motor cars or power carriages for common roads* (London: Crosby Lockwood and Son, 1897)

Wood, Nicholas, *A practical treatise on railroads and interior communication in general,* 3rd edition with additions (London: Longman, Orme, Brown, Green & Longmans, 1838)