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Photo by Fred Angus

BELOW: An elevation drawing of a typical Stephenson-gauge locomotive of the late 1830s, about ten years after the Rainhill Trials. It somewhat resembles our "John Molson". Contrast this with the Brunel broad gauge locomotive of the same era on page 136. Wood's Practical Treatise on Rail Roads, 1838.

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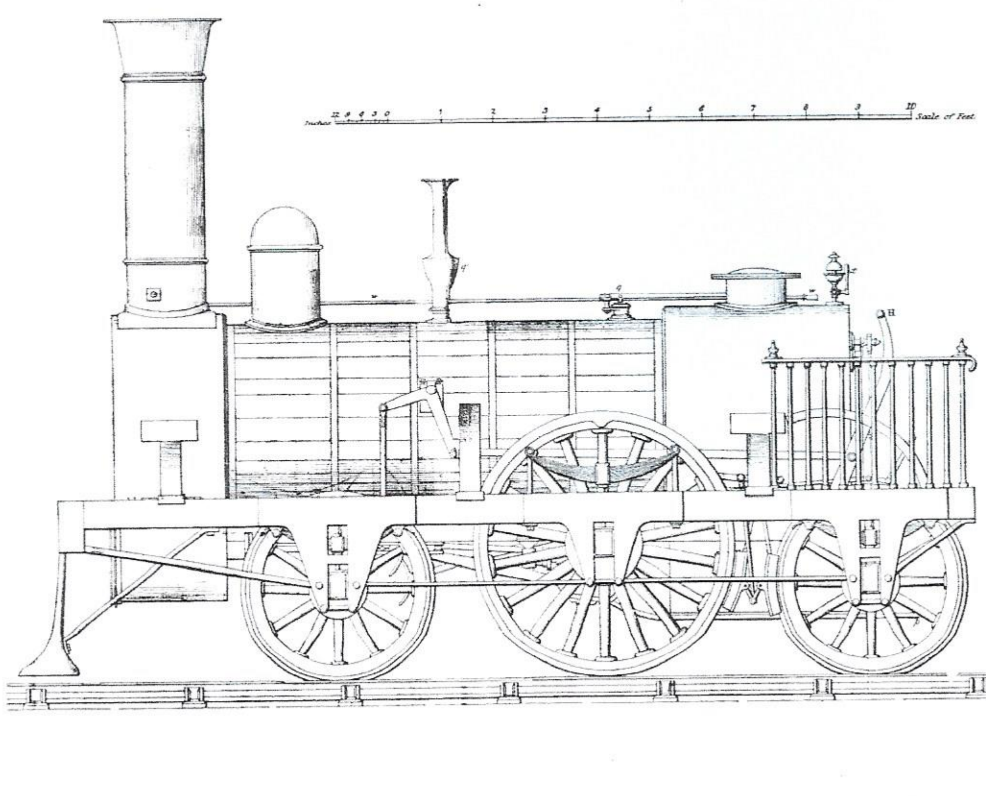
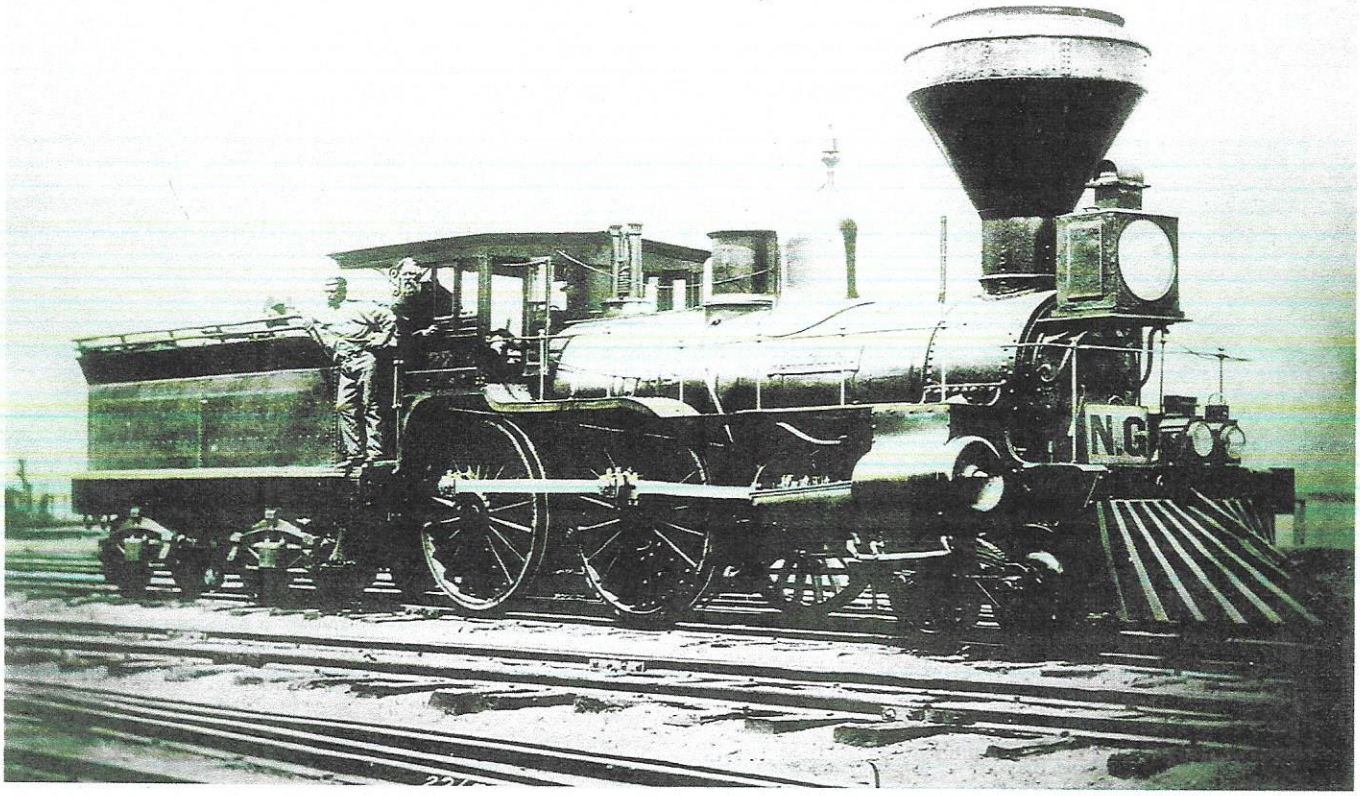


"Fruit of a Poisoned Tree" The Stephensons and the Standard Gauge

by Jay Underwood



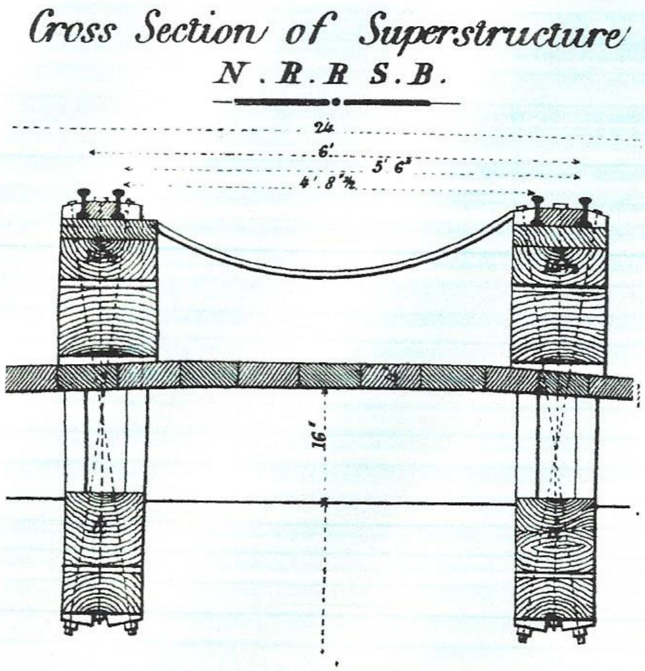
While this photo of Great Western Railway of Canada No. 27 has often been reproduced, it is of interest because of the "NG" sign on the front. This indicated that there were narrow gauge (i.e. 4 ft. 8 1/2 in.) cars in the train to which the locomotive was, presumably, about to couple. This was near the end of the era of the "Provincial Gauge" in Canada, during the time when the Great Western was operating dual gauge track. Photo given by John Loye to Donald Angus.

There is a tenet of law which posits that evidence obtained by illegal means is tainted and inadmissible in court as "fruit of a poisoned tree." This principle can be applied to the adoption of the current North American standard gauge for railways, with the "poisoned tree" being rooted in British history.

The year 2002 marks 130 years since Canada repealed the act of 1851, and thereby adopted the 4' 8 ½" (1.44 m) gauge as the standard for its railways. This move was brought about more by politics and pragmatism than by the technical merit of the gauge made so prominent by George Stephenson, the acknowledged father of the British railway system.

The conversion began in November of 1872, when the Grand Trunk Railway converted its line between Sarnia and Buffalo (via Stratford and London) in order to accommodate the interchange of traffic with connecting American lines. The remainder of the Grand Trunk's system in Canada retained the 5' 6" (1.67M) Provincial gauge until October of 1873, when the line from Stratford to Montreal was converted, and continued until 1874, when all the railway's lines east of Montreal were turned over to Standard gauge. The move effectively forced the Provincial gauge Intercolonial, and smaller lines connecting with the federally-owned railway, to follow suit in 1875, which may be said to be the year of the "official" adoption of Standard gauge.

This change has previously been documented in Omer Lavallee's *"Rise and Fall of the Provincial Gauge"* published in *Canadian Rail* No. 141 (February, 1963). His title is somewhat pessimistic, for as we shall see, the Provincial gauge has survived, and is alive and well in several countries of the world.



One of the few places in Canada where three gauges coexisted was on the Niagara Suspension Bridge. This 1855 scale drawing shows the Stephenson (4' 8 1/2") gauge in the middle, with the Erie (6') gauge between the outside rails, and the Provincial (5' 6") gauge between the second and fourth rail. The difference is quite apparent.

There was no such official date in the annals of U.S. railroading, the change occurred gradually as the nation's network expanded from the northeast and later westward with the construction of the Union Pacific-Central Pacific national transcontinental line. As a brief history of the Association of American Railroads notes:

"In 1871, more than 20 different gauges were in use in the United States — ranging from two feet to six feet. Moving passengers and freight was nothing short of chaotic. One railroad's locomotives, passenger cars and freight cars often wouldn't fit on another railroad's track.

Although there was no formal organization that accomplished it, the railroads informally agreed to a standard gauge of 4 feet 8 ½ inches. Most American railroads had converted to it by 1887."

For the most part, the early U.S. railways built on the 4' 8 ½" gauge because the earliest locomotives were imported from England, several of them from Stephenson's, then the leading exporter of locomotives.

While the motives for the change in the Canadian gauge are clear, less well-examined are the reasons for the adoption of the Stephenson gauge, effectively taken in 1846 by an act of the British Parliament, and in order to fully understand the underlying causes, this investigation must go back more than 170 years.

The first question that has to be asked, is how the 4' 8 ½" gauge was decided upon, and despite the often quite scholarly debate conducted on the topic, it can only be concluded it was a matter of pure serendipity.

There is a popular notion the gauge was derived from the width of the wheel ruts left by Roman chariots on their roads in ancient Britain. This fanciful observation is patently untrue, and fails on two points. The first is that few of the chariots preserved in museums today match the gauge. The second is that Roman roads were engineered specifically to withstand the passage of the chariots, and of the heavier baggage wagons that accompanied a legion on the move. These roads were designed for military purposes and did not see frequent commercial traffic. The ruts found in the remnants of the roads known today were left by wagons built much later, after the Roman occupation had ended and the roads had fallen into disrepair.

With the British railways developing from the northeastern coal mines like the Wylam (William Hedley and Timothy Hackworth) and Killingworth collieries (George Stephenson,) it is probably more true to say the gauge came about simply because it was the width decided upon by the local wainwrights, hence all that was available to Hedley and Stephenson to use as part of the train. It is probably no stretch of the truth to say the gauge owes its existence more to the breadth of the backside of a stout Yorkshire pit pony than any Roman thoroughbred!

While there is no doubt the father and son team of George and Robert Stephenson were already on their way to pre-eminence in the pantheon of engineers as Great Britain led the way into the railway age, it was the nine days of trials at Rainhill which established them firmly at the head of the pack, and set the industry on a course dominated by their methods and principles even today.

Popular history maintains the Stephensons triumphed at Rainhill as the result of their superior engineering in the now famous locomotive *Rocket*, but a closer look at reports of the times indicates the Stephensons indulged in some conniving, to the extent one might legitimately claim they cheated.

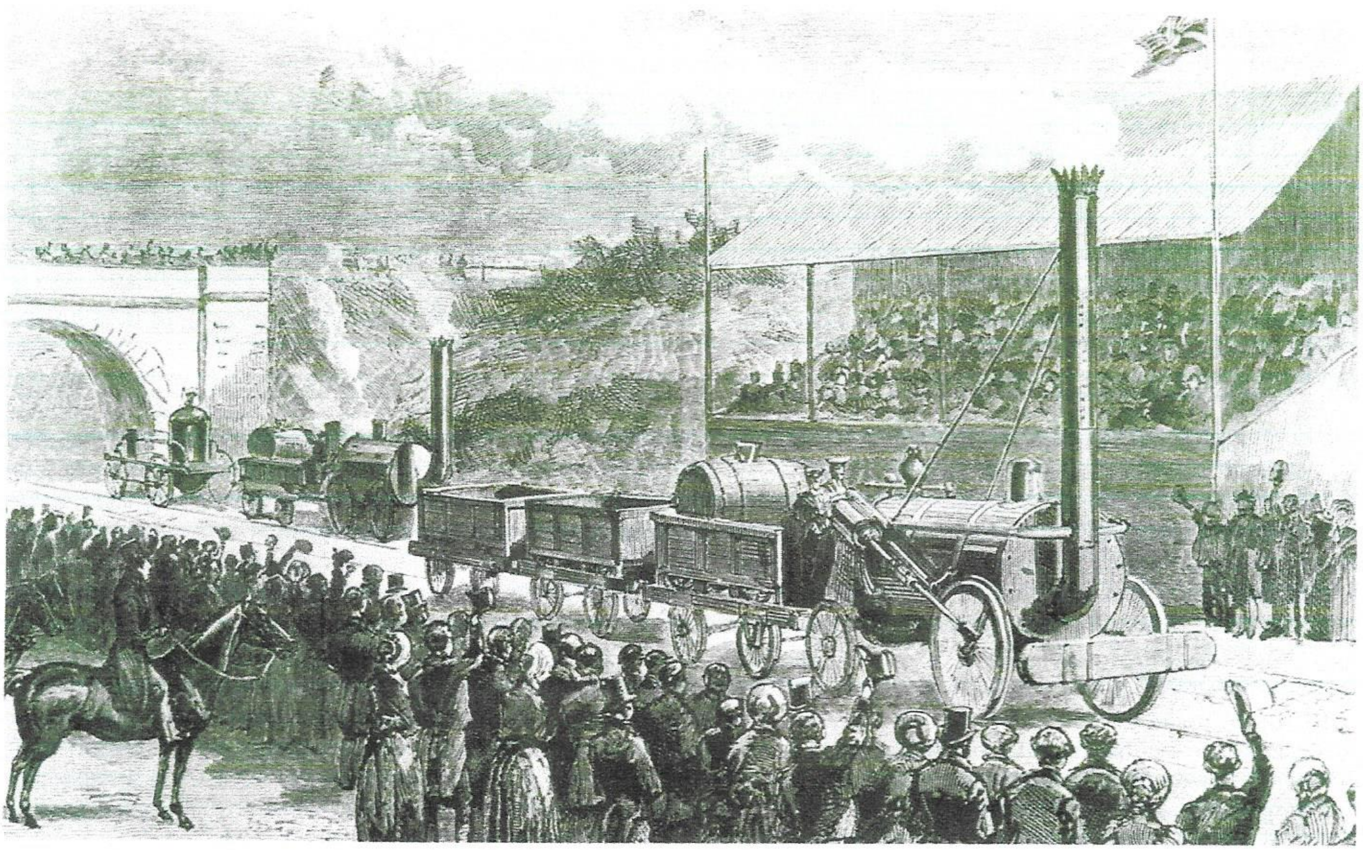
The famous trials were held by the Liverpool & Manchester Railway Co. prior to the completion of their 32-mile track between the two great industrial cities, to determine what kind of locomotive would best serve the need of the line.

There were five principal conditions of the trials:

1). Each engine should weigh not more than six tons, and be capable of pulling a train equal to three times that weight at ten miles per hour over a flat course, with a cylinder pressure of no more than 50 pounds per square inch.

2). The engine and boiler should be mounted on springs, rest on six wheels (none of the locomotives met this aspect of the criteria), and be no greater in height than 15 feet from the ground to the top of the chimney.

3). The engine should effectively consume its own smoke. This did not mean there should be no steam. By an act of Parliament, the locomotives were not to be allowed to emit smoke from their chimneys, thereby reducing the nuisance about which a great many anti-railway interests complained.



This rather fanciful illustration from a British newspaper shows *Rocket* triumphantly ahead of *Sans Pareil* and *Novelty* at the Rainhill Trials. The scene gives the impression the competition was more like a race, which *Rocket* has easily won, when in fact it is doubtful the three locomotives ever appeared on the track at the same time, and certainly never raced against each other. Such composite engravings were commonplace in the newspapers. Note the error in the illustration, which shows *Sans Pareil* pulling its tender in the rear of the locomotive, when in fact it ran at the head of the train.

4). Each engine should have two safety valves, one of which had to be placed well out of the reach of the engineer. This was to prevent engineers from tampering with the engine in order to get more work out of it, a common practice in those days, which occasionally resulted in devastating, and spectacular boiler explosions.

5). The locomotive should not cost more than £550 to purchase.

The October 1829 trials offered a prize of £500 to the engineer who demonstrated his locomotive could operate within these parameters, determined by the engineers of the railway, chief of whom was George Stephenson.

This is the first piece of evidence to suggest the trials were not conducted in an equitable fashion, and that in fact George and Robert Stephenson had the unfair advantage over the five other engineers who did manage to get to the start line at Rainhill.

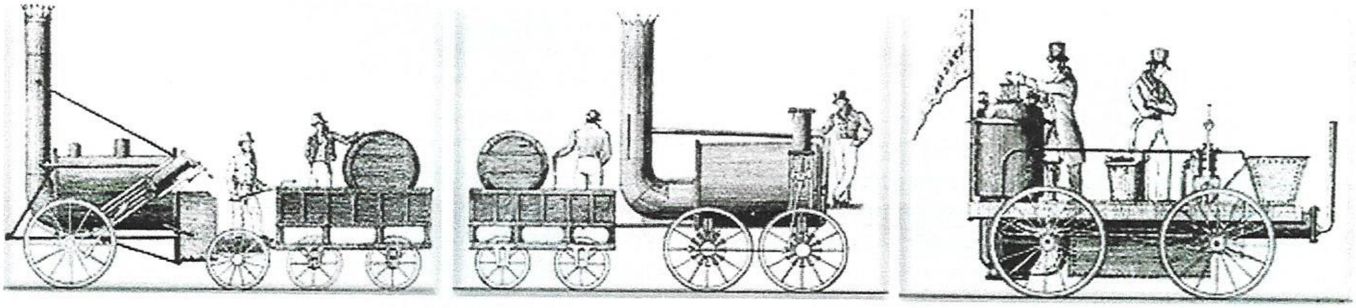
The importance of the trails cannot be understated, as Frederick S. Williams noted in *Our Iron Roads*, published in 1852:

"*...and though that amount* [the £500 prize] *was comparatively insignificant, it was obvious that on the successful engineer would devolve the construction of the entire "stud" of locomotives for the new line.*"

Robert Stephenson brought the now legendary *Rocket* to the trials, and walked away with the prize even though - contrary to the claims of popular histories - the engine did not prove to be the best entered. Born in 1803, to a father who was already well established, the younger Stephenson enjoyed an exclusive education. In 1823 Robert, his father, Michael Longdridge, and Edward Pease formed the Robert Stephenson & Company, at Forth Street, Newcastle-upon-Tyne, and became the world's first commercial locomotive builders. It was George Stephenson who recruited Timothy Hackworth as superintendent of locomotive production.

Hackworth would become a competitor at Rainhill, entering his locomotive *Sans Pareil*, and a business rival of the Stephensons for years afterwards.

Timothy Hackworth was born inWylam, near Newcastle in 1786. Trained as a blacksmith, he became involved in locomotive production when he was recruited by Christopher Blackett in 1808 to work at Wylam Colliery, where he helped Hedley produce *Puffing Billy*. He also worked with George Stephenson on *Locomotion* and was on the engine as it made its first public journey on September 27, 1825, the opening day of the Stockton and Darlington Railway.



The three competetors at Rainhill. From left to right: "Rocket", "Sans Pareil", "Novelty".

Three years later the boiler of *Locomotion* exploded, killing the driver. The locomotive was rebuilt but did not perform well, due to its inability to produce enough steam for a twenty-mile run. Hackworth assumed responsibility for the project and enlarged the *Locomotion*'s boiler, installing his revolutionary return fire tube. This improved the performance of the locomotive, but in 1827 it was surpassed by Hackworth's *Royal George*.

Hackworth, then manager of the Stockton & Darlington Railway, brought *Sans Pareil*, to the Rainhill trials straight from his workshop (he did not then have his own factory), as did the team of John Braithwaite and John Ericsson, the only other serious contenders for the prize, with *Novelty*.

The entries of Thomas Brandreth (*Cycloped*, a horse-powered contraption that was obviously unsuited to the task) and Timothy Burstall (*Perseverance*, a similarly unlikely candidate) are not considered here because their poor showing was testament to both their design and operation.

The first suspicion that is aroused concerns the length of time the competitors were given to prepare their engines, if indeed, they were designing locomotives to meet the specific requirements of the competition.

The interval between the advertisement of the event and the opening day of the trials, for example, did not give John Braithwaite and John Ericsson enough time to ensure the seal of the boiler on *Novelty*, had set sufficiently to prevent a rupture, which spoiled their chances of winning the money, despite the fact *Novelty* demonstrated a prowess equal to, and in some cases superior to, Stephenson's *Rocket*.

This was alluded to in the Liverpool *Mercury*, published the day after Braithwaite and Ericsson withdrew from the competition October 14:

"It is much to be regretted that "The Novelty" was not built in time to have the same opportunity of exercising that Mr. Stephenson's engine had, or that there is not in London, or its vicinity, any railway where experiments made with it could have been tried."

Also significant to the trials was the absence of Edward Bury, an innovative locomotive builder who could not complete his engine in time to compete. Had he done so, given the standard of his work exhibited in other engines, he would almost certainly have offered the Stephensons some severe competition. Many of Bury's engines would find work on the Liverpool & Manchester Railway, as they did on other roads upon which Bury would later work.

Robert Stephenson, on the other hand, arrived with a locomotive that needed no repairs – in part due to superior construction at his Newcastle plant, but perhaps equally in part to his prior knowledge of the stipulations laid out for the test. George Stephenson designed *Rocket* specifically for the trials, for which he helped draft the entry requirements. *Rocket* came equipped with a multi-tube boiler, similar to that designed by French engineer Marc Seguin (intended for marine use) which had been refined and patented a year earlier. It has been claimed that George Stephenson was assisted in his design by Henry Booth, the secretary of the Liverpool & Manchester Railway, and thus another individual with a vested interest in the success of *Rocket* at Rainhill is revealed. Other evidence suggests the Stephensons were heavily favored from the outset.

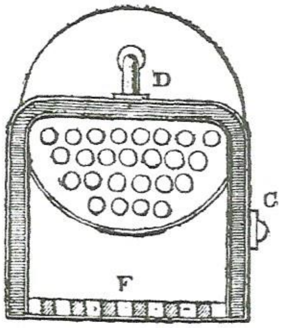
In order to appreciate this evidence, it is best to review the trials on a day-by-day basis, using the authoritative reports of *Mechanics Magazine*.

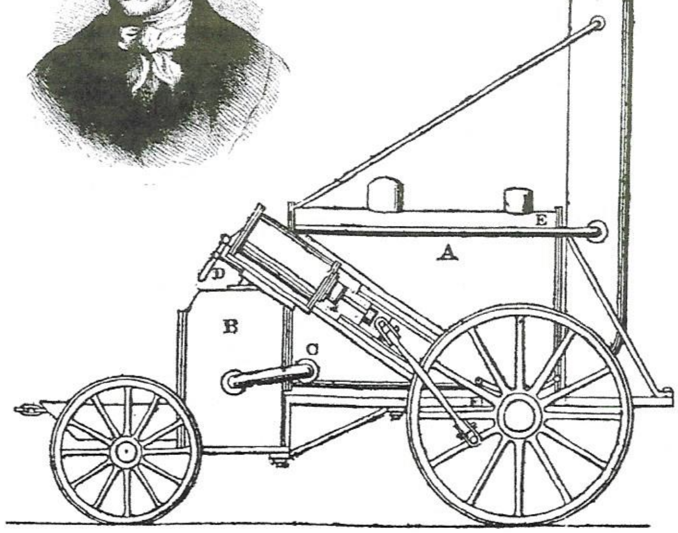
Day One: Tuesday, October 6 1829

The questionable conduct of the trials began on the very first day when *Rocket* made the first test run, despite being listed third on the official running order. It is not clear whether this was by oversight, because *Novelty* and *Sans Pareil* (first and second on the list respectively) were not ready, or because the Stephensons wanted to make the most lasting impression. *Mechanics Magazine* made a wry observation in its brief description of the engine's performance (bold type has been added for emphasis):

"The engine which made the first trial, was the "Rocket" of Mr. Robert Stephenson (the son, we believe, of Mr. George Stephenson, the engineer of the railway.) It is a large and strongly built engine, and went with a velocity, ***which, as long as the spectators had nothing to contrast it with, they thought surprising enough****. It drew a weight of twelve tons, nine cwt. At the rate of ten miles four chains in an hour, (just exceeding the stipulated maximum,) and, when the weight was detached from it, went at a speed of about eighteen miles an hour. The faults most perceptible in this engine, were a great inequality in its velocity, and a very partial fulfillment of the condition that it should "effectually consume its own smoke."*

If the Stephensons had thought to set the standard of competition, and make the most favorable impression on the crowd and the judges by going first, they had miscalculated. The inability of *Rocket* to consume its own smoke was later explained away, but the magazine would





ABOVE LEFT: Diagram of the firebox of "Rocket", showing the multi-tubular boiler.

ABOVE MIDDLE: George and Robert Stephenson.

ABOVE RIGHT: Side elevation of "Rocket".

BELOW RIGHT: Table of the performance of "Rocket" on the first day of the trial, October 6, 1829.

The diagrams, as well as those for "Novelty" and "Sans Pareil", are from "A Practical Treatise on Rail-Roads" by Nicholas Wood, printed in 1838.

find further fault with the design, a point frequently ignored in popular history. Whatever advantage the Stephensons might have sought by going first quickly evaporated when Braithwaite and Ericsson drew *Novelty* up to the start line, as *Mechanics Magazine* duly reported:

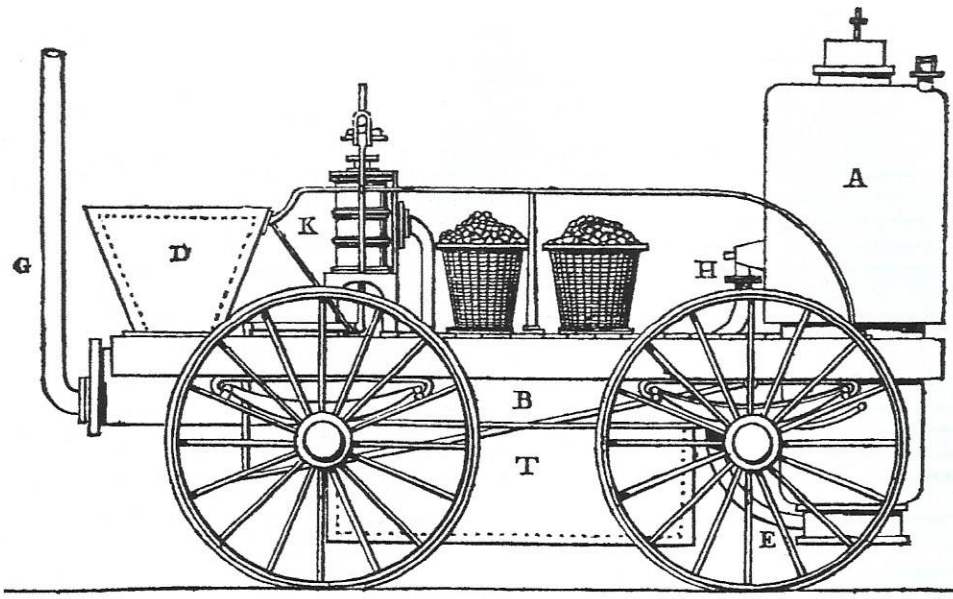
"The great lightness of this engine, (it is about one half lighter than Mr. Stephenson's) its compactness, and its beautiful workmanship, excited universal admiration; a sentiment speedily changed into perfect wonder, by its truly marvelous performances. It was resolved to try first its speed merely; that is at what rate it could go, carrying only its compliment of coke and water, with Messrs. Braithwaite and Ericsson to manage it. Almost at once it darted off at the amazing velocity of twenty-eight miles an hour, and it actually did one mile in the incredibly short space of one minute and 53 seconds! Neither did we observe any appreciable falling off in the rate of speed; it was uniform, steady, and continuous."

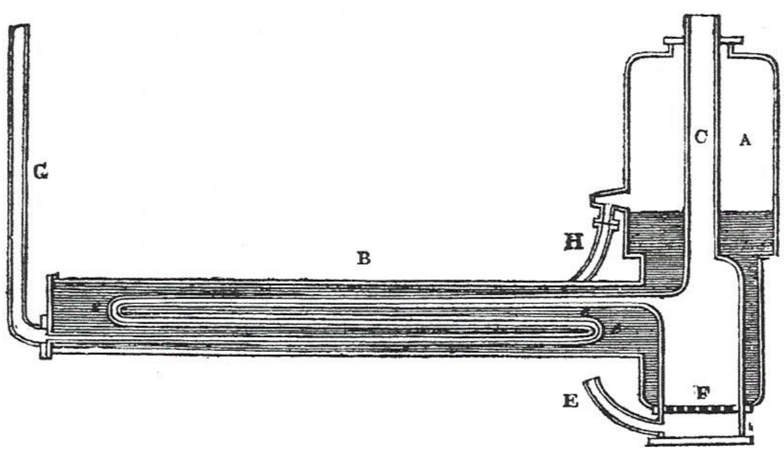
Some historians would disagree with this appraisal, like Robert H. Thurston, in his *History of the Growth of the Steam Engine*, (1878):

"The little engine does not seem to have been very possessing in appearance, and the "Novelty" is said to have been the general favorite, the Stephenson engine having few, if any, backers among the spectators."

Such was the confidence of the builders, that Braithwaite publicly offered to stake £1,000 that he could cover the entire length of the line within an hour, once the Liverpool & Manchester was complete and open. A shortage of water and coke put an end to the first day of the trial, with *Novelty* still to display its ability to pull three times it weight.

Observations.	No. of Trips.	Time in getting up and stopping the speed of the Train.	Time taken when the Engine passed the Post No. 1.	Time in coming up from Post No. 2 to No. 1.	Time in going down from Post No. 1 to No. 2.	Time taken when the Engine passed the Post No. 2	Time in stopping and getting up the speed of the Train.	Observations.
H. M. S.		H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
Started 10 36 50	......	0 1 25	10 38 15	....	0 7 43	10 45 58	....	
							0 2 14	
	1	....	10 54 55	0 6 43	....	10 48 12	....	
		0 3 42						
Stopped to oil.		....	10 58 37	....	0 7 8	11 5 45	....	
							0 4 35	Greased the Pistons.
	2	....	11 18 42	0 8 22	....	11 10 20	....	
		0 2 28						
		....	11 21 10	....	0 7 52	11 29 2	....	
							0 2 45	
	3	....	11 39 50	0 8 3	....	11 31 47	....	
		0 2 55						
		....	11 42 45	....	0 6 7	11 48 52	....	
							0 2 20	
	4	....	11 58 15	0 7 3	....	11 51 12	....	
		0 2 27						
		....	0 0 42	....	0 6 31	0 7 13	....	
							0 2 27	
	5	....	0 15 45	0 6 5	....	0 9 40	....	
		0 2 5						
		....	0 17 50	....	0 5 55	0 23 45	....	
							0 2 53	
Stopped to take in six buckets of water, equal to 19 imperial gallons.	6	....	0 35 20	0 8 42	....	0 26 38	....	
		0 4 5						
		....	0 39 25	....	0 5 55	0 45 20	....	
							0 2 35	
	7	....	0 55 30	0 7 35	....	0 47 55	....	
		0 2 24						
		....	0 57 54	....	0 5 40	1 3 34	....	
							0 3 14	
	8	....	1 13 45	0 6 57	....	1 6 48	....	
		0 3 25						
		....	1 17 10	....	0 5 18	1 22 28	....	
							0 4 2	Took in 16 Imperial Gallons of Water.
	9	....	1 33 35	0 7 5	....	1 26 30	....	
		0 2 15						
		....	1 35 50	....	0 4 12	1 40 2	....	
							0 2 1	
H. M. S. Stopped at 1 48 38	10	0 1 23	1 47 15	0 5 12	....	1 42 3	....	
From the time of starting till noon 1 23 10		0 28 34		1 11 47	1 2 21		0 29 6	
Total time 3 11 48				+			0 28 34	
			Time in going 30 miles at full speed	2 14 8		Time in starting, stopping, and going 5 miles	0 57 40	





TOP: Elevation view of "Novelty".

ABOVE: Cut-away view of the boiler of "Novelty".

BELOW: Table of the performance of "Novelty" at the trials. Unfortunately bad weather ended them prematurily.

Diagrams from Wood, op.cit.

Day Two: Wednesday, October 7 1829

The day belonged to Braithwaite and Ericsson, as *Novelty* continued to amaze the crowd and out-perform the Stephensons' entry. *Mechanics Magazine* reported:

"The "Novelty" engine of Messrs. Braithwaite and Ericsson was this day tried with a load of three times its weight attached to it, or 11 tons 5 cwt.; and it drew this with ease at the rate of 20 miles per hour; thus proving itself to be equally good for speed as for power. We took particular notice today of its power of consuming its own smoke, and did not any time observe the emission of the smallest particle from the chimney."

The weather put an end to any further trials on the second day, but *Mechanics Magazine* noted while the attendance was down (the trials had become a public spectacle):

"...there were few of those absent – the engineers, men of science, &c.- whose presence was most desirable."

Day Three: Thursday, October 8 1829

By far one of the most suspicious events indicating the Stephensons were enjoying preferential treatment came as the judges announced considerable changes to the stipulations and conditions originally set out for the trials. These nine new stipulations - termed the "ordeal"- affected the operation of the engines and the manner in which the weight of the fuel would be considered part of the weight of the locomotive. It is clear from *Mechanics Magazine* that the propriety of this sudden change was questioned:

Observations.	No. of trips.	Time in getting up and stopping the speed of the train at west end.	Time taken when the engine passed the post No. 1.	Time in coming up from post No. 2. to post No. 1.	Time in going down from post No. 1. to post No. 2.	Time taken when the engine passed the post No. 2.	Time in stopping and getting up the speed of the engine.	Observations.
H. M. S.		H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
Started 11 0 28	......	0 1 20	11 1 48	....	0 5 36	11 7 24	.... 0 2 34	
	1	....	11 16 38	0 6 40	....	11 9 58	....	
	......	0 1 20	....	0 6 40	0 5 36 0 6 40	....	0 2 34	

Total time - 0 12 16 distance 3 miles.

"We shall not go into a question which has been raised, as to the fairness of the judges making any alteration in the conditions originally promulgated. We have a perfect persuasion that they have no other desire than to ascertain, in the best manner possible, the relative powers of the competing engines, and shall not quarrel with them for any mere irregularity in the mode of their proceedings. The "new" appears to us to be also, on the whole, a "much amended" edition."

That these amendments were made before three other competitors had been given an opportunity to perform as *Rocket* and *Novelty* had done, appears to have been lost on the editors of the magazine. It was clear, however, that in one instance, observed by *Mechanics Magazine*, the effect was to handicap Braithwaite and Ericsson:

"In the original "stipulations and conditions," it was first ordered, that the load attached to each engine should be three times the weight of the engine;" and then, that the load drawn should be equal to "twenty tons, including the tender and water-tank." To reconcile these contradictory stipulations, and to make provision for the case of an engine carrying (as Messrs. Braithwaite and Ericsson's does) its own fuel and water, and therefore not requiring any tender, the matter of weight was thus arranged in the new conditions: "The tender-carriage, with the fuel and water, shall be considered to be, and taken as a part of the load assigned to the engine." And "those engines that carry their own fuel and water, shall be allowed a proportionate deduction from their load according to the weight of the engine." At first sight these seem very fair conditions; and we have no doubt the intention of them was to do equal justice to all parties."

The editors went on to note:

"When attentively examined, however, they will he found to have this defect in that they serve to place the steam-carriage, which uses a great deal of water and fuel, on the same level with one which uses very little; though a diminution of fuel and water consumed, is one of the most important improvements which can be introduced into a locomotive engine. As the judges could have no other intention than to place all parties on equal terms, they would have done better simply to stipulate, that "the weight of each engine should be considered to consist of its entire working power; that is, of the whole of the machinery, and the whole of the materials necessary for putting it in motion." The matter would then have been placed on its only just basis; and there would have been no chance of any arithmetical mystification in the results."

It is again suspicious that *Rocket* was the only locomotive to undergo a trial on the third day, according to the amended stipulations of the "ordeal".

Day Four: Friday October 9 1829

Braithwaite and Ericcson were to have taken *Novelty* onto the track for its test under the "ordeal", but elected to put any runs off until the next day.

Day Five: Saturday October 10 1829

The day nearly proved disastrous for *Novelty*, when a small pipe burst, forcing Braithwaite and Ericsson to send for new parts, and giving the Stephensons an opportunity to run *Rocket* twice along the track without any load or tender. This was clearly not in accordance with the original stipulations of the amended "ordeal," but it gave the Stephensons an opportunity to impress the large crowd with the engine's speed, which was nearly equal to *Novelty*. *Mechanics Magazine* noted, however:

"The Rocket" performed the seven miles in the space of 14 minutes 14 seconds, being the rate of 30 miles an hour! This was a rate of speed nearly equal to the utmost which "The Novelty" had achieved; but as it carried with it neither fuel nor water, it is not a speed which it could have long sustained."

With *Novelty* repaired, Braithwaite and Ericsson took the engine out for a run that was not considered to be part of the trial, but which was measured by an independent engineer – Stephenson associate George Vignoles. Perhaps in an attempt to upstage *Rocket*, Braithwaite and Ericsson then put on their own exhibition:

"Another carriage, with seats for the accommodation of passengers was now substituted for the loaded wagons attached to "The Novelty," and about forty-five ladies and gentlemen ascended to enjoy the great novelty of a ride by steam. We can say for ourselves that we never enjoyed anything in the way of traveling more. We flew along at the rate of a mile and a half in three minutes, and though the velocity was such that we could scarcely distinguish objects as we passed by them, the motion was so steady and equable, that we could manage not only to read, but write."

This observation would become an important distinction between *Novelty* and *Rocket*.

Day Six: Tuesday October 13 1829

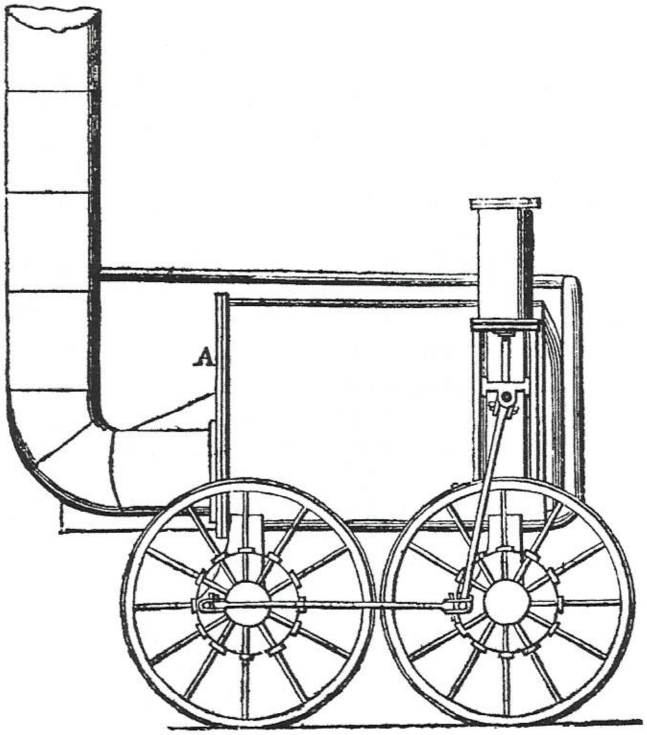
Timothy Hackworth brought *Sans Pareil* up to steam and immediately ran afoul of the judges for a weight violation. Popular histories have always dismissed Hackworth's engine as being overweight, and therefore unworthy of consideration at the trials. Frederick S. Williams appears to have been one of the first to spread this misconception:

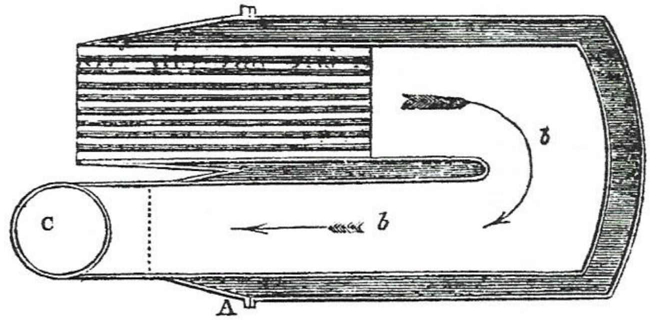
"When the Sans Pareil was examined, it was found not to have been constructed in precise accordance with the stipulations of the company, and therefore was, in strictness, disqualified; but it was resolved that a trial should be made, and that, if it displayed marked superiority, it should be recommended to the favorable consideration of the directors."

In fact, under the original stipulations of the contest, *Sans Pareil* was a qualified entry. At four tons, eight hundredweight and two quarters, *Sans Pareil* was only slightly heavier than *Rocket*. Under the amended "ordeal," however, when the weight of the fully-fueled tender was factored into total engine weight, Hackworth's machine was over the six ton limit by less than three hundredweight.

While it performed admirably, pulling three times it weight, in the eyes of *Mechanics Magazine*, *Sans Pareil* proved it was at least second best in the competition (although the magazine did not say which of *Rocket* or *Novelty* was in first place.)

Before the trial was fully complete, however, a feed pipe burst (an accident similar to that suffered by *Novelty*) and the judges agreed Hackworth would be allowed to continue his trial on October 16.





LEFT: Side elevation of "Sans Pareil".

ABOVE: The boiler of "Sans Pareil" showing the return flue.

LEFT BOTTOM: Table of the performance of "Sans Pareil" at the Rainhill Trials.

Diagrams from Wood, op. cit.

BELOW: Portrait of Timothy Hackworth.

Observations.	No. of Trips.	Time in getting up and stopping the speed of the train at west end.	Time taken when the Engine passed post No. 1.	Time in coming up from post No. 2. to post No. 1.	Time in going down from post No. 1. to post No. 2.	Time taken when the engine passed post No. 2.	Time in stopping and getting up the speed of the train at east end.	Observations.
H. M. S.		H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.	
Started at 10 10 21	......	0 1 9	10 11 30	....	0 5 9	10 16 39	....	
							0 2 6	
	1	....	10 26 22	0 7 37	....	10 18 45	....	
		0 2 12						
		....	10 28 34	....	0 6 3	10 34 37	....	
							0 2 1	
	2	....	10 43 46	0 7 8	....	10 36 38	....	
		0 2 11						
		....	10 45 57	....	0 6 8	10 52 5	....	
							0 2 11	
	3	....	11 1 37	0 7 21	....	10 54 16	....	
		0 2 35						
		....	11 4 12	....	0 5 34	11 9 46	....	
							0 1 52	
	4	....	11 18 12	0 6 34	....	11 11 38	....	
		0 2 35						
		....	11 20 47	....	0 5 39	11 26 26	....	
							0 1 55	
	5	....	11 35 17	0 6 56	....	11 28 21	....	
		0 2 40						
		....	11 37 57	....	0 6 1	11 43 58	....	Oiling carriages, and repairing forcing pump.
							0 4 11	
	6	....	0 55 21	0 7 12	....	11 48 9	....	
		0 2 54						
		....	0 58 15	....	0 6 22	0 4 37	....	Took in 8 imperial gallons of water.
							0 2 34	
One of the waggons got loose.	7	....	0 15 12	0 8 1	....	0 7 11	....	
		0 3 31						
		....	0 18 43	....	0 5 31	0 24 14	....	Took in 8 gallons of water, and examined forcing pump.
							0 3 18	
H. M. S. Stopped at 0 27 32	8	....	....	....	....	0 27 32	....	
Time till noon - 1 49 39		0 19 47		0 50 49	0 46 27		0 20 8	
				+			0 19 47	
Total time, 2 17 11			Time in going 22 miles and a half at full speed - -	1 37 16		Time in starting, stopping, &c. -	0 39 55	

Day Seven: Wednesday, October 14 1829

The full trial of *Novelty* proved to be the undoing of Braithwaite and Ericsson, for not even the repaired pipe, or minor alterations to other parts, could prevent the boiler from splitting at the "green" seams, where the cement sealing the flanges of the boiler had not been given sufficient time to cure. This accident was not, as popular histories have stated (but which *Mechanics Magazine* categorically denies), a boiler explosion. Later in the day, Braithwaite and Ericsson announced they were withdrawing from any further trials, and were prepared to let *Novelty* be judged on its past performance.

Also participating that day was Burstall's *Perseverance*, but its performance was so unexceptional compared to the three previous entries, that the magazine saw fit to dismiss it outright.

Significantly, the Stephensons chose the seventh day of the trail to take *Rocket* on yet another run that was clearly beyond the bounds of the contest, but which may have been designed to upstage Hackworth.

After losing the battle for speed to *Novelty*, the Stephensons were well aware that Hackworth excelled at producing industrial locomotives capable of hauling great loads up some relatively steep inclines. *Royal George* had proven the superiority of Hackworth's designs in that respect. Perhaps in order to attract attention away from the very large load that *Sans Pareil* would successfully pull in its first trial, Robert Stephenson took *Rocket* to another part of the Liverpool & Manchester line, in what *Mechanics Magazine* called "an experiment":

"We were informed that, early on Wednesday morning, before we reached the course, an experiment had been made with Mr. Stephenson's engine on part of the railway which runs with an inclination of 1 in 96, and that it drew up this plane a carriage containing 25 passengers, with great ease."

In order to perform this "experiment," Robert Stephenson would have needed the approval and co-operation of the railway's chief engineer – his father.

The withdrawal of *Novelty*, at least in the mind of the Liverpool *Mercury*, left Robert Stephenson the clear winner of the Rainhill trials, but another twist in the tale made the victory appear even more inevitable, as *Mechanics Magazine* noted:

"It appears that the gentlemen who were appointed to act as judges, have had only the name and not the usual powers of judges conferred upon them. All that they have been required and permitted to do is make an exact report to the Directors of the performances of the competing engines; the Directors reserving to themselves the power of deciding which is best entitled to the premium."

This clearly left George Stephenson in a position to sway the board of directors, who would turn to him to provide technical guidance to a body of men who were not engineers. Among those men would sit George Booth who reputedly helped develop the multi-tube boiler used in *Rocket*.

Had the competition been held in the modern era, the involvement of George Stephenson in the organization of a trial in which his own son was competing would have been seen as a blatant conflict of interest. In the business ethic of the pre-Victorian era, however, there were no such restrictions. Indeed, it was considered beneath the dignity of gentlemen of honour and reputation to publicly suggest another (or in this case two other) gentlemen of repute would connive to "rig" the outcome.

This suspicion was first hinted at by *Mechanics Magazine*. In the October 10 edition, the magazine roundly applauded the directors of the railway, noting they were owed a vote of thanks:

"...from the owners of the competing engines, for the liberal encouragement by which they were induced to start for the plate, and the impartial spirit, (divested of all local and personal influences) in which the competition has been conducted..."

The three judges, however, were all men with close ties to the Stephensons. John Rastrick was a personal friend to George Stephenson, as was Nicholas Wood, the manager of Killingworth Colliery. Wood had been a mentor to Robert Stephenson. John Kennedy, although not an engineer, was one of the original incorporators of the Liverpool & Manchester Railway, and participated in the hiring of George Stephenson. As it turned out, they would not make the decision which ultimately favored the Stephensons.

Day Eight: Thursday, October 15 1829

This day was given over to the trial of Brandreth's horse-powered contraption *Cycloped*, which proved to be not only inefficient, but so faulty in design the poor animal fell through the floor while straining to draw the load.

Day Nine: Friday, October 16 1829

The final trial of *Sans Pareil* proved to be Hackworth's undoing, but it too is not without some considerable suspicion. Although the first trial had gone well enough, Hackworth had not pulled his train the sufficient distance, all that remained was for his engine to complete the 20 trips along the three-mile length of track.

This was made impossible by another mechanical failure, when one of the engine's cylinders cracked, bringing *Sans Pareil's* trial to an end. Williams differs in his account of Hackworth's failure:

"On its eighth trip, however, the pump that supplied the water failed, and the accident terminated the experiment."

Because the cylinder had been cast at Robert Stephenson's foundry, there has been some speculation that it may have been a case of sabotage. Later historians believe this may have also been George Stephenson's intent. On his internet website (www.john.metcalfe.btinternet.co.uk/hackworth/hackworth7.htm) honoring Hackworth, John Metcalfe claims, without offering examples:

"In a series of letters to the Secretary of the Liverpool and Manchester Railway, Stephenson did his utmost to degrade "Sans Pareil", clearly demonstrating that he considered it a serious rival to his own locomotive...."

The letters were probably unnecessary, since the secretary was Henry Booth. Certainly Hackworth was convinced his entry had been derailed. Spectator James Dixon, writing to his brother on the day of the failure, noted:

"Timothy Hackworth has been sadly out of temper. He openly accused all George Stephenson's people of considering to hinder him of which I do believe them innocent, however, he got many trials but never got half of his 70 miles done without stopping. He burns nearly double the quantity of coke that the Rocket does and mumbles and roars and rolls about like a Empty Beer Butt on a rough pavement."

This seems oddly out of character for a man who was also a lay preacher, but his Christian beliefs did not prevent Hackworth from voicing his suspicions in a letter to the railway's board of directors:

"You are doubtless aware that on a recent occasion the Loco Motive Engine Sans Pareil failed in performing the task assigned to her by the Judges. It were now useless to enter into a minute detail of the causes. Suffice it to say

that neither in construction nor in principle was the engine deficient, but circumstances over which I could not have any control from my peculiar situation, compelled me to put that confidence in others which I found with sorrow was but too implicitly placed....."

In the same letter, Hackworth denied having a similar suspicion of the board itself, yet perhaps by this point he was also becoming aware of the favoritism being bestowed upon the Stephensons. Consider the failure of *Rocket* to "consume its own smoke' on the first day of its trial. This was later explained away by *Mechanics Magazine* as a simple oversight:

"*We have heard that on the first day there was an accidental intermixture of coal with the coke; a circumstance which, if true, would sufficiently account for the appearance of smoke on that occasion.*"

Noting that in its later trials, *Rocket* showed no signs of producing smoke, *Mechanics Magazine* appears satisfied with the explanation. It does not explain how an experienced engineer could mistake coal for coke, and raises the possibility that after the superior performance of *Novelty*, Robert Stephenson made some well-timed adjustments to his locomotive. Indeed, over the years, Stephenson made numerous adjustments to *Rocket*, resulting in a number of different illustrations of the same machine.

It is also evident the directors, in awarding the prize to the Stephensons, overlooked some design deficiencies in *Rocket*, while similar deficiencies were held against *Sans Pareil* and *Novelty*, both of which failed to complete the full course.

In their report to the directors the judges attempted to be fair in evaluating the performances of all three engines on the basis of the load pulled over the time of operation, rather than the distance. This was meant to compensate for the mechanical failures. Popular history has judged *Rocket* to be the winner based on its mechanical merit, but it is evident the directors overlooked some serious faults that were pointed out by *Mechanics Magazine*:

"*The performances of this engine indicate a very abundant and well sustained production of steam; but the extent of surface which it has been found necessary to expose to the heat, in order to obtain that effect, the great size of all the parts, and the quantity of fuel required — are faults which even a still more copious generation of steam would scarcely compensate. It is not by means of its heavy weight alone that such an engine would operate injuriously on the rails. The chimney from its great height — a height necessary to obtain that draught which in "The Novelty" is produced by means of the air-forcing apparatus — gives a swaying motion to the engine from side to side; and the rails have thus a lateral as well as a longitudinal force applied to jerk them out of their places.*"

These same forces would make *Rocket* less suitable to passenger service than *Novelty*, something Robert Stephenson would correct in the post-Rainhill improvements he would make to his father's locomotive. As for Stephenson's competitors, only Timothy Hackworth would remain prominent in the locomotive market, founding his Soho Works at Shildon in 1833. Braithwaite, Burstall and Brandreth would all fade from the scene, while Ericsson, a Swede, would travel to America and continue a career in marine engineering. In 1862, during the American Civil War, he achieved his greatest triumph with the *Monitor*, an iron gunboat which revolutionized naval warfare.

The final judgment of Rainhill should be left to *Mechanics Magazine*, although popular history has failed to take note of what was written:

"*Now, though we are of opinion that "The Novelty" is the sort of engine that will be found best adapted to the purposes of the railway; and are inclined to think that "The Sans Pareil" is at least as good an engine as "The Rocket;" yet as neither the one nor the other has equalled "The Rocket" in a performance, which had the winning of the prize of £500 expressly for its object, we do not see how the Directors can in justice do otherwise than award that prize to Mr. Stephenson. Besides, whatever may be the merits of "The Rocket," as contrasted with either of its rivals, it is so much superior to all the old locomotive engines in use, as to entitle Mr. Stephenson to the most marked and liberal consideration, for the skill and ingenuity displayed in its construction.*"

Others were more sympathetic toward Hackworth, as Williams notes:

"*The opinion has been confidently expressed to the writer, that after all the Sans Pareil was as good an engine as the Rocket. The accident that led to its withdrawment from the competition was trifling, and could now-a-days have been repaired in two minutes. But it frightened the driver, and he gave in.*"

It would, not be the last time that a Stephenson engine, though coming in second best, would end up in first place.

The most immediate effect of the Rainhill trials would be to make stock in the Liverpool & Manchester Railway a hot commodity. Some 10,000 people turned out on the first day of the trials, and the excitement generated by the event was unprecedented. The £500 award given to Robert Stephenson was paltry compared to the hundreds of thousands of pounds the company made in the sale of stock.

It was also a paltry sum for Stephenson, compared to the money he would make in orders for locomotives from British companies, and from European and American railways eager to get their hands on what was then perceived to be the best technology available. (The first British locomotives imported into the United States were *Stourbridge Lion*, made by John Rastrick's firm in 1829, and Stephenson's *America*. The *America* blew up the same year, and the *Stourbridge Lion* proved too heavy for the Delaware & Hudson Canal Company's 4' 3" (1.3 m) gauge light rails and spent most of its time in storage.)

As Williams noted:

"*The engines that issued, month by month, from the factory, were a continuous improvement on their predecessors, until the Newcastle factory became the largest and most famous in the world. As railways increased, it sent engines to all the countries of Europe, and to the United States, and it manufactured about a thousand locomotives.*"

Economic success was not necessarily an indicator of technical merit, however. American railway official J.G. Pangborn of the Baltimore & Ohio Railroad, writing in 1893, noted:

"Hardly any two of Hackworth's engines have been alike. Stephenson, on the other hand, when getting hold of a good idea, repeats it over and over again. The result is Stephenson is making lots of money and Hackworth is not; but the latter is compelling locomotive designers all over the world to step right lively to keep up with him."

For the Stephensons there were other benefits to be gleaned from Rainhill, not the least of which was the hero worship bestowed upon them by a society in awe of its technology and inexorably driven in the pursuit of "progress." The *Westminster and Foreign Quarterly Review* was almost obsequious in its praise of Robert Stephenson:

In this 1836 cartoon, satirizing the first railway mania, the gentleman on the left of a porcine John Bull is saying; " I as friend Mr. Bull, say that you are now rather intoxicated, and would advise you before you give your money for these things to get a little sober." Bull replies: "I will have some shares, don't tell me..." It is interesting to note that the seedy-looking speculator with the map is also holding a prospectus for Stephenson's railway to Brighton, while his nearest competitor holds a prospectus for a similar line bearing the name of the Rennies.

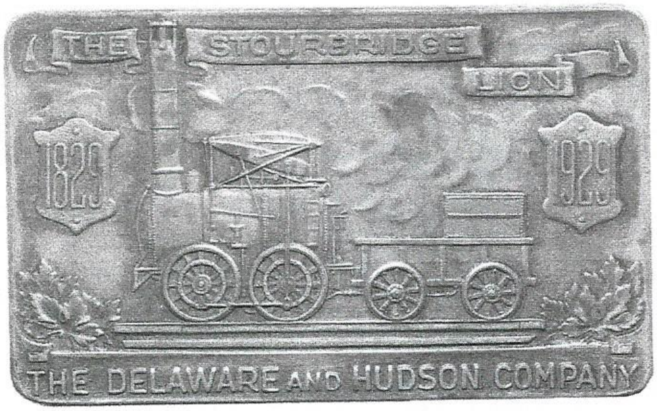
"Healthy-bodied and healthy-minded, apt in emergencies, and yet of slow, and generally of sound judgment, Robert Stephenson may be regarded as the type and pattern of the onward-moving English race, practical, scientific, energetic, and, in the hour of trial, heroic. Born almost in the coal-mine, of the racy old blood of the north, with a father strong in motherwit, stern of purpose, untiring in patience, careful of his small resources, keenly conscious of the bounded sphere his want of early education had kept him in till a later period of life, and determined to pare off from himself all luxuries, all but the merest necessaries, in order that his after-coming should start fair in life with that knowledge he himself held above all price - born thus, Robert Stephenson was emphatically well-born. With natural talents, good education, a healthy frame, the rising prestige of his father's name, little money, and a large demand for original work in a working and energetic old world, he went forth to the New World, and in the mines of South America and their environs added new manners and customs to his varied stock of knowledge. More than all this, the genial spirit that ever looked kindly on his fellow-creature, with the intellect that could generally winnow the false from the true, marked him out for a leader of men. Not to his mere mechanical skill does he owe his success in life. That might have been thwarted in five hundred ways by interested rivals; but men wish not to thwart those whom they love; and probably no chief of an army was ever more beloved by his soldiers than Robert Stephenson has been by the noble army of physical workers, who under his guidance have wrought at labors of profit, - made labours of love by his earnest purpose and strength of brotherhood."

Just as the Rainhill victory persuaded locomotive buyers to place their trust in Stephenson's designs, it likewise persuaded railway builders to follow Stephenson's practices, notably the use of the 4' 8 ½" gauge. As a marketing tool, the Rainhill Trials were a spectacular success, both in England and in North America, as William H. Brown noted in his *History of the First American Locomotives* (1871):

"The experiments of Mr. Stephenson had been carefully watched. His name and fame, as an eminent engineer, were familiar to the minds of the people of this country. His success with his "Rocket" excited the liveliest interest here, and equally as much so as in England. His bearing of the £500 prize was hailed with rapture by thousands in America, who admired him for his genius and indomitable perseverance."

The events were also witnessed first hand by American observers, as Brown notes:

"The competition in England for the £500 prize attracted many distinguished engineers, scientific men, and enterprising gentlemen, from all parts of the world, to witness the contest. Among the engineers from America was



A bronze plaque, four inches long, produced by the Delaware and Hudson in 1929 to commemorate the 100th anniversary of the "Stourbridge Lion".

Horatio Allen, Esq., late assistant engineer upon the Delaware and Hudson Canal and Railroad, who was on a trip to England to examine into the improvements in the new mode of intercommunication....

...On this visit of Mr. Allen to England, he purchased for the Delaware and Hudson Canal and Railroad Company three locomotives. The "Stourbridge Lion" was one of these, and the first, which soon after arrived in New York. Its performances in the yard of the works where it was landed (the West Point Foundry Works, foot of Beach Street) were witnessed by thousands, attracted by the novelty of the machine."

Despite the unsuccessful trial of the *Stourbridge Lion* and *America,* American railroad promoters quickly placed orders for Stephenson locomotives, or for the machines produced by Bury, built on the Stephenson gauge (the Norris brothers of Philadelphia were apostles of Bury's style.) Prominent among these engines was the Camden & Amboy's Stephenson-built *John Bull*, which made its first run in November of 1831.

George Stephenson's next assignment came as chief engineer of the London & Brighton Railway, and later the London & Birmingham line, both of which put the father and son in high demand, as Williams notes:

"On the completion of the London and Birmingham, the Stephensons undertook the formation of the Birmingham and Derby, North Midland, York and North Midland, Manchester and Leeds, Northern and Eastern Railways, and for ten years were incessantly engaged upon the surveys, plans, parliamentary battles, and construction of the vast network of lines stretching in all directions throughout the kingdom. During this period, Robert Stephenson, as engineer-in-chief, executed the great iron cross of roads which, on the one hand, unite London with Berwick, and on the other, Yarmouth with Holyhead, making, with the lines in connection with them, not fewer than 1,800 miles of the iron highways of the country."

If the "mere irregularities" of the Rainhill trials had indeed been a matter of unfair play, the poisoned tree was not long in bearing fruit. As Eric Hobsbawm notes in his internet essay on the growth of the Victorian-era railway:

"Between 1820 and 1850 some six thousand miles of railways were opened in Britain, mostly as the result of two extraordinary bursts of concentrated investment followed by construction, the little railway "railway mania" of 1837-7 [sic] and the gigantic one of 1845-7."

For the Stephensons, the second "mania" was by far the most significant, for in July of 1845, faced with 273 acts for the formation of railways requiring Royal Assent, Parliament decided the time had come to ensure the evolving network offered what today would be called "seamless" transportation - a standard gauge that would allow passengers, and commercial and industrial shippers, to connect with various railways without the expense of unloading from a train of one gauge in order to board another train of a different gauge. These railways represented a total of 1,200 miles (1,920 km) of new track.

The best example of the inconvenience of transshipment between varying gauges was experienced at Gloucester, where Brunel's Great Western Railway - built on the massive 7' 1/4" (2.14M) gauge - interchanged with a line to Bristol and thence to Birmingham, built on the Stephenson gauge. The Great Western was not the only British railway of the time built on the broad gauge, but it was by far the largest. Known for doing things in his own unique way, Brunel had deliberately snubbed the Stephenson gauge as unsatisfactory for a line that was promising premier express service to its passengers, a link in a chain that would include transatlantic steamer service to the United States. He was not alone in his disdain for George Stephenson. Sir John Rennie and his brother George, equally renowned engineers of the day, considered him to be less than competent.

These doubts were not without grounds. *Mechanics Magazine* had noted that the second day of the Rainhill trials had been suspended at the midday because:

'The weather now become wet, and the rail-ways clogged with mud, which made it necessary to suspend the prosecution of the experiments...."

This may be taken as an indication the rails were improperly ballasted. There is also evidence George Stephenson's estimate of the railway's weight requirement for locomotives was grossly inadequate. The amended Rainhill stipulations placed a six-ton limit on the weight of engine and tender, yet Dionysius Lardner, writing in *Railway Economy* (1851) noted the locomotives in use when the Liverpool & Manchester line officially opened weighed seven and a half tons each.

Other adversaries of George Stephenson were frequently frustrated by their inability to get him to commit to specific details of his projects. Edward Alderson, counsel for those opposing the Liverpool & Manchester Railway, said of Stephenson's performance before the parliamentary committee considering the legislation enabling the creation of the line in 1825:

"Mr. Stephenson never had a plan - I do not believe he is capable of making one. He is either ignorant or something else which I will not mention. His is a mind perpetually fluctuating between opposite difficulties; he

neither knows whether he is to make bridges over roads or rivers, or of one size or another; or to make embankments, or cuttings, or inclined planes, or in what way the thing is to be carried into effect. When you put a question to him upon a difficult point, he resorts to two or three hypothesis, and never comes to a decided conclusion. Is Mr. Stephenson to be the person upon whose faith this Committee is to pass this Bill involving property to the extent of £400,000/ £500,000 when he is so ignorant of his profession as to propose to build a bridge not sufficient to carry off the flood water of the river or to permit any of the vessels to pass which of necessity must pass under it?"

The task of resolving the difference of opinion within the engineering fraternity, and refereeing what would become known as the "Battle of the Gauges" fell to a three-man commission: Sir John Mark Frederick Smith of the Royal Engineers; George Biddell Airy, the Astronomer Royal; and Peter Barlow, professor of mathematics at the Woolwich military academy. In effect, the battle pitted Brunel, the aloof and often autocratic aristocrat, against George and Robert Stephenson, the national icons of the noble, self-made man.

The inquiry would ask more than 6,000 questions of 48 witnesses, and produce more than 340 pages of findings. As part of the commission's examination, trials were held in the style of Rainhill, to determine the performance of the engines on each gauge. These events produced a unique competition between the Stephensons and a former pupil, the Great Western's chief locomotive builder, Daniel Gooch.

Born in 1816, Gooch had met George Stephenson as a young boy and became an engineer at the Newcastle locomotive factory owned by Pease and the Stephensons. Gooch had been on the footplate of one of the locomotives that ran in the official opening of the Liverpool & Manchester Railway. He then found work at the Tredegar Ironworks in South Wales. In 1837, at the age of twenty-one, he was appointed locomotive superintendent of the Great Western Railway. Encouraged by Brunel, he excelled in the design of broad gauge locomotives, which traveled at much greater speeds than those made previously for other gauges, by virtue of a large firebox and boiler carried between the wide axles. In order to match that power, a Stephenson-gauge engine would need a higher boiler, significantly altering its center of gravity, and thus its stability. Gooch's engines could pull large loads at 60 mph (96 km). Among the most notable of the 340 locomotives he designed were the *Iron Duke* and the *Great Western*.

His locomotive *Ixion* set the standard for the Gauge Commission, hauling an 80-ton train at 60 (96.5 km) mph. The best speed a brand new Stephenson 4-2-0 locomotive could manage with a similar load on the narrower gauge was 53 (85 km) mph. Hamilton Ellis (*The Pictorial Encyclopedia of Railways*, Hamlyn 1973) explains the Stephenson failure:

"An altogether less happy locomotive essay by Robert Stephenson was the so-called long-boiler engine, with all the wheels between smokebox and firebox. It was not that the boiler was really so long: rather that the engine wheelbase was so short in relation to the boiler. It could be dangerously unsteady at speed, particularly on the light track of the period, which was a very serious fault in a locomotive which Stephenson's firm intended specially for fast passenger haulage. When the type was matched against Gooch's great, steady broad-gauge engines.... There was trouble..."

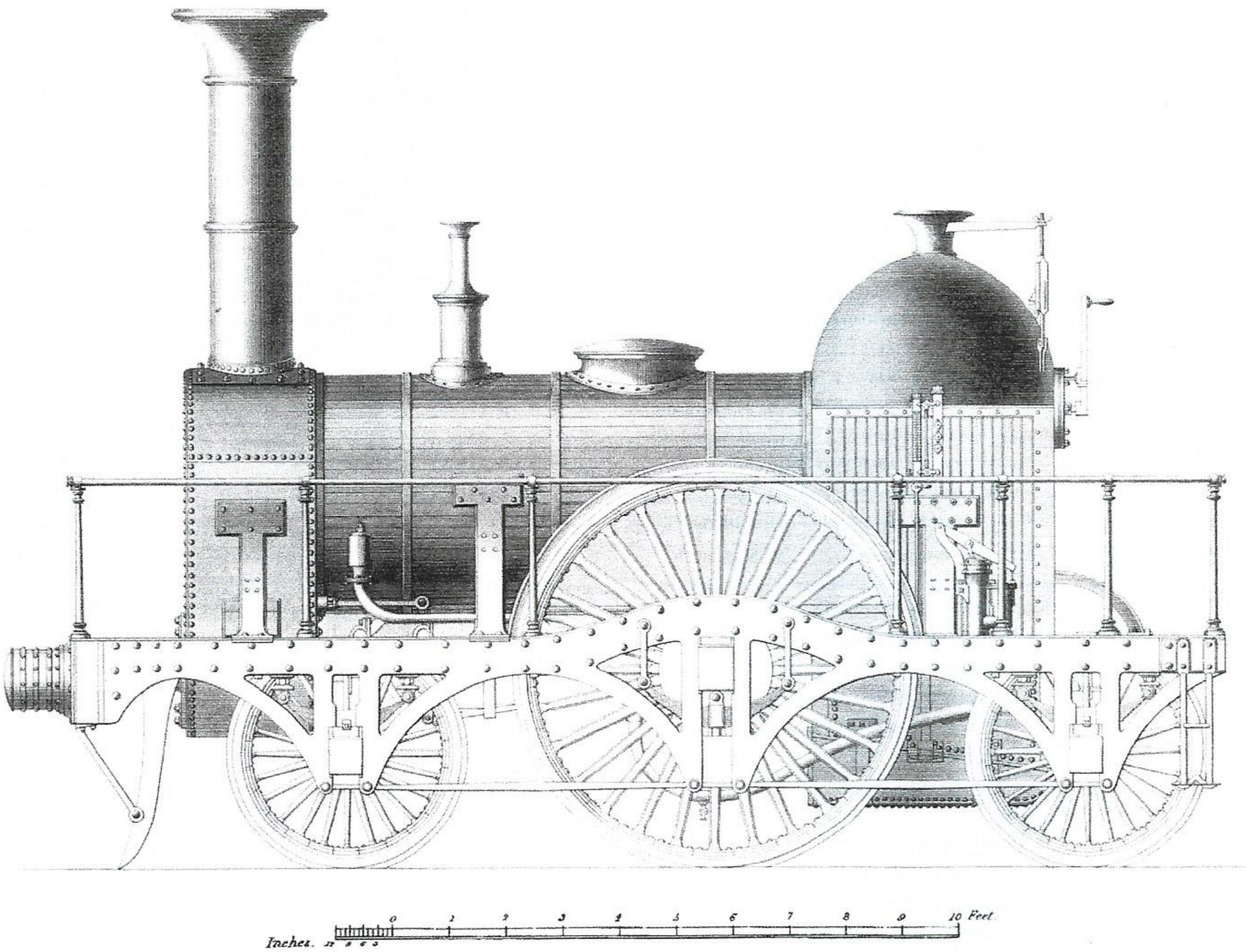
A portrait of Daniel Gooch, chief locomotive builder of the Great Western.

Once again, however, the Stephensons appear to have had the best of the affair. The list of witnesses before the commission shows the preponderance of testimony to be in their favor, including the likes of George Bidder, Robert Stephenson's acquaintance from Edinburgh University, and his lieutenant on the London & Birmingham Railway. He was a close personal friend who used to pass time wrestling with George Stephenson. Robert Stephenson would later write of this relationship:

"When my father came about the office he sometimes did not well know what to do with himself. So he used to invite Bidder to have a wrestle with him, for old acquaintance sake. And the two wrestled together so often, and had so many falls (sometimes I thought they would bring the house down between them), that they broke half the chairs in my outer office."

Also testifying were John Rastrick and Nicholas Wood, former judges of the Rainhill trials; Charles Vignoles, who worked with George Stephenson on the Liverpool & Manchester Railway survey; as did Joseph Locke, who also worked with Stephenson on the Stockton & Darlington railway, and the Grand Junction Railway. Robert Stephenson also testified, in the year prior to demonstrating his political connections by becoming the Member of Parliament for the Yorkshire riding of Whitby. He was elected for the Conservatives in the July 30, 1847 election. J.C. Jeafferson

LOCOMOTIVE ENGINE ON THE GREAT WESTERN RAILWAY.



This beautiful example of Victorian engineering drawing shows a Great Western broad gauge locomotive. This was very much larger and more impressive than the contemporary standard-gauge engines.
From "The Railways of Great Britain and Ireland" by Francis Whishaw, printed in 1840.

notes in *Life of Robert Stephenson* (1864):

"As a member of parliament Robert Stephenson voted steadily with his party, but he abstained from taking part in debates, unless the Commons stood in need of his professional information or judgement."

George Hudson

Another powerful Stephenson ally, and commission witness, was George Hudson, the MP for Sunderland (1846-59), and the major shareholder in the Midland Railway. Hudson had amassed a fortune in railway speculation - for himself and others like the Duke of Wellington - through bribery and the liberal use of stockholders' money. Constantly speaking in Parliament against any proposed government supervision of railways, Hudson earned himself the nickname of "Railway King," and the disapproval of such critics as the philosopher Thomas Carlyle, who denounced him as a "coiner," a gambler and a bully in the 1851 *Punch* article *Hudson's Statue*:

"You find a dying railway; you say to it, Live, blossom anew with scrip; — and it lives, and blossoms into umbrageous flowery scrip, to enrich with golden apples, surpassing those of the Hesperides, the hungry souls of men."

Hudson was a close friend of George Stephenson (at least until his political misdeeds began to catch up with him, at which time Stephenson attempted to distance himself from the "King.") He was also Stephenson's partner in some coal, iron and limestone quarry ventures in the Chesterfield area. From 1840 to 1845, Stephenson sat on the board of the York & North Midlands Railway, one of the many lines controlled by Hudson. By 1844, those companies operated 1,016 miles (1,625 km) of track built on Stephenson's gauge, Hudson had a vested interest in ensuring his lines were not obliged to undertake the capital expense of converting their rights of way and rolling stock to the Brunel gauge.

Monarchs and magistrates are seen paying homage to "Railway King" George Hudson in this 1845 cartoon published in *Punch*. Although he was universally distrusted by the British press, Hudson managed to retain his political power in the face of public criticism, to the point that friends rallied to help pay his debts and secure his release from prison. Many attempted to erect a statue in his honour.

The two men moved in high circles, as this biography of Queen Victoria's reign observed:

"The great man of 1845 was Hudson the railway speculator, "the Railway King." Fabulous wealth was attributed to him; immense power for the hour was his. A seat in Parliament, entrance into aristocratic circles, were trifles in comparison. We can remember hearing of a great London dinner at which the lions were the gifted Prince, the husband of the Queen, and the distorted shadow of George Stephenson, the bourgeois creator of a network of railway lines, a Bourse of railway shares; the winner, as it was then supposed, of a huge fortune. It is said Prince Albert himself had felt some curiosity to see this man and hear him speak, and that their encounter on this occasion was prearranged and not accidental."

The "great man" soon met his downfall, when a parliamentary committee began investigating his business practices, and found Hudson habitually bribed other Members of Parliament in order to secure favorable terms for his railways. Before long Hudson found himself in York prison for non-payment of debt stemming from his stock trading practices. It is interesting to note Hudson also held considerable influence in the affairs of Whitby - Robert Stephenson's riding - building several streets of houses in the town, one of which is named after him. No doubt he also played a role in helping the younger Stephenson get elected. George Stephenson had his own stable of friends in high places, even in retirement, as Thurston noted in 1878:

"His son had now entirely relieved him of all business connected with railroads, and he had leisure to devote to self-improvement and social amusement. Among his friends he claimed Sir Robert Peel, his old acquaintance, now Sir William, Fairbairn, Dr. Buckland, and many others of the distinguished men of that time."

Peel was the Home Secretary when the Liverpool & Manchester Railway opened, and Prime Minister when the Gauge Commission held its inquiry.

The only witnesses who might have been expected to testify in support of the Great Western, were Brunel, Seymour Clark (the GWR's superintendent of traffic), Richard Down (contractor on the broad gauge Bristol & Exeter Railway), Gooch, and Charles Saunders, the secretary of the GWR. Most of the other witnesses were either colleagues of the Stephensons, or worked on a railway with which they had been associated.

This is not to suggest Brunel was deprived in any way of getting his views across. He was an able orator in his own right, as John Pudney noted in his 1976 work *Brunel and his World*, quoting a witness to Brunel's abilities as the engineer presented his arguments in favor of establishing the Great Western to a parliamentary committee in the early 1830s:

"The committee room was crowded with landowners and others interested in the success or defeat of the Bill, and eager to hear his evidence. His knowledge of the country surveyed by him was marvelously great, and the explanations he gave of his plans, and answers to questions... showed a profound acquaintance with the principles of mechanics. He was rapid in thought, clear in his language, and never said too much, or lost his presence of mind."

In fact, Brunel had political connections of his own. His brother-in-law was Benjamin Hawes, the Conservative MP from Lambeth (1836) who later became under secretary of state for the colonies (1846), and author of the ambiguous letter which Nova Scotia's Joe Howe mistook as expressing Imperial support for a rail link between Halifax, Saint John and Boston.

As it was, even though the commission found Brunel's seven-foot gauge to be superior to the Stephenson gauge, it recommended adoption of the narrow gauge simply because so many lines in England had been built on the Stephenson's practice, made sublime by the Rainhill victory. The commission noted:

"...that as to the safety, accommodation and convenience of the passengers, no decided preference was due to either gauge; that with respect to speed the advantage was with the broad gauge; that in the commercial case of the transport of goods, we believe the narrow gauge to possess the greater convenience, and to be more suited to the general traffic of the country; that the broad gauge is the more costly..."

The report concluded:

"Therefore, estimating the importance of the highest speed on express trains for a comparatively small number of persons – however desirable it may be to them – it is of far less moment than affording increased convenience to the general traffic of the community - we are inclined to regard the narrow gauge as that which should be preferred for the general convenience."

It is important to note that the commission based its decision not on the technical merits of either gauge - although it certainly heard enough evidence from both sides - nor did it consider the merits of any intermediate gauge, but leaned heavily upon the "convenience" of what had apparently already become the *de facto* standard of railway engineering at the time.

The Gauge Act was given Royal Assent on August 18, 1846. The Great Western was not compelled to change immediately, although the cost of conversion spread over the 40 years was still significant. A point often missed by popular histories, is that the difference in mileage between the two gauges was less than 300 miles (480Km). At the time of assent, the Great Western operated 1,901 miles (3,041 km) of track, and the Stephenson gauge of the various other railways totaled 2,176 miles (3,481 km). Almost half of that mileage was controlled by Hudson's interests.

Once again the Stephensons had triumphed when they had not proven their superiority, once again the poisoned tree had borne fruit.

In the United States, Stephenson's gauge found a champion in the Baltimore & Ohio Railroad, which ran its own Rainhill-like trials in 1831, offering a $4,000 prize to the winner. This was perhaps an attempt to emulate the financial success of Rainhill as much as it was to determine what kind of locomotive would run on the B&O's track. Unlike the Rainhill stipulations - which automatically assumed the competitors would build to Stephenson's gauge - the B&O was quite definite in its preference:

"The flanges are to run on the inside of the rails. The form of the cone and flanges, and the tread of the wheels, must be such as are now in use on the road. If the working parts are so connected as to work with the adhesion of all the four wheels, then all the wheels shall be of equal diameter, not to exceed three feet; but if the connection be such as to work with the adhesion of two wheels only, then those two wheels may have a diameter not exceeding four feet, and the other two wheels shall be two and a half feet in diameter, and shall work with Winans's friction-wheels, which last will be furnished upon application to the company. The flanges to be four feet seven and a half inches apart, from outside to outside. The wheels to be coupled four feet from center to center, in order to suit curves of short radius."

The competition was described by Brown as having attracted...

"...an odd collection of four or five original American ideas, of which it is much to be regretted that photographs and indeed detailed drawings have not been preserved. Among these was a rotary engine, by a Mr. Childs, which, I believe, never made a revolution of its wheels, certainly not in the form of the locomotive. The engine which took the premium was built by Mr. Phineas Davis, which was the model for those built after it for three or four years."

British historian John Westwood (*The Pictorial History of Railways*, Bison Books, 1988) takes a different perspective on the U.S. gauge question:

"The coexistence in some parts of the United States of 4-foot 8 ½-inch, 4-foot 10-inch and 5-feet gauges was just as much an obstacle to low-cost long-distance transportation as the coexistence in Britain of the standard 4 feet 8 ½ inches with the GWR's 7 feet. It is quite likely that, left to themselves, the British and American companies would have never agreed on a standard gauge...

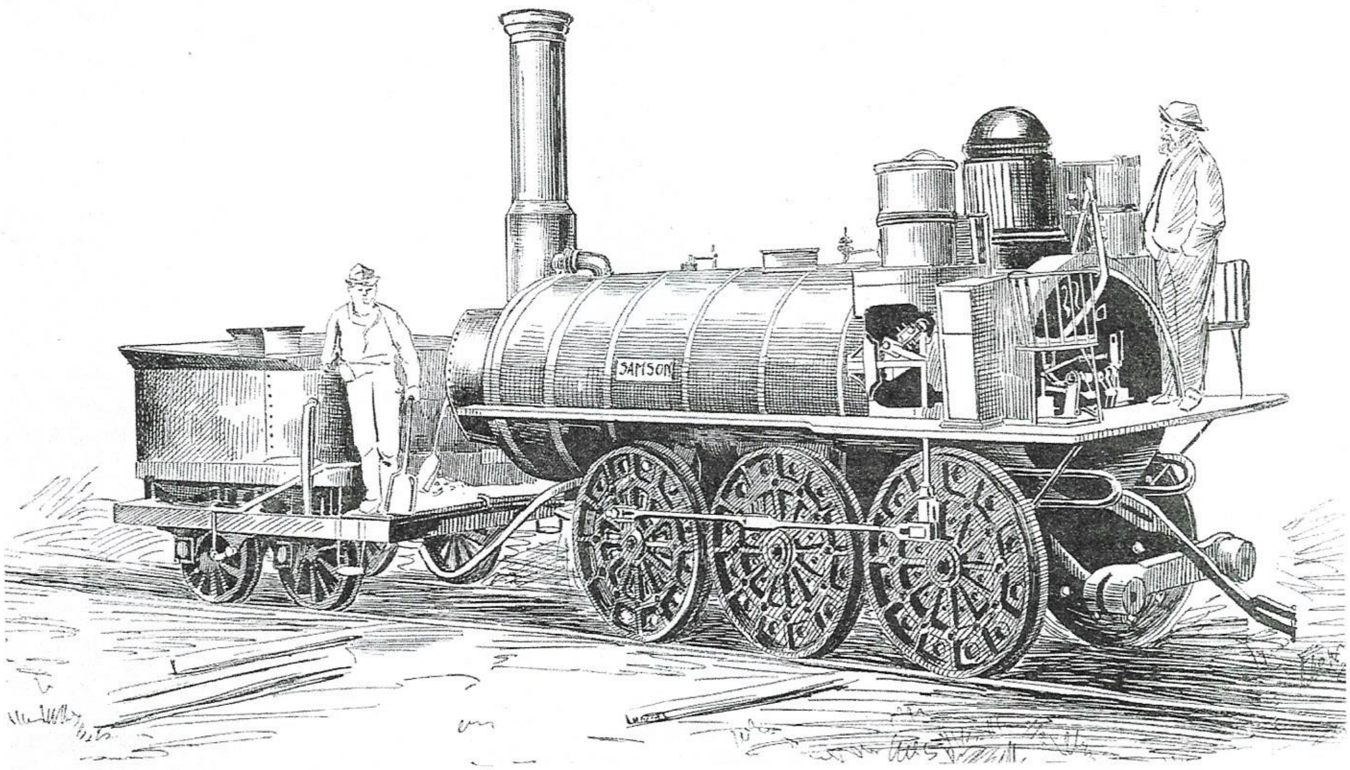
...In the United States a final decision on gauge came later, and standardization resulted not from governmental coercion, but from the federal choice of 4 feet 8 ½ inches for the first transcontinental railroad. This gave standard gauge a valuable seal of approval at a time when it was used on barely 50 per cent of Unites States mileage."

The gauge question took a different route in the British North American colonies. The first Stephenson gauge line to open was the Albion Rail Road, a coal mining operation owned by the General Mining Association of London, in Nova Scotia's Pictou County. Ironically, the first three locomotives delivered to the mine's six-mile (10Km) route were built by Timothy Hackworth. *Samson* remains today, in restored condition, at the provincial museum built on the site of the GMA's original mine.

The narrower gauge did not gain much acceptance in the colonies. In July of 1851, just three years after the mother country adopted Stephenson's gauge, the united province of Canada (now Ontario and Quebec) adopted the 5' 6" Provincial gauge as its standard. This gauge had been recommended to the legislatures of Canada, New Brunswick and Nova Scotia by Major William Robinson of the Royal Engineers in 1848, after he surveyed the route for a possible intercolonal railway from Halifax to Quebec City.

Warning against the dangers of building a "cheap" railway, and using some American railways as examples, Robinson noted:

"The whole of that part of British North America through which this line is intended to be run, being as yet free from railways, the choice of gauge is clear and open.



Locomotive *Samson* of the Albion Railroad was built by Timothy Hackworth in 1838. This drawing shows it in 1893 when it was at the World's Columbian Exposition in Chicago as part of the exhibit of the Baltimore & Ohio Railroad. It returned to Nova Scotia in 1927 and is preserved. *World's Columbian Exposition Illustrated Journal*, May 1893.

Without entering into and quoting the arguments which have been adduced in favor of the broad or narrow gauge of England, as it is more a question of detail than otherwise, it will be deemed sufficient for the present report to recommend an intermediate gauge. Probably 5 feet 6 inches will be the most suitable, as combining the greatest amount of practical utility with the least amount of increased expenditure.

With the object of proceeding on to the consideration of expense of construction, the proposed trunk line will be supposed to have a single track with one-tenth additional for side lines and turn outs, to have rail 65 lbs. to the yard, supported upon longitudinal sleepers with cross-ties, similar to the rail used upon the London and Croydon line, the wood to be prepared according to Payne's process, to have a gauge of 5 feet 6 inches, and as a principle, the top of the rails to be kept above the level of the surface of the ground, at a height equal to the average depth of the snow."

American railway promoters were perfectly happy with the cheaper narrow gauge, as Brown noted in 1871:

"In England the roads were virtually straight, or with very long curves; but in America they were full of curves, sometimes of as small a radius as two hundred feet. There was not capital enough in the United States applicable to railroad purposes, to justify engineers in setting Nature at defiance in their construction. If a tunnel through a spur could be saved, in an American railroad, by a track round it, the tunnel would be avoided, and a circuitous route adopted, although the distance was increased for miles in consequence; so, if embankments could be saved by heading valleys in place of crossing them, it was done."

One reason Robinson recommended a broader gauge was that his line was intended to have a military purpose - the movement of troops and munitions from Halifax to the Canadian interior in winter. As such, the railway needed to be able to transport heavy equipment like cannons and shot as quickly as possible.

The eventual result of the adoption of the Provincial gauge, was to oblige the Great Western Railway of Canada to lay a third rail on the Stephenson gauge, in much the same way as Brunel's Great Western in England would lay a third rail to run mixed gauges for more than 40 years after the adoption of Standard gauge. The Canadian Great Western preferred to build on the Stephenson gauge. Testifying before the legislature's railway committee in 1851, Robert William Harris, president of the company gave the following reasons:

"First, its established character; second, the saving of money in the superstructure (ties and rails requiring extra strength for broader gauge); third, saving of expenses in running machinery, for all time to come; and fourth, to form an easy and economical junction with the railroads of Michigan and New York, from which the company expect to receive very large additions to the traffic on their road, a considerable portion of which is expected to follow a Trunk Line through the Province to Montreal."

It must be noted, however, that the Great Western's investors included directors of the New York Central Railroad. The committee heard a great deal of contradictory testimony from some very credible witnesses.

Erasmus Corning, chairman of the Utica & Schenectady Railroad, spoke in favor of the Stephenson gauge, for its ease of interchange with American lines, but he admitted the relative advantages of each gauge depended upon the ability of the roadbed to sustain the weight of cars and engines. This was certainly true, and a telling condemnation of the American proclivity for building "cheap" railways.

H.C. Seymour, state engineer of New York, acknowledged the difficulties caused by transshipment between lines of differing gauge, but suggested all objections to the broader gauge had been refuted by actual experience.

John A. Roebling (builder of the Niagara and Cincinnati suspension bridges, and later the Brooklyn Bridge) told the committee the Stephenson gauge was likely to be the safer of the two, but he supported the broader gauge because it allowed for the construction of wider passenger cars. He also noted the Great Western should be allowed to remain on the Stephenson gauge because it formed a rival route between New York and Chicago to the New York & Erie Railroad, which would be of great importance to U.S. shippers, and the principal investors of the Great Western.

Thomas Rogers, of Patterson, New Jersey, the celebrated locomotive builder who might be suspected of having a vested interest in the construction of Stephenson gauge engines, gave several practical objections to that gauge, most notably the increased demand for trains of higher speed.

John Kilally, then engineer for the province's public works department, testified the broad gauge should be chosen because several miles of it had already been built on the trunk line between Toronto and Montreal. Kilally rejected the transshipment argument saying cars would always have to be changed at the border. In this respect his judgment ultimately proved to be faulty.

The committee, led by John A Macdonald (who would become the first Prime Minister of the new Dominion in 1867), decided in favor of the Provincial gauge on July 31, 1851. The principle of the Provincial gauge was enshrined in the colony's Guarantee Act of the same year, designed to offer subsidies to railway promoters.

Clearly, what Messrs. Stephenson thought held less sway with Canadian politicians than it did with their British counterparts. By the time the gauge question was being asked in Canada, however, the Stephensons had begun to lose their political clout in Great Britain, beginning with George's death in 1848 and culminating in Robert's failure to be re-elected in Whitby in 1857 (he would die in 1859), and Hudson's fall from grace in 1859.

The Provincial gauge decision was still being questioned as late as 1871, by James and Edward Trout, in their work *The Railways of Canada*:

"*We incline to think that the weight of the evidence was in favor of a four feet eight and a half inch gauge, while that of five feet six was adopted. Even Mr. T.C. Keefer* [the noted canal and railway engineer] *did not venture to suggest a greater breadth than five feet while expressing the opinion that time would vindicate the sufficiency of the narrow gauge, and most of the authorities to which he referred, including that of Robert Stevenson* [sic] *were in favor of the narrow gauge.*"

In the same year, the Toronto *Globe* (October 4, 1871) made a lengthy comment on the subject of an article in *Herapath's Railway Journal* on the gauge question:

"*The general tenor of the article is of course what might naturally have been expected from an organ of the Grand Trunk Railway. The article points out that while there is not a straw's difference between the working expenses, the cost of construction must be materially less for the narrow than for the broad gauge, and concluded that "not a very wise and economical course" will have been adopted by the Canadian Government if it builds the Intercolonial on the broad gauge, and then afterwards the Pacific on that of the 4 feet 8 ½ inches. Notwithstanding that the adoption of the broad gauge for the Intercolonial renders it a 'feeder" for the Grand Trunk Railway.*"

The journal had argued that should the Intercolonial change its gauge to the Stevenson gauge, the federal government should pay the Grand Trunk for the expense of changing its gauge from broad to standard. The journal, noting the GTR had already planned to change the gauge on a portion of its Buffalo and Lake Huron branch, went on to suggest:

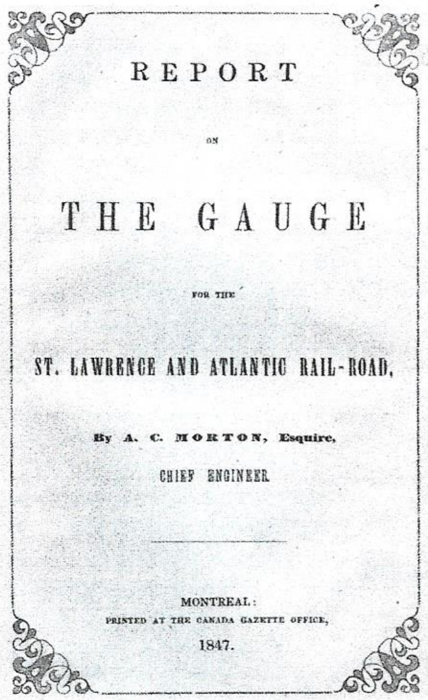
"*...as to the greater part of the Grand Trunk, unless the Canadian Government sustain the burden of of gauge alteration the Grand Trunk will not, we feel assured, spend a pound in change of gauge. A committee of Canadian parliament in 1851 decided in favour of the 5 feet 6 inch gauge, and therefore upon the Canadian Government rests the responsibility of the adoption of broad gauge. If a change is wanted, let the Government bear the expense.*"

The *Globe* bridled at this notion, observing:

"*We have always contended that in the selection of route as in the choice of gauge of the Intercolonial railway, the Dominion Government acted disastrously for the best interests committed to their charge; and so general had this impression become that last session they were saved but by a paltry majority of one from a defeat on the latter question. To argue, however, that by reason of now changing the gauge of the Intercolonial to four feet eight-and-a-half inches the country assumed the responsibility of changing the entire gauge of the Grand Trunk Railway is simply absurd.*"

The newspaper noted the Grand Trunk had already decided upon a change of gauge for its own commercial purposes:

"*Already a change of gauge has been decided on for one portion of the line, and if an equal necessity should arise for a similar change to be made over the whole line, we presume that it will be made.The projected railway from Riviere du Loup to Fredericton, N.B. — taking that short route which should at this time be occupied by the*


REPORT

ON

THE GAUGE

FOR THE

ST. LAWRENCE AND ATLANTIC RAIL-ROAD,

By A. C. MORTON, Esquire,

CHIEF ENGINEER.

MONTREAL:

PRINTED AT THE CANADA GAZETTE OFFICE,

1847.

A.C. Morton, Chief Engineer of the St. Lawrence & Atlantic, was a strong advocate of the 5' 6" gauge. This 1847 report explains why the St.L&A, and its U.S. counterpart the A& St.L, adopted the wide gauge despite the act of 1846 which recommended (but did not require) a gauge of 4' 8 1/2".

Intercolonial — is to be built on the American gauge, and if the Grand Trunk Railway wishes to constitute it in any way a "feeder" to its own line, it will be formed at any rate to make its cars "convertible." This may, to a certain extent, solve the whole question, in a slipshod way.

It is impossible to discuss seriously the proposition submitted by a Ministerial Journal — that the Government should adopt the narrow gauge on the Intercolonial, and expend the amount thus saved in placing a third rail on the Grand Trunk. Both matters must be decided on their respective merits. The neat operation proposed is far too susceptible of jobbery for it ever to gain general approval. The only real way in which the matter can be effectively disposed of is by at once altering the gauge of the Intercolonial to 4 feet 8½ inches, and then leave the Grand Trunk to do as it pleases in the matter. If it chooses to lose so important a "feeder" by still continuing its wide gauge it will, of course, do so. That it will not persist in doing so is certain.

There is too wide-spread a belief in the corruption and mismanagement which has hitherto characterized the financial dealings of the Grand Trunk, for the Government of Canada, no matter how reckless it may be in other matters, ever to have the hardihood to propose that any more of the country's money should be handed over to it. Apart from all other aspects, Mr. Brydges has a too well-known penchant for jobbery for the general public ever to see with unconcern money from the national exchequer go into his hands for the propping up of his 1,400 miles of crash-ups and smash-ups. The idea will not bear discussion. A general change of gauge to the 4 feet 8½ inches standard will, we doubt not, at some time take place. The Canadian Pacific and the New Brunswick roads will be built on it; the Intercolonial should be changed to it at once; the Northern and other roads will very shortly follow; and if the Grand Trunk alone desires petulantly to be left out in the cold, it will be its own fault. Of a certainty, the tax-payers of Canada cannot be expected to contribute another cent to a road on which they have already laid out so much, and which treats them so ill in return."

On July 15, 1853, the Grand Trunk Railway was incorporated by the amalgamation of the Grand Trunk Railway of Canada, Grand Junction Railway, Grand Trunk Railway Company of Canada East, Quebec & Richmond Railway, St. Lawrence & Atlantic Railway and the Toronto & Guelph Railway. The Provincial gauge line between Montreal and Toronto was opened October 27 1856.

In the meantime, Nova Scotia had opened its own portion of the proposed Halifax-Quebec railway as the Nova Scotia Railway, between Halifax and Truro, also using the Provincial gauge, and intending at some later date to link with the Grand Trunk at Quebec City. The scope of the change of gauge in 1875 need not be imagined; Ivan Smith makes it clear in the notes on his extensive web site (www.alts.net/ns1625/nshist06.html) of Nova Scotia history:

"Beginning in the evening of Wednesday, June 30, 1875, and continuing through the night, many work crews accomplished the task of changing the gauge of the Windsor and Annapolis Railway, between Windsor Junction and Annapolis, from 5 feet 6 inches [167 cm] *to 4 feet 8½ inches* [143.5 cm]. *This was a complicated job, which included changing all track and all switches to the new gauge. Extensive preparations had been made in advance; a spike was driven inside to the new gauge on every other tie and inside spikes were pulled from alternate ties of the broad gauge, so that when the time came to make the change it was only a matter of removing the remaining inside spikes on the broad gauge and sliding the rail over to the new gauge, and driving new outside spikes on every other tie. Only one rail was moved, with the other remaining in its original location".* Marguerite Woodworth, in her 1936 book History of the Dominion Atlantic Railway, wrote: *"The whole work was done in a little over ten hours, with no disruption of train service." After trains resumed running on the new gauge, track crews went back and completed the work by driving all missing spikes. All rolling stock, including locomotives and freight and passenger cars, had to be converted to run on the new gauge. The Dominion Government exchanged the old, broad-gauge locomotives for nine standard-gauge engines, and, in exchange for similar quantities of broad gauge equipment, the Government provided 14 pairs of standard gauge passenger trucks and 145 pairs of freight car trucks. Rolling stock was converted at Kentville by lifting each car, then removing the old broad-gauge trucks, and placing new standard-gauge trucks."*

North Americans (and the British for that matter) would do well to remember, however, that what they call the Standard gauge is not necessarily the international standard. It is claimed that at least 27 gauges are in use on the world's railways. Indeed, the Provincial gauge, although no longer in use in Canada, still exists in Argentina, Chile, India, Pakistan and Sri Lanka. Australia, Brazil and Ireland still have lines built on the 5' 3" (1.60 m) gauge, and the Russian and Finnish railways operate on the 5' (1.52 m) gauge.

Safely insulated from the influence of the Stephensons and Hudsons of the British railway world, other railways were not so enthusiastic about using the Stephenson gauge.

In Russia, the adoption of the five foot gauge was achieved through less democratic measures than a parliamentary commission. Despite the fact that Stephenson locomotives were among the first imported for Czar Nicholas I's Tsarkoseloye railway (1837), linking his palaces at St. Petersburg (then the imperial capital) to his holiday residence 15 miles (24 km) away, and that at least two other lines had been built in the intervening period, the Czar was persuaded by his American engineer George Washington Whistler (1800-1849), to use the five foot gauge on the St. Petersburg-Moscow railroad when construction began in 1846. The line opened in 1851.

Whistler, a graduate of the West Point military academy, had previously surveyed the Western Railroad (incorporated in 1833) from Worcester, Massachusetts the State Line to New York, to connect Boston with the Erie Canal. He was given the challenge of engineering the route through the Berkshire Mountains. [He was also the father of the well known artist James McNeil Whistler whose painting "Whistler's Mother" is world famous].

The five-foot gauge became the standard by royal decree, and was used when the TransSiberian railway was begun in 1891, but this did not prevent smaller, privately-built Russian lines from adopting narrow gauges.

The Stephenson gauge might have gained favor in Spain had George Stephenson shown more enthusiasm for the region. He lost his opportunity to influence the Spanish, however, when he wrote his famous 29-word report on the potential for railways there in 1845:

"I have been a month in the country, but have not seen during the whole time of that enough people of the right sort to fill a single train."

One can only wonder what Stephenson meant by "the right sort" of people. As it happened, royal decree was also used to establish the Castilian gauge of five foot six inches (equal to the Canadian Provincial gauge) in 1844. This was also a strategic move by the Spanish to prevent French railways from making direct connections into the Iberian Peninsula; such was the measure of distrust between the two nations. The Portuguese were not long in following suit, with conversion of the Stephenson gauge Eastern Railway in 1861, and the Southern Railway in 1864.

This is not to suggest the British influence was lacking in Portugal. On May 13, 1853, a contract between the government and British engineer Hardy Hislop, director and representative of the Peninsular Central Company, was signed for the construction of a railway from Lisbon to the Spanish border, passing through Santarém. This line was built on the Castilian gauge.

With British military engineers so involved in the construction of railways in India, Sri Lanka (formerly Ceylon) and Pakistan, it is little wonder the Provincial gauge would find favor in that part of the empire. Indeed, as construction of many of the British North American railways got underway according to the Robinson recommendations of 1848, the first railway on Indian sub-continent opened over a 21-mile (33 km) stretch from Bombay to Thane. As the web site (www.indianrailway.com/railway/history.html) of Indian Railways notes:

"The idea of a railway to connect Bombay with Thane, Kalyan and with the Thal and Bhore Ghats inclines first occurred to Mr. George Clark, the Chief Engineer of the Bombay Government, during a visit to Bhandup in 1843. The formal inauguration ceremony was performed on 16th April 1853, when 14 railway carriages carrying about 400 guests left Bori Bunder at 3.30 pm "amidst the loud applause of a vast multitude and to the salute of 21 guns."

The Indian railways spread quickly, and although the meter gauge and two other narrow gauges were used in mountainous areas, the five foot six inch width became the standard without having been designated by any governing authority, as the Indian Railways web site notes:

"In south the first line was opened on Ist July, 1856 by the Madras Railway Company. It ran between Veyasarpandy and Walajah Road (Arcot), a distance of 63 miles. In the North a length of 119 miles of line was laid from Allahabad to Kanpur on 3rd March 1859. The first section from Hathras Road to Mathura Cantonment was opened to traffic on 19th October, 1875."

At no time, it seems, did the colonial British feel obliged to follow the conventional wisdom of the Stephensons at home, or in the American colonies, and even today, under what the Indian government calls "Project Uni-gauge," the five foot six inch gauge is triumphing where it failed in North America:

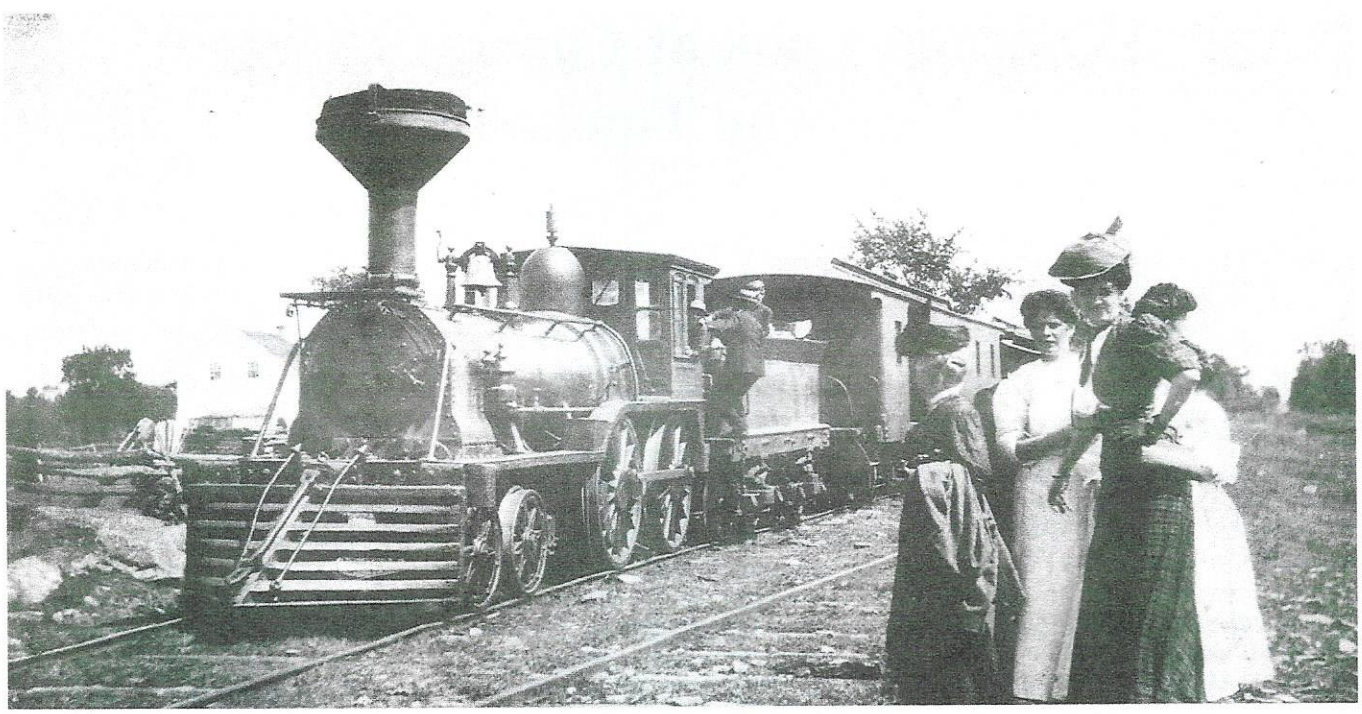
"Project uni-gauge has been undertaken to develop alternative routes to connect important places with the broad gauge network, develop backward regions and avoid problems faced at transshipment points. During the Eighth Plan, 6,733 km of meter and narrow gauge track were converted. In the Ninth Plan, conversion of another 6,200 km has been planned."

A different approach was taken in Ireland, where the Stephenson gauge was the first adopted. It did not meet with the political approval it enjoyed in England, and compromise appeared to be out of the question, as Mike Irlam's web site (www.railhistory.f9.co.uk/home.html) history notes:

"The first three railways had lines of three different gauges, the dimensions being : Dublin and Kingstown Railway, 4 ft. 8½ in.; Ulster Railway, 6 ft. 2 in.; Dublin and Drogheda Railway, 5 ft. 3 in. According to one legend, the engineers of the Ulster Railway and those of the Dublin and Drogheda line deliberately planned the tracks on different gauges, so that if two lines ever met, neither company could use the rolling-stock of the other."

The six-mile long Dublin & Kingstown Railway was constructed by William Dargan, and opened on December 17, 1834. Durgan consulted with George Stephenson on the design of the railway, but it is clear the name of Stephenson did not hold the same weight it had in England, as Irlam notes:

"A Royal Commission was set up to report on the muddle, with the result that the width of the Irish gauge was fixed at 5 ft. 3 in. The gauge of the Ulster Railway was altered about 1846, and that of the Dublin and Kingstown Railway in 1857, the alteration costing the latter company £38,000."



The last Provincial gauge railway in Canada was the Carillon & Grenville, which did not connect with any other line. It continued to use 1850s equipment until it was abandoned in 1910. This view dates from the 1890s.

The "commission" was headed by Major General Charles William Pasley of the Royal Engineers, on behalf of the Board of Trade. Irish legend claims Pasley effected the ultimate compromise, simply halving the difference between the narrow (Stephenson) gauge and the Ulster Railway (the broadest of the three). In fact, since Irish railways were built more for the transport of passengers than freight, his prime consideration may have been the broad gauge's ability to carry people in more comfort, while the Dublin & Drogheda Railway had the greater length of track.

In *Outline of Irish Railway History* (David & Charles, 1974), H.C. Casserly maintains the Stephensons were consulted by Pasley:

"The Stephensons suggested as a compromise for Ireland something between 5 ft. 0 in. and 5 ft. 6 in., whereupon the major-general came up with the discovery that the average between the two figures was exactly 5 ft. 3 in., and this was the figure which was decided upon."

In doing so, the engineer unwittingly validated the benefit of the broader gauge so readily dismissed by the Gauge Commission:

"The little extra width in most Irish coaches makes an appreciable difference in comfort to the four-a-side arrangement in main-line coaches, both of the side corridor and center gangway type."

Australia's experience proved to be an even more tangled web than Ireland, best described by Westwood:

"Australia was less fortunate. The British government, bearing in mind the trouble experienced with the Great Western broad gauge at home, was anxious that each of the colonies in Australia should have the same gauge. Australia's first railway, from Melbourne to Port Melbourne, was of the 5-foot 3-inch gauge, whereas the second, from Sydney to Parramatta, was 4 feet 8 ½ inches. The New South Wales administration was persuaded to change to 5 feet 3 inches, but before doing do it reduced the salary of its chief engineer, who resigned. His successor, from England, was a strong supporter of the 4-foot 8 ½-inch gauge and persuaded the New South Wales government to continue with that gauge. Any hope of a standard gauge in Australia was thereby lost. Later, Western Australia and Queensland chose three feet six inches, South Australia stayed with adjacent Victoria on the 5-foot 3-inch gauge while Tasmania, starting with 5 feet 3 inches for its Launceston to Deloraine line in 1871, soon changed its mind and adopted 3 feet six inches."

Australia did not come close to adopting the Standard gauge until 1960.

The evidence presented here is admittedly circumstantial, but it is also substantial, and compelling enough to allow the conclusion that North America adopted the wrong gauge for the wrong reasons, and that the merits of a broader gauge deserve review.

As the railway industry seeks ways to compete with the surface and airline modes for both freight and passenger business, it seems broad gauge offers the greater advantages of increased loads and more comfortable passenger accommodation at higher speeds.

If a link with European and Asian rail systems by way of an Alaskan-Siberian tunnel, an idea that has been vaunted at several times in the past, comes to fruition it could mark the next engineering milestone in the development of the North American railway system. However the Stephenson gauge, whether or not it is the "fruit of a poisoned tree", is here to stay and any connection with the Russian railways will have to contend with that fact.