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## The “Evil” of Railway Gauge Breaks: A Study of Causes in Britain, India, Japan, and Manchuria

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**The “Evil” of Railway Gauge Breaks:  
A Study of Causes in Britain, India, Japan, and Manchuria**

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Thesis in History  
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## Thesis Introduction

This thesis is about train gauges, but it begins with a story about tires. On February 24, 2022, Russia launched an invasion of Ukraine as part of Vladimir Putin's campaign to rebuild the Russian empire. The United States was so convinced that Kyiv would fall within weeks, if not days,<sup>1</sup> that it offered Ukrainian President Zelensky assistance in fleeing the capital, to which Zelensky is reported to have replied, "The fight is here; I need ammunition, not a ride."<sup>2</sup> Lost in the widespread expectations of a quick Russian victory were a handful of 'tire guys' on Twitter who argued that the Russian army would never reach Kyiv because the wheels on its vehicles were much too old and/or poorly maintained to travel off-road through mud as needed. They showed authenticated images of flat tires, some old enough to have "USSR" imprinted on them, and argued that the abysmal state of Russian tires suggested the military was badly compromised, probably by corruption, poor leadership, poor maintenance of its equipment, and terrible training.<sup>3</sup> Military analysts dismissed their conclusions,<sup>4</sup> only to find themselves agreeing months later that the Russian military's performance was "shambolic" and citing many of the same reasons offered by the tire guys a week into the war.<sup>5</sup>

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<sup>1</sup> Jim Sciutto, "US concerned Kyiv could fall to Russia within days, sources familiar with intel say," *CNN*, February 25, 2022, <https://www.cnn.com/2022/02/25/politics/kyiv-russia-ukraine-us-intelligence/index.html> (accessed January 29, 2023).

<sup>2</sup> Glenn Kessler, "Zelensky's famous quote of 'need ammo, not a ride' not easily confirmed," *New York Times*, March 6, 2022, <https://www.washingtonpost.com/politics/2022/03/06/zelenskys-famous-quote-need-ammo-not-ride-not-easily-confirmed/> (accessed January 29, 2023).

<sup>3</sup> Peter Weber, "How cheap Chinese tires might explain Russia's 'stalled' 40-mile-long military convoy in Ukraine," *The Week*, March 3, 2022, <https://theweek.com/russo-ukrainian-war/1010857/how-cheap-chinese-tires-might-explain-russias-stalled-40-mile-long> (accessed January 23, 2023). Retired military specialist Trent Telenko noted, "Military trucks need to be turned over and moved once a month for preventative maintenance reasons." He added that otherwise the "side walls get rotted/brittle such that using low tire pressure setting for any appreciable distance will cause the tires to fail catastrophically via rips."

<sup>4</sup> Eric Tegler, "Have Flat Tires and Ukraine's Mud Season Stalled the Russian Column Outside Kyiv?," *Forbes*, March 6, 2022. <https://www.forbes.com/sites/erictegler/2022/03/06/have-flat-tires-and-ukraines-mud-season-stalled-the-russian-convoy-outside-kyiv/?sh=41e9ad3861e2> (accessed January 23, 2023).

<sup>5</sup> Max Bergmann, "What Could Come Next? Assessing the Putin Regime's Stability and Western Policy Options," *Center for Strategic & International Studies*, January 20, 2023. <https://www.csis.org/analysis/what-could-come-next-assessing-putin-regimes-stability-and-western-policy-options> (accessed January 23, 2023).

The tire story is a reminder that small details can have huge implications, and a great deal of information can be deduced from a seemingly minor component of a much larger system. This is the case with the railroad gauge, defined as the width between two rails on a track. At a glance, the “Battle of the Gauges” seems like an insignificant historical footnote. However, this thesis argues that the study of gauge breaks can provide meaningful insight into why Britain and Japan differed so greatly in constructing their own railroads, differences that carried over into their approaches to overseeing the railway systems in India and Manchuria.

First, the thesis provides an overview of gauges and gauge breaks and examines how costly they might be to a system. The thesis next examines the earliest days of railroad construction in Britain to determine what factors led to the country’s gauge breaks, and whether any those factors impacted railway development in India. Britain built the world’s first railroads in the early 19<sup>th</sup> century, but the first tracks were built in different gauge sizes. This was mainly due to a localist approach, where both railway companies and Parliament considered the merits of each line one project at a time. Essentially railroads were seen either as “one-off” lines that ran between major hubs (i.e. cities and ports), or as spokes radiating out of a major hub to the minor hubs (i.e. trade towns). The concept of connecting the lines into a national network free of gauge breaks does not seem to have been a government priority until the 1840s. This type of localist thinking was aggravated by the fact that railroads were privately financed, so each company was in fierce competition with each other. Private financing also led to periods called “railway manias” where investors flocked to railroad companies and pushed Parliament to approve as many new railroads as possible, regardless of the lines’ location or gauge size. The popularity of *laissez faire* economics—the belief that competition in the free market would correct major issues—led to Parliament’s resistance to regulatory oversight. It was not until

British investors lost money in railroad companies that failed, and the public and businesses suffered the aggravation and cost of gauge breaks, that Parliament was pushed to act. The government finally began to consider railways as a national, rather than local, infrastructure project. The first major regulatory act affecting railroads was the standardization of gauges in 1846, although a gauge war continued between two sizes for another seventy years thanks to continued popularity in Parliament of *laissez faire* economics, with its pro-competition, anti-regulatory message.

The thesis then examines how, even though Britain had standardized its gauge by 1846, India became the country with the worst gauge break problem in the world—a problem that persisted until the 21<sup>st</sup> century. Indian railroads began under the watch of Governor-General Dalhousie, a man who envisioned a single-gauge national system for the country, which would be the broad gauge. However, less than a decade after he left office, Governor-General Lawrence introduced a second gauge—the meter, or narrow, gauge. As in Britain, financing and localism played major roles in Lawrence’s decision. Indian railroads were financed under guarantee contracts where the Government of India (GOI) guaranteed a five percent profit even if the company lost money. Losses would be covered by the Indian taxpayers. This disincentivized companies to keep costs low when constructing the railroads and led to investors being indifferent to any issues impacting the lines, especially since they were located thousands of miles away. When the GOI took over railroad construction under Lawrence, it decided to build tracks in narrow gauge to save money. Lawrence and subsequent Governor-Generals returned to localism in how they viewed the railways. In other words, they returned to approving one line at a time regardless of whether it created transshipment points. But, the gauge break problem persisted largely because Indians had little to no influence in railway policy. Despite the high

turnover in senior levels at the GOI, the British decided all railroad policies while prohibiting Indians from holding senior positions, even as counselors. The Indians were even prohibited from manufacturing their own equipment, which could have resulted in tremendous cost savings. Unfortunately, the few Indians in leadership positions who might have pressured the British for reform, mainly those from the princely states, seemed to have the same localist approach to trains that helped create gauge breaks in the first place.

Next, the thesis turns to Meiji Japan, which seems to have absorbed the gauge break lessons from Britain, although it may not have had a choice. Again, financing mattered. In the 1870s, Japan did not have a sea of wealthy investors eager to speculate on new technology, and therefore, there was not many promoters pushing to open lines. The first Japanese railroads were financed by a loan from Britain, and the government had every incentive to ensure it was profitable. A default on the loan could lead the British to send its military to the country on the pretext of protecting its investment. To optimize the new railway system's efficiency, gauge breaks needed to be avoided. Moreover, the Meiji government seemed to have quickly realized the railways' potential as a symbol of national unity and progress, which was especially important during this period when the government was trying to forge a national identity. No records exist as to any debate about gauges; the government simply declared that all railroads would be constructed in the narrow (Cape) gauge. By the 1890s, when economic liberalism was spreading the Japanese had sufficient wealth and systems to support private investment in the railways, the government had established itself as the arbiter of national railway policy.

This thesis concludes by examining the impact of railway imperialism on train gauges in Manchuria, a region first informally occupied by the Russians and then the Japanese. Russia was the first imperial power to build railways in Manchuria with their Trans-Siberian Railroad

because of an arrangement with China after the Sino-Japanese War. In exchange for paying China's debt to Japan, the Chinese allowed Russia to establish the Chinese Eastern Railway Company (CER) in Manchuria which would connect the Trans-Siberian Railway to Vladivostok and Port Arthur on Russia's broad gauge, even though most Chinese railroads operated on standard gauge. China allowed the Russians to create an autonomous territory next to the CER called a Railway Zone, protected by its military, from which Russia had planned to informally expand its empire. During the Russo-Japanese War, Japan took over and converted the CER to narrow gauge military lines, which introduced a third gauge. After Japan won the war and received the southern portion of the CER, it formed the South Manchuria Railway (SMR) and followed Russia's path of railway imperialism. To facilitate trade with China and guard against future Russian aggression, Japan immediately changed all SMR track to standard gauge. Since the SMR was set up as a joint stock corporation owned by the Japanese government and Japanese investors, there was great incentive for the venture to succeed. This meant the government kept tight control over railway policy.

Following an analysis of gauge breaks in Britain, India, Japan and Manchuria, the thesis concludes that whether a gauge break problem arose and was resolved largely depended on the following factors: how the railroad was financed; whether those overseeing a line's location and construction had a localist or nationalist view of railways; and whether the government exercised consistent oversight of railway policy. In India and Manchuria, different approaches to imperialism also impacted gauge decisions.

### **Gauge Basics and the Potential Cost of Gauge Breaks**

Before analyzing gauge break problems and resolutions in different countries, it is important to provide background information on gauge breaks and why they have been called

“evil.” The space between two wheels is called a gauge, and in the earliest days of railroad development, especially in North America and Britain, many different gauges existed. These include the Scotch narrow gauge (4’6”), Ohio gauge (4’10”), California gauge (5’), Canadian Grand Trunk gauge (5’6”), Irish gauge (6’2”), and Brunel gauge (7’¼”). It is estimated that by 1870, the U.S. had over twenty different gauges.<sup>6</sup> In this thesis, the term “standard gauge” refers to the 4’8½” gauge now used throughout much of the world, including in Britain, the U.S., Canada, Europe, and China.<sup>7</sup> Anything smaller is considered a “narrow gauge” and wider is called “broad gauge.” As shown in the map below (Image 1), there are eight gauges for the world’s major railways, often called trunk lines, although with rare exceptions (e.g. Spain and Japan), industrialized nations operate on a single gauge within their borders.

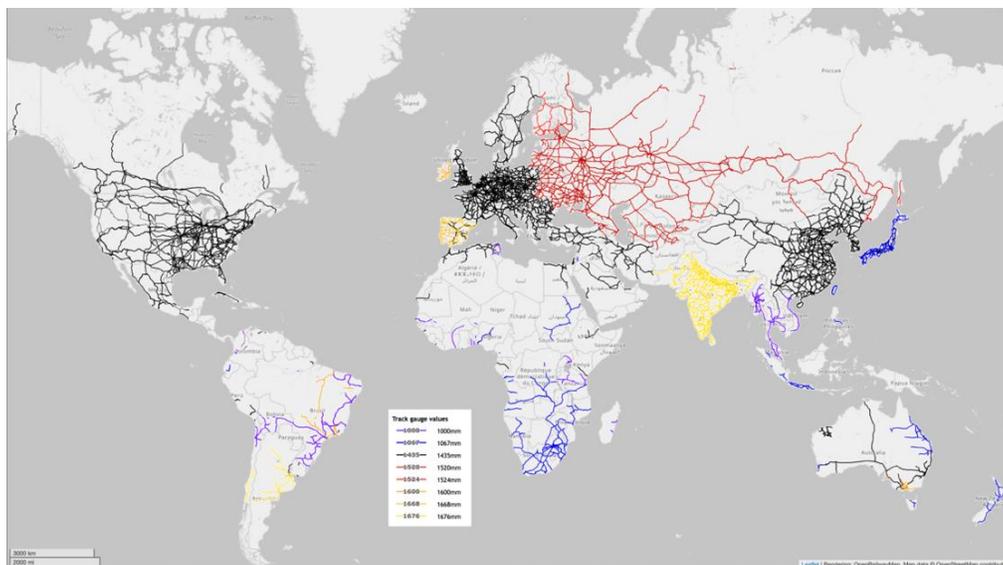


Image 1: 2022 World Railroad Gauge Map<sup>8</sup>

<sup>6</sup> “Standardization of American Rail Gauge,” Linda Hall Library: The Transcontinental Railroad, <https://railroad.lindahall.org/essays/rails-gauge.html> (accessed January 28, 2023).

<sup>7</sup> Approximately three-fifths of the world operates on the 4’8½” standard gauge, which is sometimes referred to as the international gauge, uniform gauge, normal gauge and, in Britain, the Stephenson gauge. See T. Editors of Britannica, “gauge,” *Encyclopedia Britannica*, April 6, 2018, <https://www.britannica.com/technology/gauge-railroad-track> (accessed April 20, 2023).

<sup>8</sup> Arnold Reinhold, “World RR Gauge Map.agr.png,” Open Railway Map, June 20, 2022, [https://commons.wikimedia.org/wiki/File:World\\_RR\\_Gauge\\_Map.agr.png](https://commons.wikimedia.org/wiki/File:World_RR_Gauge_Map.agr.png) (accessed April 11, 2023). This map suggests that countries that were not colonized developed a national gauge for ease of intra-border transportation

Since the mid-1800s, widespread consensus has been that gauge breaks are extremely inefficient and costly.<sup>9</sup> Lord Dalhousie, who headed Britain’s Board of Trade during the earliest ‘gauge wars’ and was also India’s Governor-General, was the first, but hardly the last, to refer to gauge breaks as “evil.”<sup>10</sup> While gauge breaks in Britain, India, Japan, and Manchuria are the subject of this thesis, it should be noted that the U.S. probably experienced more gauge breaks than any country in the world—at least twenty in the 19<sup>th</sup> century.<sup>11</sup> Moreover, economist Daniel Gross observes that during this period, “each break in gauge imposed a full-day delay on through shipments and necessitated significant labor and capital for transshipment, which at the time was performed manually, aided by cranes.”<sup>12</sup> In fact, some historians cite gauge breaks as a significant reason for why the South lost the Civil War,<sup>13</sup> observing that Confederate states operated on the broad gauge, while the rest of the U.S. rapidly switched to standard gauge during the war. “This disconnect kept much of the South isolated.”<sup>14</sup> Twenty years after the Civil War ended, railroad

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and trade extended to neighboring countries. For example, the standard gauge is used in the United States, Canada, Central America and most of Western Europe. Similarly, during the Soviet Union, Russia and most of its satellite countries used the broad gauge. Area for further study would be those regions with gauge breaks such as Australia, South America and Africa.

<sup>9</sup> For a summary of complaints about gauge breaks in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, see Frederick George Royal-Dawson, “The Indian Railway Gauge Problem” (Paper No. 4392), November 15, 1921, *Minutes of the Proceedings of the Institution of Civil Engineers*. Vol. 213 Issue 1922, 1922, pp. 15-55, <https://doi.org/10.1680/imotp.1922.14496>, (Accessed October 2, 2022), Ice Virtual Library, <https://www.icevirtuallibrary.com/doi/abs/10.1680/imotp.1922.14496>

<sup>10</sup> Atkinson, W., Giles, A., Leslie, Sir B., Lewis, Mosse, M., W.B., Shelford, W. and Williams, E.C.S. “Discussion of Indian Railways” from *Minutes of the Proceedings of the Institution of Civil Engineers*, Volume 97, Issue 1889 (1889) 154, <https://doi.org/10.1680/imotp.1889.20757>. Accessed October 2, 2022. <https://www.icevirtuallibrary.com/doi/abs/10.1680/imotp.1889.20757>

<sup>11</sup> “Standardization of American Gauge.”

<sup>12</sup> Daniel P. Gross, *Collusive Investments in Technological Compatibility: Lessons from U.S. Railroads in the Late 19<sup>th</sup> Century*, National Bureau of Economic Research, September 2019, [https://www.nber.org/system/files/working\\_papers/w26261/w26261.pdf](https://www.nber.org/system/files/working_papers/w26261/w26261.pdf) (accessed April 3, 2023), 6.

<sup>13</sup> “How The Railroad Won the War,” Smithsonian American Art Museum, <https://americanexperience.si.edu/wp-content/uploads/2015/02/How-the-Railroad-Won-the-War.pdf> (Accessed April 11, 2023).

<sup>14</sup> Ibid. This article also notes that in addition to gauge break issues, the South purchased most of its iron from the North, so replacing damaged lines became very difficult. When General Sherman marched through the South, he had his soldiers destroy tracks using the Sherman “necktie” method of heating the tracks and wrapping them around trees.

companies spent 36 hours changing 13,000 miles of Southern track from broad to standard gauge, which finally allowed the South to integrate with the rest of the country.<sup>15</sup>

The “transshipment point” is the location where a gauge break occurs, forcing the transfer of passengers and goods. After the Raj ended, Britain left India with 53 transshipment points on its railway system.<sup>16</sup> The image below (Image 2) is from the Hensley Collection showing workers loading freight cars in Calcutta in 1944. The photo suggests how slow and labor-intensive the transfer process could be, even halfway into the 20<sup>th</sup> century.



Image 2: Transferring coal from broad to narrow gauge<sup>17</sup>

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<sup>15</sup> Gross, *Collusive Investments*, 1.

<sup>16</sup> K. Murthi, “Battle of the Gauges on Indian Railways,” *The Economic Weekly*, April 25, 1953, 496, [https://www.epw.in/system/files/pdf/1953\\_5/17/battle\\_of\\_the\\_gauges\\_on\\_indian\\_railways.pdf](https://www.epw.in/system/files/pdf/1953_5/17/battle_of_the_gauges_on_indian_railways.pdf) (accessed February 1, 2023).

<sup>17</sup> Dipak Raychaudhuri, “History & Heritage of Indian Railways,” August 16, 2015, <http://dipakrc.blogspot.com/2015/08/kalighat-falta-railway-kfr.html> (accessed May 2, 2023).

Can one quantify just how costly and inefficient the gauge breaks are? Is it possible to put a number on their inefficiencies? It has proven difficult to locate historical data that quantifies gauge break costs in India, which probably would have studied the issue the longest, but two annual reports from the Cincinnati, New Orleans & Texas Pacific Railroad company cited gauge break expenses being \$32,365 (1884), which was 350% of the railroad's net income of \$9,210, and \$33,355 (1885), which was 21% of the railroad's net income of \$159,011.<sup>18</sup> Importantly, these expenses included the cost of hoists and laborers, but did not include "indirect" costs, including "extra switching engines, extra yard crews ... and delay to business."<sup>19</sup> There was also the problem of "damage and theft" at transshipment points as unloaded goods waited, sometimes for days, to be reloaded.<sup>20</sup>

Gross also analyzed gauge break costs in America by studying the conversion of 13,000 miles of tracks in the South in 1886, an event mentioned above. Specifically, he examined the levels of train and steamboat freight traffic, pre- and post-conversion, to determine whether the sudden and massive change in track gauge had an immediate impact on the region's trade, and whether it reduced the cost of rail shipments. Based on extensive mathematical calculations, Gross deduced that after the South switched from broad to standard gauge, rail traffic increased by about 50%, while steamship traffic decreased by around 30% on routes up to five hundred miles.<sup>21</sup> However, he could not quantify savings from standardization because most railroad companies had monopoly power and did not pass those savings onto customers. Rates for train freight remained "rigid," and companies may have justified not lowering prices because of the

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<sup>18</sup> The discrepancy is due to the fact that net income rose for the railway, meaning that expenditure on gauge breaks as a percentage of profits decreased. But, it is unclear why the income rose.

<sup>19</sup> Gross, *Collusive Investments*, 21-22.

<sup>20</sup> Royal-Dawson, 1922 Minutes, 43.

<sup>21</sup> Gross, *Collusive Investments*, 12-13.

high cost of the gauge conversion.<sup>22</sup> However, Gross notes that “evidence from railroads’ stock returns around the time of the event indicates that investors perceived large financial returns to standardizations.”<sup>23</sup>

Gross also suggests that historically, fixes to gauge break problems were rarely a good substitute for having a railway system that was free of transshipment points.<sup>24</sup> He writes:

By the 1870s, several adapter technologies had developed to reduce these costs, the most common of which was bogie exchange, whereby each rail car was raised by a steam-powered hoist, and its chassis (“bogie” or “truck”) replaced with one of a different gauge. Bogie exchange required not only steam hoists and extra labor for switching trucks, but also rail yards full of empty trucks of both gauges, sidetracks, extra buildings, and extra clerical workers, and although changing a single rail car took only a few minutes, a full train could take much longer and might have to wait for exchange facilities to become available. Bogie exchange also yielded a mismatched car and bogie, which damaged tracks, had to run at reduced speeds, and were at risk of tipping on curves. The true cost of incompatibility was thus considerably higher than the physical act of interchange alone  
....<sup>25</sup>

Finally, while this thesis discusses several instances where many miles of gauges were changed quickly, there are an equal number of examples when such a conversion was not undertaken for a variety of reasons, including cost, geography, and whether tracks were being converted from broad to narrow gauge or vice-versa. As a practical matter, it is much easier to narrow tracks than to widen them because broad gauge ties can accommodate a narrower gauge. For example, during World War I, German trains used standard gauge while Russia trains used broad gauge. When the Germans took over Russian tracks, they changed them to standard gauge and then cut off the ends of the railroad ties so that the Russians could not restore its broad gauge

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<sup>22</sup> Gross, *Collusive Investments* 14-15.

<sup>23</sup> Gross, *Collusive Investments*, 1.

<sup>24</sup> Other ways to work around the gauge break problem include transporter cars, adjustable-gauge wheels, and multiple gauge tracks, usually with a third rail laid. But, most have proven to be a “distant second-best to an integrated network.” Daniel P. Gross, “The Ties that Bind: Railroad Gauge Standards and Internal Trade in the 19<sup>th</sup> Century U.S.,” Harvard Business School Working Paper, September 22, 2016, <https://www.stern.nyu.edu/sites/default/files/assets/documents/TTTB.pdf> (accessed April 11, 2023), 6.

<sup>25</sup> Gross, *Collusive Investments*, 5.

without rebuilding the entire track.<sup>26</sup> Also, for technical reasons outside the scope of this thesis, many broad gauge trains, which tend to be wider and longer, are unable to run on the tighter curves of narrow gauge tracks, which means that converting from a narrower to a wider gauge can often involve re-routing tracks through heavily populated areas. The bottom line is that most gauge breaks are costly and inefficient, and even present-day solutions are no substitute for a train system free of transshipment points.

## **Gauge Breaks in Britain and India**

### ***Britain***

The ancient Greeks are credited with developing the first type of rail transportation system in 600 BCE, followed by the German wagonways from the 1500s to the 1700s.<sup>27</sup> However, Britain took railroading to the next level when it invented the first steam locomotives in the early 1800s. At first, railways were viewed as little more than alternatives to local roads, but they quickly developed into a highly efficient means of transporting people and goods over long distances.<sup>28</sup> The first major line between Liverpool and Manchester opened in 1825 and, when it became a success, railway speculation took off.<sup>29</sup> The British quickly learned that railroads were preferable to canals and roads for carrying heavy loads and many passengers.<sup>30</sup>

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<sup>26</sup> Slawomir Lotysz, "Narrowing is easier," *Inventing Europe*, <https://www.inventingeurope.eu/story/narrowing-is-easier> (accessed March 23, 2023). See also Malcolm W. Davis, "Railway Strategy in Manchuria," *Foreign Affairs* 4, no. 3 (1926): 499, <https://doi.org/10.2307/20028472>.

<sup>27</sup> Mary Bellis, "The History of Railroad Technology," *ThoughtCo*, Aug. 27, 2020, <https://www.thoughtco.com/history-of-railroad-4059935> (accessed January 29, 2023).

<sup>28</sup> Mark Casson, *The World's First Railway System: Enterprise, Competition, and Regulation on the Railway Network in Victorian Britain*, Oxford: Oxford University Press (2009) 16-17.

<sup>29</sup> A. G. Kenwood, "Railway Investment in Britain, 1825-1875," *Economica* 32, no. 127 (1965): 316. <https://doi.org/10.2307/2552228>.

<sup>30</sup> Casson, *The World's First Railway System*, 26.

Market towns bypassed by the railways discovered that their trade would suffer, sometimes leading to virtual extinction.<sup>31</sup> As a result, towns became eager to have a railroad come through it, and promoters constantly pushed for new lines to open. The process of setting up railroads was that promoters would seek approval from Parliament to form a railway company for a single line.<sup>32</sup> With the exceptions of directly competing lines, Parliamentary committees examined “one project at a time” to weigh issues like profitability and public benefit.<sup>33</sup> However, for obvious reasons, towns placed tremendous pressure on Members of Parliament (MPs) to grant approval, who then pressured the committees. Also, many MPs became investors in their local railroad companies, often because they were landowners who had a vested interest in bringing railways to their region.<sup>34</sup> This meant that around one hundred railway projects were introduced to the public between 1835 and 1837,<sup>35</sup> and Parliament approved another six hundred new or extended lines between 1844 and 1847, while implementing very few regulations.<sup>36</sup> Importantly, much of the investment came from private parties engaging in financial speculation on stock exchanges.<sup>37</sup> Eventually, the lack of government oversight led to numerous railway scandals concerning fraudulent enterprises, unsafe conditions, and poor financial record-keeping.<sup>38</sup>

There were three waves of railway investments followed by crashes as noted in the chart below during the 1830s, 1840s, and 1860s (Image 3). Each wave following a similar pattern,

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<sup>31</sup> Ibid., 9.

<sup>32</sup> Geoffrey Channon, “The Business Morals of British Railway Companies in the Mid-Nineteenth Century.” *Business and Economic History* 28, no. 1 (1999): 70, <http://www.jstor.org/stable/23703251>.

<sup>33</sup> Casson, *The World's First Railway System*, 27.

<sup>34</sup> Channon, “The Business Morals of British Railway Companies,” 71.

<sup>35</sup> Daniel Thorner, *Investment in Empire: British Railway and Steam Shipping Enterprise in India 1825-1849* (Philadelphia: University of Pennsylvania Press, 1950) 14.

<sup>36</sup> Ibid., 15.

<sup>37</sup> Casson, *The World's First Railway System*, 27-29.

<sup>38</sup> Channon, “The Business Morals of British Railway Companies,” 69-72.

beginning with railway speculation that built to a fever pitch of “railway mania” followed by a financial crisis.<sup>39</sup>

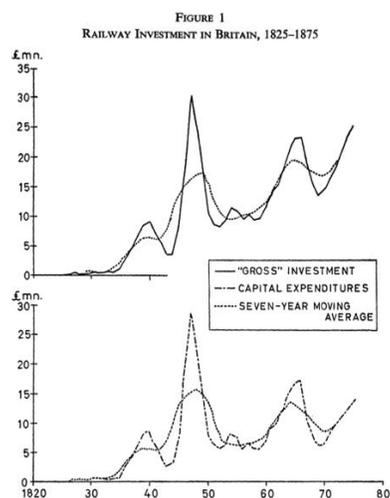


Image 3: Railway Investments in Britain, 1825-1875<sup>40</sup>

However, what moved the needle towards more regulation was the “great commercial crash of 1847-48.”<sup>41</sup> Many companies failed and took the earnings of investors with them.<sup>42</sup> There was also a consensus that railroad lines had been duplicated and were inefficient.<sup>43</sup> Economist Mark Casson has estimated that by 1860, “20,000 miles of railways were constructed when only 13,000 miles were required.”<sup>44</sup>

The lack of government oversight over railway policy during the 1830s and 1840s could be partly attributed to “an ideological commitment to the principle of competition” made popular by *laissez faire* and free market economics, especially in the first half of the 18<sup>th</sup> century.<sup>45</sup>

<sup>39</sup> A.G. Kenwood, “Railway Investment in Britain, 1825-1875,” *Economica* 32, no. 127 (1965): 316-319. <https://doi.org/10.2307/2552228>

<sup>40</sup> *Ibid.*, image at 315.

<sup>41</sup> Thorner, *Investment in Empire*, 18.

<sup>42</sup> Casson, *The World's First Railway System*, 18.

<sup>43</sup> *Ibid.*, 19-20.

<sup>44</sup> *Ibid.*, 16.

<sup>45</sup> *Ibid.*, 221.

*Laissez faire* is the belief that an economy is most prosperous when competition among entrepreneurs is rigorous and government regulation is minimal.<sup>46</sup> MPs not only did little to regulate or financially aid the earliest railroads, they allowed railway companies to raise funds and force the sale of private property for the railways' right-of-way.<sup>47</sup> As a result, the "UK railway system was constructed entirely by private enterprise, with minimal state subsidies ... [and] the efficiency of the system is therefore, indirectly, a judgment on the performance of private enterprise,"<sup>48</sup>—a "performance" that was uneven at best. Private enterprise built the railroads in Britain, but the absence of oversight resulted in a system that one critic called "helter-skelter."<sup>49</sup> Another critic suggests that Parliament's *laissez faire* approach to railways "promoted a highly permissive system of commercial law, tolerated high levels of fraud, and offered investors little or no protection ...."<sup>50</sup>

Starting in the 1840s, a critical battle developed between MPs, proponents of *laissez faire* competition, and the Railway Committee of the Board of Trade, led by Lord Dalhousie. The Railway Committee proposed significant regulations and reforms, which Parliament initially approved until its members realized that they had angered their constituents and thereafter fought the changes.<sup>51</sup> As Casson notes, "The Board of Trade was rightly skeptical of the benefits of competition to the railway system, but this attitude only increased Parliament's suspicions of the Board."<sup>52</sup> While some regulations were passed, Parliament continued to approve new lines and frustrate the Board of Trade's attempts at regulation—a frustration that Dalhousie remembered later when he became India's Governor General. The economic collapse of railroad stocks in the

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<sup>46</sup> Ibid., 36-37.

<sup>47</sup> Thorner, *Investment in Empire*, 15-16

<sup>48</sup> Casson, *The World's First Railway System*, 1

<sup>49</sup> Ibid., 17.

<sup>50</sup> Channon, "The Business Morals of British Railway Companies," 71.

<sup>51</sup> Casson, *The World's First Railway System*, 18.

<sup>52</sup> Ibid., 278.

1840s, however, led to widespread public criticism of poor government oversight and pressured Parliament to implement more regulations.<sup>53</sup>

One issue was impossible even for free market MPs to ignore: gauge breaks. The earliest developers of railway lines had different theories about the ideal gauge size and early railroad companies experimented with different gauges. Unfortunately, having railroads with different gauges meant trains could not connect with other lines when they met up. Instead, passengers and freight would have to unload and reload, which, as discussed earlier, was costly and frustrating. The problem was so severe that one British engineer stated about the period, “The general opinion of those who entered into the question, many years ago, was that the break of gauge was a national evil.”<sup>54</sup>

Gloucester Station was the transshipment point where the broad gauge Bristol Railway met the narrow gauge Birmingham Railway. Three engravings by W.J. Linton, titled “The Break of Gauge at Gloucester,” were published in the *Illustrated London News* in 1846.<sup>55</sup> They demonstrate the chaos that occurred as passengers, luggage and freight, including livestock, had to be unloaded from one train and reloaded onto another (Images 4 to 6). These types of images, based on real world experiences, “fanned the flames of the gauge war” and led to considerable debate in Parliament over the problem.<sup>56</sup> In response, Parliament established the Gauge Commission, which singled out Gloucester as a particularly egregious example of the gauge break problem. One recounting of the debate states:

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<sup>53</sup> Channon, “The Business Morals of British Railway Companies,” 71.

<sup>54</sup> Atkinson, 1889 *Minutes*.

<sup>55</sup> “Break of Gauge at Gloucester Lithographs” *Changing Trains—The Journey from Broad Gauge to Narrow Gauge*, STEAM Museum of the Great Western Railway, <https://www.steam-museum.org.uk/object-of-the-month/july-2022/> (accessed May 2, 2023).

<sup>56</sup> “Break of Gauge at Gloucester Lithographs” *Changing Trains*.

First case of BREAK OF GAUGE, on junction of two Railways of different widths, at Gloucester—Evils brought about by Break of Gauge—Compels a transfer of passengers from Broad carriage to Narrow, and from Narrow to Broad—like the old stage coach system—compels transfer of private carriages—of horses and cattle—of mineral ore and coal—unpacking merchandize—repacking—difficulty with cattle—breakage with merchadize—pilferage—injury to coal—delay and expense—a Break of Gauge a barrier to trade like a Custom House—a tax of time—a tax of money—all taxes paid by the public ....<sup>57</sup>



Image 4: Break of Gauge at Gloucester (1846)<sup>58</sup>

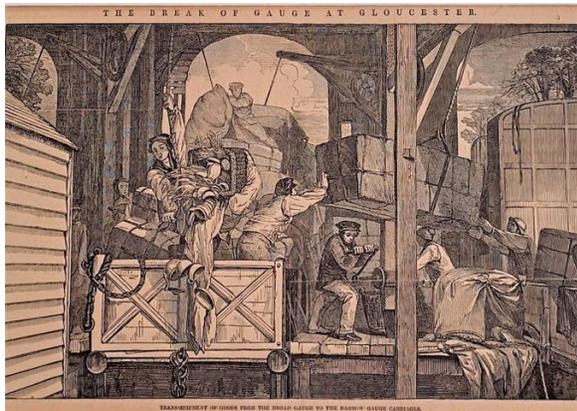


Image 5: Break of Gauge at Gloucester

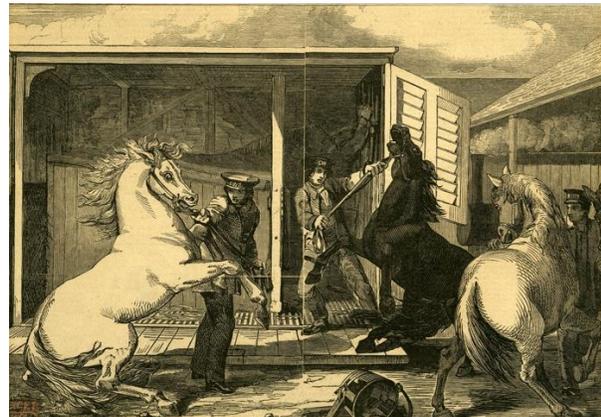


Image 6: Break of Gauge at Gloucester

<sup>57</sup> Samuel Sidney, *National Uniformity of Gauge: History and Prospects of the Railway System Illustrated, By the Evidence given before the GAUGE COMMISSION.*, London: Edmonds and London: Vacher, <https://play.google.com/books/reader?id=8aJVAAAACAAJ&pg=GBS.PA1&hl=en> (accessed May 2, 2023).

<sup>58</sup> Linton, "The Break of Gauge at Gloucester," June 6, 1846.

Eventually, Britain's Battle of the Gauges came down to a fight between two men. George Stephenson advocated for 4 feet 8½ inches as the standard gauge because it was less expensive to build and had more miles already constructed, while Isambard Kingdom Brunel thought his 7-foot broad gauge railways should be the national standard because it allowed for faster trains and a smoother ride. Railroad lines using these two gauges clashed across England, which resulted in many transshipment points where the lines merged. Eventually Parliament passed the Railway Regulation (Gauge) Act of 1846, first proposed by Dalhousie and the Royal Commission for Railway Gauges, which stated that "it shall not be lawful (except as herein-after excepted) to construct any Railway for the Conveyance of Passengers on any Gauge other than Four Foot Eight Inches and Half an Inch in Great Britain, and Five Feet Three Inches in Ireland."<sup>59</sup> By then, Britain had eight times more miles of Stephenson's gauge than Brunel's gauge.<sup>60</sup> But, the Gauge Act still permitted the construction of broad gauge railroads with Parliament's approval, so the gauge break issue continued until the last of Brunel's trains left Paddington Station on May 20, 1892—forty-six years after the problem was supposedly resolved.<sup>61</sup> This suggests that the *laissez-faire* ideology is not perfect and competition does not always result in more efficient systems. As Casson repeatedly observes, competition can be detrimental to an efficient transportation system.<sup>62</sup>

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<sup>59</sup> Railway Regulation (Gauge) Act 1846, <https://www.irishstatutebook.ie/eli/1846/act/57/enacted/en/print.html> (accessed April 20, 2023).

<sup>60</sup> Dennis, Gareth, "The not-so-glamorous origins of standard gauge track," *Medium.com*. November 10, 2021. <https://garethdennis.medium.com/the-not-so-glamorous-origins-of-standard-track-gauge-2b5f1ae7e3bc> (accessed April 19, 2023).

<sup>61</sup> Richard E. Penoyer, "The Great Western Railway: NOTES ON THE BROAD GAUGE PERIOD 1835-1892," *The Railway and Locomotive Historical Society Bulletin*, no. 38 (1935): 26, <http://www.jstor.org/stable/43517077>.

<sup>62</sup> Casson, *The World's First Railway System*, 278.

To reiterate, the British Battle of the Gauges primarily occurred for three reasons. First, railway promoters and Parliament looked at each line locally, rather than nationally. This meant applications for new railroad companies were considered in isolation, without regard to how the line might fit into a larger network. Importantly, companies were based entirely on locality. Second, there was tremendous pressure for Parliament to approve railroad ventures, not only to protect towns and local trade, but to provide new investment opportunities. British railroads were built by private equity, and this often led to decisions based on personal interests (e.g. profit) rather than the public good. Initially, investors sought opportunities with little regard for whether a particular railroad would integrate into a wider network. However, each time the economic bubble burst on railway manias and shareholders lost money, investors demanded more efficiencies from railroad companies to boost profits and minimize losses, which included fixing the gauge break problems. Third, the popularity of *laissez faire* economics meant that Parliament was resistant to regulatory oversight by the Board of Trade, even though the Board's proposals were meant to produce a national network that would serve all of Britain. During much of the 19<sup>th</sup> century, there was a widespread belief that competition between railroad companies would ultimately produce the best system.<sup>63</sup> But, as Casson notes, railway infrastructure is unique in that it depends on linkages to maximize a network's efficiency. More competition between railway companies can work against that efficiency, resulting in issues like gauge breaks.<sup>64</sup>

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<sup>63</sup> Ibid., 278.

<sup>64</sup> Ibid., 277-78.

## *India and the Raj*

India's railways were the most expensive colonial project in history,<sup>65</sup> with ninety percent of funding coming from Britain.<sup>66</sup> When the Raj ended in 1947, India had the world's fourth largest railroad network but also had the world's worst gauge break problem, with fifty-three transshipment points where meter and broad gauges connected. Britain left India with two separate railway systems operating on two non-standard gauges, both of which had to try and function as one.<sup>67</sup> For purposes of analyzing the gauge break issue in India, it is useful to divide the development of Indian railways into four periods—Lord Dalhousie and the First Guarantee Period (1840s to the early 1860s); Takeover by the Government of India (GOI) (mid-1860s to mid-1880s); the Second Guarantee Period to the End of the Raj (late-1880s to 1947), and Indian Control (1947 to the present day).

Lord Dalhousie and the Original Guarantee Period. If any country was going to avoid a gauge problem, it should have been India. This is because Lord Dalhousie was appointed India's Governor-General as the first railways were being built, and he was adamantly against gauge breaks. As discussed earlier, Dalhousie headed the Railway Committee on Britain's Board of Trade during the contentious introduction of railroad regulations, which met fierce resistance from Parliament, investors, and the public. Despite strong opposition, he oversaw the passage of the Railway Gauge Act of 1846, which ordered that all new railroads would be built using George Stephenson's standard gauge. When Dalhousie was offered the position of Governor-

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<sup>65</sup> Daniel R. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940*, Oxford: Oxford University Press (1988), 53.

<sup>66</sup> Tara Sethia, "Railways, Raj, and the Indian States: Policy of Collaboration and Coercion in Hyderabad," in *Railway Imperialism*, edited by Clarence B. Davis and Kenneth E. Wilburn, Jr., New York: Greenwood Press (1991) 106.

<sup>67</sup> Headrick, *Tentacles*, 53-56.

General of India in 1848, he accepted on the condition that he would be the final decision-maker on railway policy.<sup>68</sup> Fresh from his wounds in Britain's gauge break battles, Dalhousie insisted only one gauge would be used in India.<sup>69</sup> He also outlined an ambitious plan for an Indian railway network that would be national rather than local in scope and would have strong government oversight of construction and management of the lines.<sup>70</sup> At first, it appeared that India would benefit from Britain's mistakes.

Although Dalhousie left the Governor-General position in 1856, his views influenced India's railway policy for decades.<sup>71</sup> While he was in office, and even a decade after he stepped down, Indian gauges were uniform. But trouble was brewing. First, Dalhousie decided India's trains would run on the broad gauge, which was far more expensive to build than narrower gauges, and many have challenged Dalhousie's decision to use it.<sup>72</sup> Dalhousie wanted the broad gauge, believing that "the particular conditions of India, with its mountainous terrain requiring steep gradients and its high winds, needed the stability of a wider gauge."<sup>73</sup> Furthermore, he adopted a plan first introduced in Britain that railroads should be financed privately, but with a government guarantee, an arrangement that became known as the guarantee contract.<sup>74</sup> To say that the guarantee contract created a host of problems for India and its railroads would be an understatement.<sup>75</sup> However, before discussing these contracts, it would be helpful to understand the history behind Britain's decision to build railroads in India.

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<sup>68</sup> Christian Wolmar, *Railways & the Raj*, London: Atlantic Books (2017) 17.

<sup>69</sup> *Ibid.*, 20.

<sup>70</sup> *Ibid.*, 21.

<sup>71</sup> Headrick, *Tentacles of Progress*, 64.

<sup>72</sup> *Ibid.*, 71-72.

<sup>73</sup> Wolmar, *Railways & the Raj*, 20.

<sup>74</sup> Headrick, *Tentacles of Progress*, 64.

<sup>75</sup> Generally, under guarantee contracts, net earnings were paid to the company. If the net earnings yielded less than a five percent return as a proportion of the company's capital outlay, then the GOI paid for the difference. If net earnings exceeded the guaranteed level, the company gave half of the surplus profits to the GOI. Dan Bogart and

As the Industrial Revolution continued to expand the British economy in the 1840s, British businesses needed more raw materials and markets for finished goods.<sup>76</sup> At first, most manufacturers ignored India as a potential source since most of the country's roads were inefficient, only navigable by oxen-pulled cart, and therefore much of the interior could not be reached.<sup>77</sup> With the development of the railroad, however, manufacturers became enthusiastic about the possibility that the colony had "the most extensive undeveloped resources of any country in the world" and was "capable of consuming as much of our manufactures as we now exported to all the world ...."<sup>78</sup> Historian Robert Robinson writes that "the locomotive was the main engine of imperialism" because it had "a unique propensity for integrating and annexing territory, for monopolizing its resources, and for preempting the future of great stretches of country."<sup>79</sup> In other words, railways provided a relatively cheap, efficient way to transport raw materials and goods, which allowed merchants to bypass the poor road systems. As a result, the British quickly became convinced that the railways would serve as an excellent means of exploiting colonized areas that were previously considered unreachable.<sup>80</sup> Two men in particular, promoters Rowland Stephenson and John Chapman, waged relentless campaigns to receive deeds from Parliament and the British government to build railways in India—requests that were finally granted to Stephenson's East India Railway Company (EIR) in 1845 and to Chapman's Great Indian Peninsula Railway (GIP) in 1849.<sup>81</sup> The GIP completed the first Indian railway in

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Latika Chaudhary, "Railways in Colonial India: An Economic Achievement?" May 1, 2012, <https://ssrn.com/abstract=2073256> (accessed April 20, 2023) 5.

<sup>76</sup> Thorner, *Investment in Empire*, 1-2.

<sup>77</sup> *Ibid.*, 7.

<sup>78</sup> *Ibid.*, 2.

<sup>79</sup> Robert E. Robinson, "Introduction: Railway Imperialism," in *Railway Imperialism*, edited by Clarence B. Davis and Kenneth E. Wilburn, Jr., New York: Greenwood Press (1991) 3.

<sup>80</sup> *Ibid.*, 3.

<sup>81</sup> Both Stephenson and Chapman seem representative of the railway entrepreneurs that helped fuel railway mania both in Britain and throughout the world. These promoters have been described as "adventurous, determined men, sensitive to Britain's needs and to the (profitable) opportunities in India of satisfying them," and in Chapman's case,

1853 that ran between Bombay and Thana, and the EIR completed its first railway line from Howrah to Benares in 1854.<sup>82</sup> Soon after, these companies were joined in the 1850s by six others independent entities, each building a separate line, but Dalhousie ensured that all tracks were constructed with the broad gauge.<sup>83</sup>

As in Britain, India's earliest railroads were privately funded, but unlike the investments in British trains, the GOI agreed to provide a guarantee contract for investors in India's railroads. Under the terms of the contract, the GOI not only protected train companies and its investors against any financial losses but guaranteed a return of five percent. If the railways failed to meet the five percent threshold, then Indian taxpayers—*not* British taxpayers—would make up the difference.<sup>84</sup> This contractual arrangement has been called a "'heads-I-win, tails-you-lose' proposition for Britain,"<sup>85</sup> and, under such generous terms, it is no surprise that investors were easy to find.<sup>86</sup> If India's railroads had been highly profitable, then there would have been no burden placed on Indian taxpayers. Unfortunately, as historian Daniel Thorner notes, "[F]or many decades the railways did not pay their way and acted as a serious drain on the finances of the Government of India."<sup>87</sup> Contrast this to what happened in Britain when railroads struggled or failed, and investments suffered or were lost. British investors grew irate and demanded change from its government, which led to stricter financial regulations, greater attention to

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as a man of "talent, vision, great energy, and dogged determination bolstered by his Baptist faith . . ." Ian J. Kerr, "John Chapman and the Promotion of the Great Indian Peninsula Railway, 1842-1850," *Docutren.com*, <http://www.docutren.com/HistoriaFerroviaria/Semmering2004/pdf/14.pdf> (accessed February 25, 2023), 6.

<sup>82</sup> Ian J. Kerr, *Building the Railways of the Raj, 1850-1900*, Oxford: Oxford University Press (1995) 28-29.

<sup>83</sup> Daniel R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century*, New York: Oxford University Press (1981) 184.

<sup>84</sup> Kerr, *Building the Railways of the Raj*, 17-18.

<sup>85</sup> *Ibid.*, 184.

<sup>86</sup> Wolmar, *Railways & the Raj*, 75. Of the 50,000 shareholders in Indian railways, fewer than one percent were Indian.

<sup>87</sup> Daniel Thorner, "Capital Movement and Transportation: Great Britain and the Development of India's Railways," *The Journal of Economic History* 11, no. 4 (1951): 392, <http://www.jstor.org/stable/2113695>.

profitability, and the standardization of British gauges in 1846.<sup>88</sup> There remained strong resistance to government oversight, although many objections lessened over time.<sup>89</sup>

Unfortunately, pressure to reform, economize, and integrate the railway system did not materialize in India as it had in Britain. Railroad companies were not liable for losses since those fell to the Indian taxpayers, who were all but voiceless under the Raj.<sup>90</sup> The largest railway in Asia had no Indians in senior positions or “posts of real responsibility” serving in the GOI or with railway companies, and therefore no one to argue for reform.<sup>91</sup> Instead, the managers of those railroad companies were “aging financiers living in London,” and they “were little troubled by this system, knowing their stockholders were guaranteed a safe return on their investment.”<sup>92</sup> Nor were British investors concerned about unprofitable, inefficient or even non-existent lines so long as they got a return on capital.<sup>93</sup> As one historian observes, “London shareholders [who] were said not to care whether the rails and locomotives they funded were thrown into the Hooghly River or put into operation.”<sup>94</sup> As in the early days of British railroads, many were only interested in the return on one line and did not concern themselves with whether that line could integrate into a network. Once British investors suffered economic hardship, however, attention became focused on how and why the loss occurred. For example, after the bubble burst on the Railway Mania of 1846, the government standardized Britain’s gauge for all newly constructed tracks unless an exemption was granted.<sup>95</sup> But, without ‘skin in the game,’ investors shrugged when gauge problems arose in India; they received the same return regardless.

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<sup>88</sup> Casson, *The World’s First Railway System*, 277-279.

<sup>89</sup> *Ibid.*, 275-276.

<sup>90</sup> Headrick, *Tentacles of Progress*,” 70-71.

<sup>91</sup> Thorner, “The Pattern of Railway Development in India,” 208.

<sup>92</sup> *Ibid.*, 76

<sup>93</sup> Robinson, *Railway Imperialism*. 5

<sup>94</sup> *Ibid.*, 188.

<sup>95</sup> The gauge break issue continued in Britain continued until 1892, but virtually all new lines constructed after 1846 were standard gauge.

Dalhousie suffered from poor health which forced him to retire and return to England in 1856, and he died in 1860.<sup>96</sup> There have been countless debates over Dalhousie's wisdom in choosing the far more expensive broad-gauge system, which was purchased from Britain rather than made in India.<sup>97</sup> British rails were considered the international gold standard because they were meticulously made and rigorously inspected, unlike the U.S. lines which prioritized quantity over quality. As historian Daniel Headrick notes, "India got British quality at British prices; it had no choice in the matter."<sup>98</sup> One can only speculate whether India would have experienced a gauge break issue if Dalhousie had chosen a narrower gauge. But, after the Raj ended, India ultimately standardized its network using the broad gauge.<sup>99</sup> As one historian commented, "Dalhousie would be chuffed."<sup>100</sup>

GOI Control and Gauge Breaks (1860s to 1880s). Over time, the Indian taxpayers became more vocal about their growing tax burden, and the GOI worried that their anger might lead to a revolt like the Indian Uprising of 1857.<sup>101</sup> Governor-General Canning was the first to declare, in 1862, "I will not guarantee a single rupee for a single day," although he was later forced to backtrack.<sup>102</sup> However, the GOI was concerned enough to lobby the British government to let it

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<sup>96</sup> K. A. Ballhatchet, "James Andrew Broun Ramsay, marquess and 10th earl of Dalhousie," *Encyclopedia Britannica*, April 18, 2023, <https://www.britannica.com/biography/James-Andrew-Broun-Ramsay-Marquess-of-Dalhousie> (accessed April 20, 2023).

<sup>97</sup> Atkinson, 1889 *Minutes* and Royal-Dawson, 1922 *Minutes*.

<sup>98</sup> Headrick, *Tentacles of Progress*, 75.

<sup>99</sup> For a discussion on Project Unigauge, see pages 35-36.

<sup>100</sup> Wolmar, *Railways & the Raj*, 308.

<sup>101</sup> *Ibid.*, 74. Numerous reasons have been cited for the Uprising of 1857, including "over-ambitious changes" and influence by Dalhousie and Canning, unhappiness within the ranks of Indian soldiers in the British army, and religious unrest. Peter Robb, "On the Rebellions of 1857: A Brief History of an Idea," *Economic and Political Weekly* 42, no. 19 (2007), 1696-99. <http://www.jstor.org/stable/4419572>. Others cite land rights and government revenue collecting plans as one of the main reasons. The authors suggesting the reasons were "complex and varied," but did not constitute a "mass uprising" of nationalists. *The Cambridge Economic History of India, Volume 2: c. 1757 - c. 1970*, edited by Dharma Kumar and Meghnad Desai, Cambridge: Cambridge University Press (1983), 55-56.

<sup>102</sup> Wolmar, *Railways & the Raj*, 75.

cancel the original guarantee contracts; it proposed building and operating the railways lines itself using borrowed capital.<sup>103</sup> Not surprisingly, investors were furious about this, so the British government agreed to let the original guarantee contracts continue on *more* favorable terms for the existing lines, while new lines would be built by the GOI and paid for with loans.<sup>104</sup>

When the GOI took charge of building new railway lines in 1864, it wanted to lower construction costs. Ideally, state control meant it could build new lines that integrated seamlessly with existing ones. As Casson points out, the most efficient railway networks rely on linkage hubs that minimize disruption.<sup>105</sup> Unfortunately, this would not be the case here. In the same year that the GOI assumed control of building India's railroads, Sir John Lawrence became Governor-General. He was an interesting choice because he had lived in India since 1827, had once reported to Dalhousie, and had earned his reputation for his military role in helping to defeat the 1857 uprising.<sup>106</sup> He believed private enterprise was robbing the GOI and was among those who had called for an end to the original guarantee contracts. However, he primarily blamed the high cost of building railroads on the broad gauge.<sup>107</sup> He was correct that India was given one of the most expensive railroads in the world because the broader gauge required larger turns and far more infrastructure to support the line.<sup>108</sup>

As a result, Lawrence made the fateful decision to build railroads using the less expensive narrow (meter) gauge instead of the broad gauge. He justified his choice by stating, "Wholly to reject railways for a country which is not able to support lines of the most costly

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<sup>103</sup> Chaudhary, "Railways in Colonial India," 6.

<sup>104</sup> Wolmar, *Railways & the Raj*, 77.

<sup>105</sup> Casson, *The World's First Railway System*, 278.

<sup>106</sup> Frederick P. Gibbon, *The Lawrences of the Punjab*, London: J.M. Dent & Co (1908): 299-317, <https://ia801301.us.archive.org/14/items/TheLawrencesOfThePunjab/TheLawrencesOfThePunjab.pdf> (accessed February 26, 2023).

<sup>107</sup> Headrick, *Tentacles of Progress*, 72.

<sup>108</sup> *Ibid.*, 62.

description is quite unreasonable, and if ... the expense of the ordinary gauge seems prohibitory, while lines of the narrow gauge would be financially practicable, I should consider it a most mistaken view to reject the narrow gauge line.”<sup>109</sup> There is no question that the narrow gauge was cheaper to build than the broad gauge, but a comprehensive study conducted in 1889 found that the broad gauge track was a better economic investment based on factors like speed limits, train size, and the amount of goods that could be carried.<sup>110</sup> Also, if Lawrence was so concerned about cost savings, he could have allowed India to manufacture its own railroad equipment. Instead, by the end of the Raj, those employed in factories comprised only 1% of the Indian population.<sup>111</sup> India was forced to buy almost everything from Britain, which meant that most of the economic benefits from investments in Indian railways flowed to the British.<sup>112</sup> As one historian concluded, the railways “became a captive and publicly subsidized market for English steel-makers and locomotive builders.”<sup>113</sup>

Lawrence proposed that the GOI build all new lines in meter gauge, which was approved by his successors. When the military became irate about the sudden switch to narrow gauge, it was agreed that new military lines would remain broad gauge.<sup>114</sup> Headrick writes:

If the original decision to adopt the wider gauge was a costly mistake, Lord Lawrence’s meter gauge only compounded it. It saddled India with two systems, each with its own kind of rails, locomotives, rolling stock, and workshops, and no way to shift equipment from one system to another. Even transfers between meter-gauge lines was impossible because they were separated by stretches of standard-gauge [broad] track. Freight going

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<sup>109</sup> Ibid., 72.

<sup>110</sup> Waring, Francis John. “Indian Railways. The Broad and the Narrow-Gauge Systems Contrasted” from *Minutes of the Proceedings of the Institution of Civil Engineers*, Volume 97, Issue 1889 (1889), 150-190, part 3, <https://doi.org/10.1680/imotp.1889.20756>. Accessed October 2, 2022. <https://www.icevirtuallibrary.com/doi/abs/10.1680/imotp.1889.20756>

<sup>111</sup> Thorner, “The Pattern of Railway Development,” 214.

<sup>112</sup> Wolmar, *Railways & the Raj* 166-67.

<sup>113</sup> Satya, “British Imperial Railways,” 71.

<sup>114</sup> Headrick, *Tentacles*, 72.

between two lines had to be reloaded from train to train, and at every transfer point it was subject to delays, mishandling, and the attention of thieves.<sup>115</sup>

Lawrence sacrificed the operational efficiency of India's railways on the altar of arguable cost savings. It is hard to believe he was not made aware of his homeland's gauge break battles, even though he left England before they occurred. There had been considerable debate in Parliament prior to the passage of the Railway Gauge Act of 1846, with one MP arguing that gauge breaks were dangerous because they caused "great confusion" while never "serving the interests of the public."<sup>116</sup> Nor did Lawrence appear to share Dalhousie's vision of a national railroad network for India. He merely concluded that the narrow (meter) gauge was all that a poor country like India could afford.<sup>117</sup> No one seems to have pointed out the huge cost of creating two railway systems in one country,<sup>118</sup> or that Indian taxpayers were still bearing the heavy expense of ensuring profitability for investors thousands of miles away under guarantee contracts.<sup>119</sup> In his book on British railroads, economist Mark Casson argues that competition between the earliest railroad companies impeded a more efficient network by creating obstacles like gauge breaks to mark their territory and frustrate rivals. In these cases, government oversight

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<sup>115</sup> *Ibid.*, 72.

<sup>116</sup> Henry Labouchere, "Railway Gauge—Adjourned Debate," UK Parliament, Volume 87: debated on Thursday 18 June 1846, <https://hansard.parliament.uk/Commons/1846-06-18/debates/56159395-fdfb-43b6-8f87-6861c1eeb423/RailwayGauge—AdjournedDebate> (accessed April 16, 2023).

<sup>117</sup> Atkinson *1889 Minutes*, 157.

<sup>118</sup> It does not appear that British companies who operated in India protested the disruptions to the railway system caused by transshipment points. But, one historian has noted that the railroads were built primarily to transport food and raw materials out of India. Therefore, most lines were built to connect regions with raw materials to ports, rather than to move these items around India. That is why grain exports did not drop significantly during the famines. Joseph McQuade, "Colonialism was a disaster and the facts prove it," *The Conversation*, September 26, 2017, <https://theconversation.com/colonialism-was-a-disaster-and-the-facts-prove-it-84496> (accessed April 17, 2023).

<sup>119</sup> In his important work, "The Pattern of Railway Development in India," Daniel Thorner notes that anti-India, pro-British policies include the "Buy British" policy that required India import all railway equipment and supplies from England, as well as the discriminatory employment practices that refused to allow Indian employees to rise in the ranks of the railway structure because the British "were not interested in training Indians for the higher positions, nor in giving them advanced technical training" (208).

was needed.<sup>120</sup> But, Casson fails to recognize that governments are equally capable of wreaking havoc on infrastructure, as Lawrence proves. This is especially true when that government is an imperial power not answerable to the people most impacted by its decisions.

Between 1889 and 1922, British engineers met several times to discuss gauge breaks in India. They cited many problems caused by the gauge breaks,<sup>121</sup> but one engineer offered additional insight into why the problem was never addressed:

It was certainly strange that, notwithstanding the almost unanimous views of the Indian railway men mentioned by the Author, and their consensus of opinion in favour of the adoption of the 5 feet 6 inches gauge, coupled with the general consensus of opinion in favour of uniformity of gauge of members of The Institution, when the subject was previously discussed, no definite policy appeared yet to have been taken up by the Government of India. No doubt that was, as the Author pointed out, *mainly due to the constant changes in their advisers.*<sup>122</sup> [emphasis added]

When the engineer references “Indian railway men,” it is unlikely that he is referring to anyone of Indian descent. Almost all engineers, technicians, and supervisors who worked on India’s railroads were British because Indians were not allowed into senior positions.<sup>123</sup> Furthermore, Indians had little to no influence the GOI’s decisions concerning the railroads. It is true that the GOI maintained close ties to the leaders of the princely states, although there is no evidence to suggest those leaders would have disagreed with Lawrence’s gauge break decision. Just the opposite. In 1875, Salar Jung, the prime minister of the princely state of Hyderabad, attempted to construct a narrow-gauge line with financing he obtained in London over the GOI’s objections.

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<sup>120</sup> Casson, *The World’s First Railway System*, 277.

<sup>121</sup> Royal-Dawson, Frederick George. “The Indian Railway Gauge Problem” (Paper No. 4392). November 15, 1921. *Minutes of the Proceedings of the Institution of Civil Engineers*. Vol. 213 Issue 1922, 1922, 15. <https://doi.org/10.1680/imotp.1922.14496>. Ice Virtual Library. Accessed October 2, 2022. <https://www.icevirtuallibrary.com/doi/abs/10.1680/imotp.1922.14496>

<sup>122</sup> *Minutes Royal-Dawson*, 57.

<sup>123</sup> Tara Sethia, “Railways, Raj, and the Indian States: Policy of Collaboration and Coercion in Hyderabad,” in *Railway Imperialism*, edited by Clarence B. Davis and Kenneth E. Wilburn, Jr., New York: Greenwood Press (1991) 106.

In response, the GOI forced Hyderabad to build a broad-gauge line, and when Salar Jung tried to obtain more funding to extend the line, the GOI frustrated his efforts. After Salar Jung died in 1883, Hyderabad agreed to almost all of the GOI demands, including relinquishing most of its control over the line although it technically retained ownership.<sup>124</sup> One lesson of the Hyderabad debacle was that India's railways would remain firmly under British control and serve British interests, even in the rare case of Indian ownership by a princely state.<sup>125</sup> Also, Salar Jung wanted a narrow gauge line without any concern about a gauge break with other railroads. His focus was on the needs of Hyderabad, not those of India as a whole. This is similar to the early days of British railroads, when MPs and towns cared only about the local impact of the new railroad lines. It was not until Indians gained independence in 1947 that they sought to transform their patchwork of independent lines into a national network.

Fifteen years after the British government gave the GOI control over building the railways, it took that power away. During the 1870s, Britain began a war with Afghanistan, and the worst series of famines for India took place. These events put a severe strain on the GOI's finances, which promoters jumped on as proof that the state could not build and run the railway system. So, in 1879, the British government overturned its earlier decision to let only the GOI construct railroads.<sup>126</sup> By then, however, the damage was done in terms of gauge breaks in the Indian system, and it would not be undone for over a century.

Moreover, the gauge fight in Hyderabad shows how haphazard railway planning had become. While the GOI was permitting narrow gauge lines in some territories, it was requiring broad gauge lines in others. Even railway companies were building lines using both gauges in a

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<sup>124</sup> Ibid., 107-117.

<sup>125</sup> Ibid., 109.

<sup>126</sup> Thorner, "Pattern of Railway Development" in *Railways in Modern India*, edited by Ian J. Kerr, Oxford: Oxford University Press (2001) 86.

single territory. For example, the Madras & Southern Mahratta Railway in the princely state of Mysore had 861 miles of broad gauge and 82 miles of meter gauge in 1884, but by 1910 it had 1042 miles of broad gauge and 2091 miles of meter gauge.<sup>127</sup> Importantly, gauge decisions seemed to depend on whether military or private interests were more persuasive with senior GOI leadership—British men whose terms averaged less than five years. For the British engineers who consulted on railway issues, India was a “way station in careers that spanned several continents,” and it “did not retain good engineers for long.”<sup>128</sup> Nor were Indians allowed to work as railway engineers until the 1920s, long after gauge break problems had become entrenched.<sup>129</sup> As a British engineer had astutely observed in 1922, no cohesive gauge policy could be implemented because GOI leaders and their advisors were constantly changing.<sup>130</sup>

The lack of an efficient national system that served India as a whole became obvious during the famines of the late 19<sup>th</sup> century, which killed up to 30 million people.<sup>131</sup> While the GOI sought permission to build 20,000 miles of “famine railways” that could transport food to certain regions,<sup>132</sup> incredibly, mortality rates were highest in areas with railroads because those lines were used to export food.<sup>133</sup> Data suggests that during the famines, the export of grains like rice and wheat often remained steady.<sup>134</sup> This demonstrates that India’s railway system was largely designed to serve the needs of British merchants in moving raw materials and grains to ports for export, which was Britain’s priority. However, the system was not intended for the

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<sup>127</sup> John Hurd and Ian J. Kerr, *India’s Railway History: A Research Handbook*, Boston: Brill (2012), 206 and 218.

<sup>128</sup> Headrick, *Tentacles*, 84.

<sup>129</sup> *Ibid.*, 84.

<sup>130</sup> Royal-Dawson, 1922 *Minutes*, 57.

<sup>131</sup> Joseph McQuade, “Colonialism was a disaster.”

<sup>132</sup> Kerr, *Building the Railways of the Raj*, 43. The Famine Commission of 1880 recommended that India needed 20,000 additional miles of railways, including 5,000 to be built immediately. However, it is unclear how many miles of famine railways were constructed.

<sup>133</sup> Joseph McQuade, “Colonialism was a disaster.”

<sup>134</sup> K.C. Ghosh, *Famines in Bengal 1170-1943*, Calcutta: Indian Associated Publishing (1944): 31, <https://archive.org/details/in.ernet.dli.2015.462405/page/n61/mode/2up> (accessed March 8, 2023).

efficient transportation of freight within India, or there would have been little need for famine railways.<sup>135</sup>

Second Guarantee Period to the End of the Raj: 1880s to 1947. The end of GOI control led to another boom in Indian railway construction, especially between 1880 to 1914, as well as a second guarantee period which Headrick calls a “time for organizational muddling.”<sup>136</sup> It is outside the scope of this thesis to explore the many different types of ventures that were formed to build railways. However, Headrick attempts to summarize them:

There were not two but several types of railways in India: state-owned and operated, privately owned and operated, state-owned but privately managed, privately owned and state managed (a few), and owned by the Princely States. Thus in 1902 there were 96 railways operated by different administrations: 24 companies, 4 government agencies, and 5 princely states. Even state acquisition of private railways did not simplify the situation: in 1920 the government owned 73 percent of all the track in India but operated only 21 percent, whereas private companies, which only owned 15 percent, managed 70 percent (the rest were in the Princely States). Such fragmentation was inefficient, costly, and confusing.<sup>137</sup>

The increasingly chaotic structure of the Indian railway system meant little to the British investors who were delighted by the return of the guarantee contract. The new contracts were not as generous as the original, but they still required Indian taxpayers to make up for any losses that British investors might suffer. Headrick notes, “What shareholders of Indian railways stock were investing in, after all, was not so much the profitability of the railways of India, as the ability of the Indian government to collect taxes from its subjects.”<sup>138</sup> Indeed, only a handful of engineers

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<sup>135</sup> Shashi Tharoor, “‘But what about the railways ...?’ The myth of Britain’s gifts to India,” *Teh Guardian*, March 8, 2017, <https://www.theguardian.com/world/2017/mar/08/india-britain-empire-railways-myths-gifts> (accessed May 2, 2023). Tharoor notes that even passenger travel was “incidental.”

<sup>136</sup> Headrick, *Tentacle of Progress*, 77.

<sup>137</sup> *Ibid.*, 77

<sup>138</sup> *Ibid.*, 78.

seemed to advocate for fixing the gauge break problem, despite the fact that the British government itself acknowledged the high cost of creating transshipment points when it all but abolished them in 1846. The investors and company managers did not care, and the GOI continued to ignore the problem it had created.<sup>139</sup> As noted above, the need for 20,000 miles of “famine railways” demonstrates the lack of connectivity between Indian regions. Moreover, the experiences of passengers at transshipments points in Britain, like the one at Gloucester, was important in driving gauge reform. However, the experiences of Indian passengers on Indian railways were largely ignored. The railways serviced 19 million passengers in 1871, which grew to almost 200 million passengers by 1900.<sup>140</sup> But complaints by subjects of the Raj usually fell on deaf ears because their railroad lines were “built principally to carry freight to and from the ports, and to ensure that troops could be ... dispatched quickly to trouble spots.”<sup>141</sup>

The gauge issue went unaddressed, even when the GOI took over almost all remaining privately owned and operated railway lines before World War II.<sup>142</sup> By then, Indian railroads were in serious decline. Locomotive failures were increasing at a rapid rate, while service was deteriorating. When the Raj ended in 1947, the railway system was in “sorry shape after two decades of neglect.” Not surprisingly, the British expected the railway system to collapse after they left, which did not happen. As one historian notes, “The fact that the railways not only held together in this time of turmoil following Independence, but actually flourished in the post-Partition period, was the most powerful possible rebuke to the British, who had so long resisted

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<sup>139</sup> Bogart and Chaudhary, “Railways in Colonial India,” 1.

<sup>140</sup> Wolmar, *Railways & the Raj*, 120.

<sup>141</sup> *Ibid.*, 120-21.

<sup>142</sup> *Ibid.*, 277.

the Indianization of the railways.”<sup>143</sup> Unfortunately, the gauge problem that was a century in the making continued to plague India for another fifty years.

India First. When India’s railways were nationalized in 1951, the government confronted a mountain of problems left behind by the British, including 53 transshipment points on 42 different railway systems, all with different gauges and technical standards, infrastructure and rolling stock, and all desperately in need of repair and modernization. To compound India’s problem, the 1950s was a time when steam engines were being replaced with diesels. However, Indians had paid far too high a cost for the railroads to let them fail. The Railway Board of newly created Indian Railways divided into regional zones and worked to standardize the system.<sup>144</sup> It immediately simplified the bureaucracy and abolished racist policies favoring whites, and it quickly became a rallying cry among railroad workers to ensure that the system succeeded under Indian control.”<sup>145</sup>

It is unclear why it took decades for India to address the gauge problem throughout the country. Certain regions of Indian Railways began to eliminate transshipment points shortly after Independence, but a standardized national gauge was not agreed upon until the 1990s.<sup>146</sup> In 1991, after a decades-long long debate over whether to use broad or meter gauge, the government finally launched Project Unigauge, a conversion plan that would switch almost all track to broad gauge.<sup>147</sup> Following a slow start, by 2022, 96% of the tracks had been converted, with only 2.4%

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<sup>143</sup> Ibid., 283.

<sup>144</sup> Ibid., 279-283.

<sup>145</sup> Ibid., 283.

<sup>146</sup> “Gauges in India,” *Indian Railways Fan Club*, <https://www.irfca.org/faq/faq-gauge.html> (accessed April 20, 2023).

<sup>147</sup> Wolmar, *Railways & the Raj*, 308.

of narrow gauge remaining.<sup>148</sup> A uniform gauge has allowed India to introduce electrification and double the speed of their trains in some areas.<sup>149</sup> Although correlation is not causation, the years of the Project Unigauge parallel the period when India's economy began its steep growth, going from a GDP of \$266 billion to over \$3 trillion in 2022, when it surpassed Great Britain to become the fifth largest economy in the world.<sup>150</sup> At a minimum, it is clear that India believed the gauge issue needed to be corrected once and for all and finally had the financial resources to complete the extensive project. Unfortunately, despite India's rapid economic growth, its trains have remained frustratingly slow compared to railways in Europe, China, and Japan, with most train speeds averaging 31mph.<sup>151</sup>

In 2014, India and Japan reached an agreement for Japan to build India's first Shinkansen-style high speed railway between Mumbai and Ahmedabad, which is expected to be completed by 2026. It will cut the end-to-end journey from roughly seven hours to two hours, and each train will seat up to 1,300 people. But, as in Japan, the high-speed line will introduce a gauge break because it will be an independent corridor that runs on the standard gauge.<sup>152</sup> At least, this time India is in full control of its gauge decisions.

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<sup>148</sup> Railway Board, *Indian Railways Year Book 2021-22*, Ministry of Railways, [https://indianrailways.gov.in/railwayboard/uploads/directorate/stat\\_econ/2023/PDF%20Year%20Book%202021-22-English.pdf](https://indianrailways.gov.in/railwayboard/uploads/directorate/stat_econ/2023/PDF%20Year%20Book%202021-22-English.pdf) (accessed March 9, 2023), 61.

<sup>149</sup> Christopher Finnigan, "Changing tracks: Modernising India's Railways," *London School of Economics*, June 7, 2019, <https://blogs.lse.ac.uk/southasia/2019/06/07/changing-tracks-modernising-indias-railways/> (accessed March 7, 2023).

<sup>150</sup> "World Economy Ranking 2022, 22 Biggest Economies in the World, March 22, 2023, <https://urbanaffairskerala.org/world-economy-ranking/> (accessed April 20, 2023).

<sup>151</sup> Ben Jones, "Slow progress for India's high-speed rail revolution," *CNN*, March 1, 2022, <https://www.cnn.com/travel/article/india-high-speed-rail-cmd/index.html> (accessed March 7, 2023).

<sup>152</sup> *Ibid.*

Several factors led to India's gauge break problem despite Dalhousie's best laid plans. First, Indian railroads were financed by investors who did not care about the construction costs or profitability of the railroads as long as they received a return on their investment under the guarantee contract. Without the risk of losses, investors were unlikely to push for reforms as they had in Britain. Second, Indian lines were built with a local, rather than national, focus. Even princely states like Hyderabad wanted a narrow-gauge line, even if its trains could not then run on the broad-gauge line passing through its territory. Ultimately, the GOI was the only entity that could have avoided the gauge break problem as Indians had almost no power over railway policy. Rather than having the interests of Indians in mind, Lawrence and subsequent Governor-Generals permitted the gauge break to save the GOI money in construction costs—savings that could have easily been achieved by letting India manufacture its own railways. The GOI never permitted this, however, because colonialism is not meant to benefit the colonized. As one historian noted, “[T]he railways could have done so much more for India had they not been first and foremost a colonial project.”<sup>153</sup>

For reference purposes and to appreciate the scope of the gauge break problem, below is a 1911 map of India's railways (Image 4). The thick black and red lines represent the broad-gauge railroads, and the thin black lines are the narrow gauge. Where the thick and thin lines meet are transshipment points.

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<sup>153</sup> Catherine L. Phipps, Christian Wolmar et al., *Is Asia Reconnecting?: Essays on Asia's Infrastructure Contest*. Report, Edited by Hillman Jonathan E. Center for Strategic and International Studies (2017): 42, <http://www.jstor.org/stable/resrep23193.10> (accessed June 20, 2021).

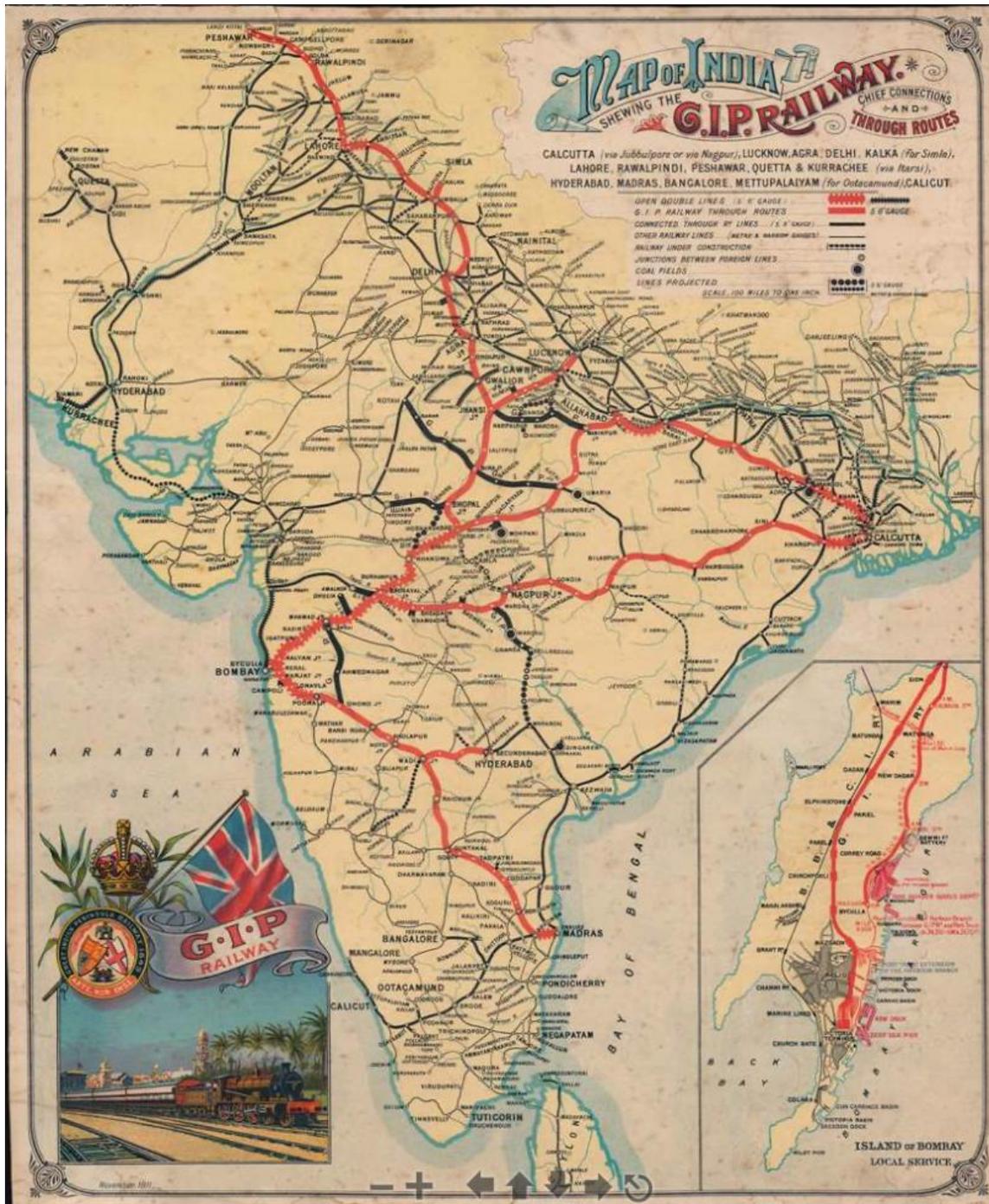


Image 4: 1911 GIP Railway Map of India<sup>154</sup>

<sup>154</sup> Waterlow and Sons, “Map of India Shewing the G.I.P. Railway, Chief Connections and Through Routes, 1911. Image accessed from Geographicus Rare Antique Maps, <https://www.geographicus.com/P/AntiqueMap/indiagiprailway-waterlow-1911> (accessed April 17, 2023).

## Gauge Breaks in Japan and Manchuria

### *Japan*

Many consider Japan's current railway system to be the international gold standard. Japanese trains are famous for being clean, fast, efficient, and punctual,<sup>155</sup> and the Shinkansen might be the most famous brand in modern railroading. Furthermore, Japanese companies have been among the leading manufacturers and exporters of trains and railway technology for decades.<sup>156</sup> By contrast, the "Great British Railways" are in such decline that a report prepared by Britain's Secretary of State for Transport acknowledges numerous problems, including "chaotic timetable changes," outdated equipment and systems, and "the almost total collapse of passenger demand" after the pandemic that has yet to recover to anywhere near its pre-pandemic levels.<sup>157</sup> Not surprisingly, the report calls for "radical change."<sup>158</sup>

It is ironic that Britain is now in Japan's shadows since it invented railway technology and was a leading exporter of trains well into the 20<sup>th</sup> century. In fact, the British financed and oversaw construction of the first Japanese railway in 1872. But Japan's rise to the top of the train world began with it having strong government oversight during the earliest years of railway development. Furthermore, no decision may have served as a better foundation for building a strong national network than the Meiji government's choice of a single national gauge for all of Japan—a decision that helped it avoid the costly and chaotic gauge break problems that plagued

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<sup>155</sup> Kristin Mariano, "The fascinating train culture of Japan," *Travel Daily Media*, April 1, 2022, <https://www.traveldailymedia.com/the-fascinating-train-culture-of-japan/> (accessed February 12, 2023).

<sup>156</sup> See "Japanese Rail World Wide," Japan Overseas Railway System Association, <https://www.jorsa.or.jp/en/exports/> (accessed April 20, 2023), and Christopher P. Hood, "Bullets and Trains: Exporting Japan's Shinkansen to China and Taiwan," *The Asia-Pacific Journal*, Vol 5, Issue 3, March 1, 2007, <https://apjif.org/-Christopher-P.-Hood/2367/article.html> (accessed April 20, 2023).

<sup>157</sup> *Great British Railways: The Willaims-Shapps Plan for Rail*, May 2021, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/994603/gbr-williams-shapps-plan-for-rail.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/994603/gbr-williams-shapps-plan-for-rail.pdf) (accessed February 1, 2023) 6.

<sup>158</sup> *Ibid.*, 7. While the pandemic led to a global decrease in railway use, it is worth considering whether other issues with the British railways may have exacerbated the problem.

other countries like India, the U.S. and Britain. It was not until the 1960s, when Japan was faced with the reality that high speed trains cannot travel on narrow gauge tracks, that it created a gauge break for the purpose of *increasing* its railways' efficiency.

Mystery surrounds the Meiji government's decision to build its network on narrow gauge tracks. Railway expert Dan Free writes that it is "one of the great, unanswered questions of Japanese railway history,"<sup>159</sup> and historian Akira Saito notes that if a written record exists as to why the 3'6" gauge was selected, "no historian has ever found it."<sup>160</sup> It has been suggested that Edmund Morel, a British engineer who had worked with narrow gauges in other countries, convinced his Japanese employers that the small gauge "was best suited to the special circumstances of Japan, specifically its mountainous terrain and shortage of capital"<sup>161</sup>—probably more the latter than the former. The selection of the narrow gauge may have also received support from Masara Inoue, the *only* Japanese railway expert at the time. Between 1863 to 1867, Inoue had defied the Tokugawa shogunate's ban of foreign travel and secretly studied railway engineering in Britain. His period of study coincided with a growing interest by Britain in constructing narrow gauges in European countries like Norway, as well as many European colonies. At the time, rail experts argued that smaller gauges were "an excellent way to bring modern civilization to underdeveloped parts of the world."<sup>162</sup> But, others believe that the gauge decision was reached as early as 1868, before either Morel or Inoue were involved in the

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<sup>159</sup> Dan Free, *Early Japanese Railways 1853-1914: Engineering Triumphs That Transformed Meiji-era Japan*, Rutland: Tuttle Publishing (2008) 65.

<sup>160</sup> Akira Saito, "Why Did Japan Choose the 3'6" Narrow Gauge?," *Japan Railway and Transport Review*, volume 31, June 2002, [https://www.ejrcf.or.jp/jrtr/jrtr31/pdf/f33\\_sai.pdf](https://www.ejrcf.or.jp/jrtr/jrtr31/pdf/f33_sai.pdf) (accessed February 1, 2023) 33.

<sup>161</sup> Ericson, Steven J. *The Sound of the Whistle: Railroad and the State in Meiji Japan*. Cambridge: Council on East Asian Studies, Harvard University (1996), 396, footnote 19.

<sup>162</sup> Saito, 37-38.

railroad's planning.<sup>163</sup> Free argues that British engineer and consultant George Preston White, who had worked on railways in Britain and India, was the decision-maker.<sup>164</sup>

There is also a lack of clarity and documentation about why Japan never developed a gauge break problem, especially in the earliest years of operations. When the Tokyo-Yokohama line opened in 1872, gauge battles were still occurring throughout the world. For example, the standard gauge was still fighting for supremacy with Brunel's broad gauge in the South of England, the U.S. had over twenty gauges, and India's gauge problems were just beginning. It is possible that Inoue, who returned to Japan in 1868, witnessed firsthand the chaos caused by gauge breaks in Britain and cautioned the government to avoid the problem at all costs. Historian Steven Ericson also offers insight when he observes that the Meiji government recognized early how the railway could promote "national integration in a political as well as social and economic sense."<sup>165</sup> The Meiji Restoration, beginning in 1868, was a time when the Japanese government was trying to unite and modernize a previously fractured and feudal country. This is why it abolished the *shi-nô-kô-shô* caste system and conscripted all men into the military.<sup>166</sup> While many citizens, especially from the samurai class, at first feared the "serpent born of civilization [that was] slithering its way over the silver rails,"<sup>167</sup> senior officials quickly saw its potential as a unifying symbol of national progress and modernization. Ericson writes that trains helped to link agrarian and urban areas, break down regional differences, and "drive forward a sense a

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<sup>163</sup> Free, 65.

<sup>164</sup> Ibid., 66.

<sup>165</sup> Ericson, 92.

<sup>166</sup> Christopher Goto-Jones, *Modern Japan: A Very Short Introduction*, New York: Oxford University Press, 2009, 53.

<sup>167</sup> Even though the train was a symbol of progress for some, many others, like Meiji novelist Natsume Sôseki, saw it as a symbol of alienation and dehumanization. In his novel, *The Three-Cornered World*, he writes, "The railway train which blunders ahead blindly into the pitch darkness is one example of the very obvious dangers which abound in modern civilization" (Ericson 57).

nationhood.”<sup>168</sup> It would have been counter-productive to have competing gauges battling for supremacy at the same time the state was seeking to forge a national identity through this new technology.

Furthermore, Japan may have avoided the issues of gauge breaks early on because, unlike Britain, its economy had not developed to the point where private investors and financial markets were eager and able to speculate on new railway construction, something which might have created a Japanese railway mania. Until 1867, Japan was primarily an agricultural economy with a feudal shogunate.<sup>169</sup> Despite the rapid progress that took place in the industrial, technological, and financial sectors during the Meiji period, Japan would have been considered a less advanced, non-industrialized country in 1872. Being neither a wealthy country nor a European colony with an abundance of natural resources to exploit, there were no Stephenson and Brunel types lobbying the Japanese government to build railroads in their preferred gauge. As Akira Saito writes, “At the end of the 1860s, who would have thought that Japan would become a major economic power? In those days, the government still had not come up with its strident ‘Enrich the Country and Strengthen the Military’ slogan. The cheap-to-build narrow gauge was probably the only option considered at the time.”<sup>170</sup>

Significantly, the first Japanese railway was state-owned but paid for with a loan from a British bank. However, this was one of the few times that the Meiji government borrowed from a foreign money market to pay for a state railway. The railway loan was highly controversial because a default risked Britain’s armed intervention.<sup>171</sup> The Japanese feared that using foreign

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<sup>168</sup> Ericson, 92.

<sup>169</sup> Aoki Eiichi, Mitsuhide Imashiro, Shinichi Kato, Yasuo Wakuda, *A History of Japanese Railways: 1872-1999*. Tokyo: East Japan Railway Culture Foundation (2000) 5.

<sup>170</sup> Saito, 38.

<sup>171</sup> Free, 62.

funds opened the door for other countries to occupy Japan under the guise of protecting the creditor's interests in the railways, a concept that the Japanese would later exploit in Manchuria. Therefore, the Meiji government vowed to pay for all future state-owned lines and mostly stuck to its promise.<sup>172</sup> This contrasts sharply with the railway network in England, where the entire system was built by private enterprises<sup>173</sup> and could offer insight into why the Meiji government exercised such tight control over railway policies from the beginning. The British government could afford a more *laissez faire*, less involved, approach to railroads because it did not fear colonization or occupation. Imperial Britain was at the height of its political and economic power, with the British singing "Rule, Britannia! Rule the waves: Britons never never shall be slaves." Meanwhile, Meiji Japan was seeking to forge a centralized government and national identity from an isolated and fractured country that had long been under shogunate rule. After Commodore Perry's arrival in 1853, Japan was far more vulnerable to being occupied in the 1870s and 1880s and had to limit the risk of opening its doors even further to foreign intrusion. Furthermore, uniting the country meant thinking about infrastructure projects in more of a national context, rather than considering only the local impact of each line.

By the 1880s, the government created financial institutions that provided Japanese companies and railway promoters with more tools to privately finance railway construction based on the European model. This included the introduction of a modern currency and banking

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<sup>172</sup> Ibid., 62.

<sup>173</sup> Whether transportation should be state-owned or privately-owned is a never-ending debate. In search of the optimal way to operate railroads, some countries go between being nationalizing and privatizing its networks. Japan formally nationalized its railways in 1904 and privatized them in 1987, and British nationalization took place in 1948 and re-privatization occurred in 1993. Meanwhile, India has remained nationalized for decades. Emma Loffhagen, "What does rail renationalization mean and who owns the UK's railways?," *Evening Standard*, January 3, 2023, <https://www.standard.co.uk/news/transport/rail-nationalisation-trains-who-owns-labour-party-keir-starmer-b1028349.html> (accessed February 12, 2023).

system.<sup>174</sup> However, there were high-ranking officials in place who were strong advocates for maintaining government oversight and control of national railway standards and policies. For example, in 1881, when Matsukata Masayoshi lobbied the government to let him build Japan's first private line with government subsidies and guarantees, similar to financial arrangements in Europe, he was met with fierce opposition by Inoue Masuru, head of the Railway Bureau, who was "an outspoken advocate of unified state control over the railway network."<sup>175</sup> Following considerable pressure, private lines eventually began construction, but at least for the first twenty years of Japanese railway development, the state set railway policy with minimal input from private companies.<sup>176</sup> However, the government's power lessened once the Diet was opened in 1890. As Ericson writes, "Within the Meiji state, then, decision making on railroads came to involve an array of participants—bureaucrats, bankers, and businessmen—all jostling with one another for influence over railway policy."<sup>177</sup> While this initially resulted in a confusing patchwork of train lines, the supremacy of the narrow gauge remained unchallenged until the military decided that it would operate more efficiently on a standard gauge system. Following the first Sino-Japanese War (1894-1895), the military began to lobby the government to replace *all* tracks in Japan with standard (broader) gauge.<sup>178</sup> The proposal was almost adopted before the military dropped it in exchange for nationalization of the railways in 1905.<sup>179</sup>

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<sup>174</sup> Natalie McPherson, "India and Japan: Laissez-Faire and Economic Development from 1850 to 1939," *Canadian Journal of Development Studies*, vol. 6, no. 2 (February 2011): 298, <https://doi.org/10.1080/02255189.1985.9670127>.

<sup>175</sup> Ericson, 117.

<sup>176</sup> *Ibid.*, 16.

<sup>177</sup> *Ibid.*, 17.

<sup>178</sup> *Ibid.*, 274-75.

<sup>179</sup> *Ibid.*, 261-262. The Japanese military again lobbied for standard gauge in 1919, but that proposal was rejected because of a change in government. Japan did not consider standard gauge again until the 1960s when it built the first Shinkansen. Aoki, *A History of Japanese Railways*, 52.

In retrospect, the first twenty years of tight state oversight of railway policies might have been critical to keeping Japan free from gauge break problems. By the 1890s, when Japan was most at risk of developing gauge break issues with the growing influence of private and political parties, most countries had nationalized their gauges. In particular, both Britain and the U.S. had demonstrated to the world why transshipment points are incompatible with an efficient railway network. Japan seems to have absorbed these lessons, possibly from the many engineering students who were now studying abroad, especially in the West. In fact, the only country where gauge breaks problems grew much worse was India under British control. Thorner identifies Japan's autonomy as perhaps the most significant reason why the country diverged so greatly from India in railway development:

The foreign orientation of India's economic life and the wasteful use of her limited resources stand in sharp contrast to the domestic orientation of Japan's economy and the careful husbanding of the limited capital available to the Japanese. The difference in the pattern of evolution of the two countries is certainly not attributable to a single factor like railway policy. Rather, the difference in railway policy simply illustrates the difference in the direction and emphasis between a country running its own affairs and a dependency whose affairs were being managed by an external power.<sup>180</sup>

A continuing debate about Japan's narrow gauge selection should be mentioned. Several critics have argued that the narrow gauge was probably not the best choice for the country because the narrower the gauge, the slower the top speed.<sup>181</sup> While a narrow gauge track can make tighter turns, it lacks the stability to run high speed trains.<sup>182</sup> As mentioned above and discussed in the section on Manchuria, the Japanese military expressed a preference for standard gauge in the late 1800s and early 1900s. More recently, Free suggests the selection of narrow

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<sup>180</sup> Thorner, "The Pattern of Railway Development in India," 214.

<sup>181</sup> Christopher P. Hood, *Shinkansen: From Bullet Train to Symbol of Modern Japan*, New York: Routledge (2006) 22-23.

<sup>182</sup> T. Editors of Encyclopedia Britannica. "gauge." *Encyclopedia Britannica*.

gauge “is an issue that would forever flavor and bedevil the Japanese railway system” by limiting its ability to run faster trains and have its freight cars run on standard tracks in China and Korea.<sup>183</sup> Another train expert, Christopher Hood, suggests that without the Shinkansen, Japan’s railway network today would not be considered remarkable. He suggests that two train systems exist in Japan—the gold standard Shinkansen that runs on standard gauge and whatever commuter and freight traffic operate on the narrow gauge. As to the latter, he observes, “Having been to all 47 prefectures, and most by train, I can say from personal experience that many trains are old, dirty and even do not run to schedule.”<sup>184</sup> Saito falls somewhere in the middle, writing, “There are still some loud complaints about the problems caused by Japan’s adoption of the 3’6” narrow gauge[,] but it is simplistic to say that if Japanese railways had switched to standard gauge they would have immediately enjoyed greater capacity and speed.”<sup>185</sup> Note the use of the word “immediately” because few today question that the standard gauge would have been preferable in hindsight. Outside of discussions in social media forums by railway enthusiasts,<sup>186</sup> it is difficult to locate scholarship in English that analyzes why Japan never regauged its tracks. Free has remarked the “congestion and inadequacies of the Japanese narrow gauge lines ... gave rise to the decision to build an entirely new network fresh from the ground up in the 1950s that acme to be the Shinkansen or ‘Bullet Train’ network.”<sup>187</sup> Therefore, while the Japanese

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<sup>183</sup> “On Board With Dan Free, Author Of ‘Early Japanese Railways,’” *The Shogun House Blog*, March 13, 2009, <http://www.theshogunhouse.com/2009/03/on-board-with-dan-free-author-of-early.html> (accessed February 13, 2023).

<sup>184</sup> Hood, *Shinkansen*, 15. Hood’s book was published in 2006, so it may not be an accurate description of Japan’s trains today.

<sup>185</sup> Saito, 38.

<sup>186</sup> Online opinions range from the gauge conversion probably being too slow or too extensive given Japan’s 12,864 kilometers of narrow gauge track. See u/OOcrashtest, “Why Doesn’t Japan regauge its railways to standard Gauge?,” *Reddit*, July 2022, [https://www.reddit.com/r/transit/comments/w6u41u/why\\_doesnt\\_japan\\_regauge\\_its\\_railways\\_to\\_standard/](https://www.reddit.com/r/transit/comments/w6u41u/why_doesnt_japan_regauge_its_railways_to_standard/) (accessed April 20, 2023) and Karson Chan, Why did Japan stick with the 1067 mm gauge railways instead of adopting the 1435 mm (standard gauge), *Quora*, 2018, <https://www.quora.com/Why-did-Japan-stick-with-the-1067mm-gauge-railways-instead-of-adopting-the-1435mm-standard-gauge> (accessed April 20, 2023).

<sup>187</sup> “On Board with Dan Free, Author Of ‘Early Japanese Railways.’”

government has stubbornly stuck to its ‘narrow gauge’ guns, a strong argument can be made that it was the wrong decision in the long run.

### ***Manchuria.***

“Railway Imperialism.” Before discussing gauge breaks in Manchuria, it is important to define the term “railway imperialism” as it is used in this thesis. In the “Introduction” to the collection of essays in *Railway Imperialism*, historian Ronald E. Robinson describes railways building as “an instrument of informal empire” and the locomotive “as the main engine of imperialism.”<sup>188</sup> Railroads were a technological advancement that provided a quick and efficient way to move troops and extract raw materials and crops. Countries with imperial aspirations often seized opportunities to finance railroads in poorer countries in return for concessions, like determining where lines would be built and taking over management of the railroads after construction.<sup>189</sup> The takeover of rail lines could also be achieved through negotiated treaties. But to the extent control of the railways developed into an informal empire, they often required more diplomatic finesse than merely invading a country. As one historian noted, there are a “gamut of imperialisms, from the most violent to the most cooperative.”<sup>190</sup> For purposes of this thesis, the term “railway imperialism” refers to expanding an informal empire along the rail lines through concessions and negotiations, but without declaring war. This is why the term is applicable to Manchuria, but not India.

Railways and Gauge Breaks in Manchuria. At the end of the 19<sup>th</sup> century, Britain and Japan could not have been more different. Britain was an imperial power with one of the world’s

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<sup>188</sup> Robinson, “Introduction,” 2-3.

<sup>189</sup> Ibid., 4-5.

<sup>190</sup> Daniel R. Headrick and Kenneth E. Wilburn, *The International Journal of African Historical Studies* 25, no. 1 (1992), 194, <https://doi.org/10.2307/220184>.

largest economies, while Meiji Japan was a young nation adapting to “the predatory environment of the age of Imperialism.”<sup>191</sup> However, both countries wanted to expand into Asia and believed that railways provided a cost-effective way of “absorbing small states into empire.”<sup>192</sup> As historian Yoshihisa Matsusaka, observes, “the establishment of a railhead in a territory [had become] the equivalent of a military presence.”<sup>193</sup> Throughout China, Western nations like France, Germany, Russia and the U.S. joined Britain and Japan in seeking to claim informal empires through railway imperialism. Therefore, between 1894 and 1898, China went from having 250 miles of tracks to 6,500 miles of tracks under foreign contracts.<sup>194</sup> Almost all railroads were constructed using Europe’s standard gauge, except in Manchuria for reasons discussed below.

In the 1890s, Russia was an imperial power that worried Japan, and importantly, it was trying to build connections to the Trans-Siberian Railway through Manchuria. It planned for one line to go to Vladivostok, a Russian port that is frozen half of the year, and the other to Darian (later renamed Port Arthur), an ice-free port in the Liaotung Peninsula that borders Korea. To realize its ambitions, Russia became China’s protector after the Sino-Japanese War ended in 1895, a mutually beneficial arrangement because China needed an ally in its hostile relationship with Japan. Russia lent China money to pay off its war debt to Japan in exchange for the right to extend the Trans-Siberian Railway through Manchuria.<sup>195</sup> Constructing tracks with Russia’s broad (five feet) gauge, rather than the standard gauge used through most of China, introduced a

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<sup>191</sup> Yoshihisa Tak Matsusaka, *The Making of Japanese Manchuria, 1904-1932*, Boston: Harvard University Asian Center (2001), 21.

<sup>192</sup> Robinson, “Introduction,” *Railway Imperialism*, 1

<sup>193</sup> Matsusaka, *The Making of Japanese Manchuria*, 24.

<sup>194</sup> Yoshihisa Tak Matsusaka, “Japanese Imperialism and the South Manchuria Railway Company, 1904-1914,” Doctoral Dissertation, Harvard University, 1993, 26-27.

<sup>195</sup> S. V. Constant, “The Railways of Manchuria” *The Military Engineer* 25, no. 140 (1933), 119-120, <http://www.jstor.org/stable/44563739> (accessed March 27, 2023).

gauge break in Manchuria.<sup>196</sup> In exchange for the loan, China agreed to let Russia establish the Chinese Eastern Railway Company (CER) that would connect to the Trans-Siberian Railroad to Vladivostok and Port Arthur.<sup>197</sup> This arrangement gave Russia colonial-like powers on its lines, including use of the Russian military as railway “security,” while establishing a “Railway Zone”—territory that ran along the tracks where Russia had sovereign nation status. This allowed the Russians to build facilities near the tracks like commercial buildings, residential communities, schools, and hospitals.<sup>198</sup>

The CER is a classic example of railway imperialism, where nations use railroads to create an informal empire, and it is a lesson that the Japanese would learn well in both Manchuria and Korea. While the Japanese occupation of Korea is not discussed here, it is important for background information to explain that the First Sino-Japanese War came about because China and Japan were seeking control of Korea between 1876 and 1894.<sup>199</sup> Japan saw Korea as both a launching point for its imperial ambitions and a critical line of defense against Chinese and Russian aggression, a threat called “a dagger pointed at the heart of Japan.”<sup>200</sup> This is why, as early as 1888, a Japanese general warned, “The day the trans-Siberian railway is completed is the day the crisis comes to Korea, and when the crisis comes to Korea, all of the

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<sup>196</sup> Constant, “The Railways of Manchuria,” 120. It is unclear why Russia chose the broad gauge. A popular belief among some railway historians is that the Russians chose the broader 5-foot gauge because they wanted to prevent invasions by European militaries using the standard gauge. Historian R. M. Haywood argues that this is probably not true since Russia had already built a standard gauge line between Warsaw and Vienna, and a senior Russian officer also noted it would simply destroy tracks to avoid their use by approaching enemy. Haywood suggests that the 5-foot gauge was selected *only* for the St. Petersburg-Moscow Railway as a compromise with those who wanted a 6-foot gauge and because the builders thought the line would never connect to Europe. But, as more lines were built in Russia, most connected to the St. Petersburg-Moscow line. Therefore, in 1860, the government of Tsar Alexander II ordered that the 5-foot gauge be used throughout Russia despite the fact it would cause a gauge break with Europe. See Haywood, R. M. “The Question of a Standard Gauge for Russian Railways, 1836-1860.” *Slavic Review* 28, no. 1 (1969), 78-79. <https://doi.org/10.2307/2493039>.

<sup>197</sup> Matsusaka, *The Making of Japanese Manchuria*, 28.

<sup>198</sup> *Ibid.*, 71.

<sup>199</sup> Peter Duus, “Introduction: Japan’s Informal Empire in China: 1895-1937: An Overview,” *The Japanese Informal Empire in China, 1895-1937*, xxii.

<sup>200</sup> Matsusaka, *The Making*, 23.

Orient will face upheaval.”<sup>201</sup> Following China’s loss to Japan, it recognized Korea as a sovereign and independent state, ending its long occupation of the country.<sup>202</sup> Japan would proceed to step into the void left by China.

Japan built its first railways in Manchuria because of the Russo-Japanese War (1904-05). Following its victory in the Sino-Japanese War, the Japanese remained concerned that Russia would use the railways to conquer both Korea and Japan, especially after Count Sergei Witte, Russian diplomat and architect of the CER, openly discussed “conquest by railway” as the future of his country’s global expansion.<sup>203</sup> Again, Russia may have been the first imperial power to see the potential of railway imperialism to achieve colonization using diplomacy, negotiation, and railroad technology instead of military force. Japan’s concern about Russian encroachment was reinforced by the Triple Intervention in 1895 when China had agreed to give up the Liaotung Peninsula to Japan, but Russia, France, and Germany forced its return.<sup>204</sup><sup>205</sup> Ten months after the Triple Intervention, China signed a contract with the Russo-Chinese Bank that granted Russia the right to build the CER to Port Arthur in the Liaotung Peninsula—exactly what Japan feared might happen.<sup>206</sup> But, the Japanese military was torn on whether to declare war against Russia. On the one hand, the Tsar’s army had a reputation for being the strongest in the world, and Japan knew that it could not match Russia in “absolute military power.”<sup>207</sup> But, Japan also worried that the longer it waited to confront Russia, the stronger the country would become in Asia.<sup>208</sup>

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<sup>201</sup> Ibid., 24.

<sup>202</sup> Lawrence H. Battistini, “The Korean Problem in the Nineteenth Century,” *Monumenta Nipponica* 8, no. 1/2 (1952), <https://doi.org/10.2307/2383005>, 62

<sup>203</sup> Matsusaka, *The Making of Japanese Manchuria*, 65 -66.

<sup>204</sup> Ibid., 25.

<sup>205</sup> This concession caused an outcry among the Japanese, who felt humiliated and cheated by the West again, which laid the groundwork for a war with Russia. Matsusaka, *The Making of Japanese Manchuria*, 25.

<sup>206</sup> Herbert Wright, “Japan’s Rights in Manchuria,” *Advocate of Peace through Justice* 94, no. 1 (1932): 40, <http://www.jstor.org/stable/20681662>.

<sup>207</sup> Matsusaka, *Japanese Imperialism*, 46.

<sup>208</sup> Matsusaka, *The Making of Japanese Manchuria*, 35.

Once Japan decided to declare war, it took advantage of its proximity to China and quickly replaced sections of the CER's broad gauge track, beginning at Port Arthur, with Japan's narrow gauge. This introduced another gauge into Manchuria, but it was the only way for the Japanese army to support military operations using Japan's own rolling stock.<sup>209</sup> Importantly, the army quickly narrowed the CER's broad gauge tracks and then cut off the ends of the railroad ties so that the tracks could not be returned to the original gauge—a technique the Germans employed with Russian tracks during World War I.<sup>210</sup> Japan also built a narrow gauge line from the Korean border to the center of the Liaoting Peninsula as a way to quickly replenish soldiers and supplies.<sup>211</sup> As Japan's military analysts predicted, Russia struggled in the earliest months of the war because of its "absolute dependence on the railroads," as well as the difficulties of transporting equipment and soldiers on the single line of the Trans-Siberian Railroad, which was still under construction.<sup>212</sup> Matsusaka suggests that railroads were a major factor in not only shaping the battlefields of Manchuria, but determining the war's outcome as well.<sup>213</sup> In 1905, Japan shocked the world by declaring victory against Russia.<sup>214</sup> A Japanese military analyst wrote:

The tactical mobility of a large army depends on the efficiency and effectiveness of its logistical apparatus, and there is no better way to ensure sound logistics than to make use of the high-speed transportation capabilities of the railroad. Our success during the recent war would not have been possible had we not [been] able to make sure of the Chinese Eastern Railway.<sup>215</sup>

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<sup>209</sup> Malcolm W. Davis, "Railway Strategy in Manchuria," *Foreign Affairs* 4, no. 3 (1926), 499, <https://doi.org/10.2307/20028472>.

<sup>210</sup> *Ibid.*, 499.

<sup>211</sup> Matsusaka, *Japanese Imperialism*, 60.

<sup>212</sup> *Ibid.*, 75.

<sup>213</sup> *Ibid.*, 80.

<sup>214</sup> Matsusaka, *The Making of Japanese Manchuria*, 46-47.

<sup>215</sup> Matsusaka, *Japanese Imperialism*, 80.

Japan gained important concessions from Russia, including Port Arthur and the portion of the CER in south Manchuria, although Russia managed to maintain control of the CER in north Manchuria during peace negotiations.<sup>216</sup> At this point, the Japanese military and government debated whether to colonize Manchuria informally by engaging in the same type of railway imperialism as Russia. Although Japan had agreed to remove its military from Manchuria within two years, ownership of the railways meant it could leave behind a ‘security force’ that would protect the sovereign status of the Railway Zone which Russia had already established. In other words, Japan agreed with Witte that occupying the most important infrastructure in a country was a back door route to colonization. Manchuria was a poor region, but potentially rich in raw materials like coal. It had farmland that produced a large soy crop<sup>217</sup> and had two large rivers, although those were frozen for part of the year.<sup>218</sup> It also had a population of forty million people who could be a source of cheap labor and a market for goods since all textiles were imported into the region.<sup>219</sup> Manchuria was also an under-developed country with a transportation system that resembled India’s—oxen-pulled carts on muddy roads, which were useless during the rainy season.<sup>220</sup> Its economy was weak, with most industry centered on coal and soy production. Manchuria could be to Japan what India was to Britain but without a military takeover.

Manchuria was the only part of China with gauge breaks; standard, broad- and narrow-gauge railroads all operating in the region. Japan would have to address this issue if it wanted trade with China that had no transshipment points. But standardizing Manchuria’s railways would cost money, and post-war Japan was struggling economically.<sup>221</sup> The Japanese were so

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<sup>216</sup> Constant, “The Railways of Manchuria,” 119–22.

<sup>217</sup> Matsusaka, *The Making of Japanese Manchuria*, 66.

<sup>218</sup> *Ibid.*, 17.

<sup>219</sup> Bix, Herbert P. “Japanese Imperialism and the Manchurian Economy, 1900-31.” *The China Quarterly*, no. 51 (1972): 425–43. <http://www.jstor.org/stable/652483>. 425

<sup>220</sup> Constant, “The Railways of Manchuria,” 122.

<sup>221</sup> *Ibid.*, 120.

uncertain about what to do with Manchuria that they briefly entered into a joint venture with Edward Henry Harriman, an American railway magnate, to let the Union Pacific build and manage railways in Manchuria.<sup>222</sup> But, the joint venture was never finalized for reasons that still remain unclear. Matsusaka makes a persuasive argument that the ongoing threat posed by Russia and imperial aspirations may have finally convinced Japan to expand into Manchuria, although this meant the Manchurian endeavor had to be profitable.<sup>223</sup> Matsusaka writes:

Key to the empire-building strategies employed in Manchuria was a creative, three-fold use of the railroad: as a military device, as an instrument of territorial control, and as a source of revenue to finance the venture as a whole. To be sure, none of these applications of the railroad technology were, in themselves, Japanese innovations. All were well established in Western practices by the end of the nineteenth century. What was special about the use of the railroad in Japanese strategies was the intensity and skill with which its potentialities were exploited.<sup>224</sup>

The first thing Japan did was to borrow Russia's blueprint of using the sovereignty of the Railway Zone to allow Japan to build along the tracks as it pleased. It also claimed that railways were commercial ventures that needed to be guarded by its 'security,' which meant its military. To maintain the illusion that Japan was not using the railways to become an occupying power, it created a company called the South Manchurian Railway (SMR), which would be headed by Gotō Shimpei, a well-respected physician turned bureaucrat who led civilian affairs in Taiwan.<sup>225</sup>

As discussed earlier, when Dalhousie became the Governor-General in India, he arrived with a background in railroad operations. Based on the many difficulties he encountered with the

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<sup>222</sup> Matsusaka, *The Making of Japanese Manchuria*, 43-44.

<sup>223</sup> Matsusaka observes that there is a "lack of direct evidence pertaining to the decision-making process" of Japan's leaders at this time but feels that not enough focus has been directed at national security concerns (*Japanese Imperialism*, 70, 114-15).

<sup>224</sup> Matsusaka, *Japanese Imperialism*, 7-8.

<sup>225</sup> *Ibid.*, 6-7.

gauge break problem in England, he was determined that India should use only a single broad gauge for its entire network. In Manchuria, Gotō Shimpei provided the same visionary leadership as Dalhousie for the region's railway network, since Gotō had some experience with railway operations in Taiwan.<sup>226</sup> According to his personal secretary and biographer, Gotō was “the primary architect of the Manchurian railway project” and was heavily influenced by how the East Indian Railway Company was structured.<sup>227</sup> In a page out of a spy novel, it was reported that in 1905, Gotō rode a horse to military headquarters and met secretly with the general in charge of the armed forces in Manchuria.<sup>228</sup> He laid out his plan for a large railway operation in Southern Manchuria as a means for Japan “to manage its victory spoils” from the Russo-Japanese War.<sup>229</sup> Gotō's national vision for the Manchurian railways was a perfect fit for Japan's international aspirations. An informal empire, with exploitation of Manchuria's natural resources and people, could be achieved without a declaration of war.

Unfortunately, as Matsusaka often observes, there are few documents from this period that discuss Japan's decision-making process in the early days of operations in Manchuria.<sup>230</sup> This lack of documentation includes the decision about gauges. All that is known is that in 1906, Gotō ordered the conversion of all railways to standard gauge, including Japan's 760 miles of narrow gauge tracks and the remaining unconverted miles of CER broad gauge now under

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<sup>226</sup> Mitsuhide Imashiro, “Japanese Railway History 4; Nationalisation of Railways and Dispute over Reconstruction to Standard Gauge,” *Japanese Railway and Transport Review*, No. 4, <https://www.ejrctf.or.jp/jrtr/jrtr04/history.html> (accessed March 23, 2023).

<sup>227</sup> Matsusaka, *Japanese Imperialism*, 155-56.

<sup>228</sup> Ramon H. Myers, “Japanese Imperialism in Manchuria: The South Manchuria Railway Company, 1905-1933,” in *The Japanese Informal Empire in China, 1895-1937*, Princeton: Princeton University Press (1989), 101.

Matsusaka challenges the suggestion that Gotō was the SMR's mastermind primarily because there is a lack of evidence to support it. Unlike Dalhousie, who wrote hundreds of pages on India's railways, the outline proposing the SMR does not even contain Gotō's name. Matsusaka suggests Gotō was later lionized to give legitimacy to the SMR when it later faced scrutiny. *Japanese Imperialism*, 156-59.

<sup>229</sup> *Ibid.*, 102.

<sup>230</sup> Matsusaka, *Japanese Imperialism*, 114-15.

Japanese control.<sup>231</sup> Because Japan only manufactured narrow gauge trains at the time and had not yet expanded into other markets, Gotō had to order 50,000 tons of American railway cars to run on the tracks.<sup>232</sup> One engineer suggests a primary reason for the conversion was to cut the Russian military's access to south Manchuria and Port Arthur.<sup>233</sup> This is supported by the fact that when Russia finally sold the northern portion of the CER to Japan in 1935, the Japanese military immediately switched 150 miles of broad gauge track to standard gauge *in three hours* (Image 5), a massive undertaking similar to what railroad companies had done in the South in 1886.<sup>234</sup> But, even before selling the northern CER line, Russia had stopped almost all railroad construction in Manchuria.<sup>235</sup> Japan's decision to use the SMR as a security buffer against Russia had proved to be a good decision.

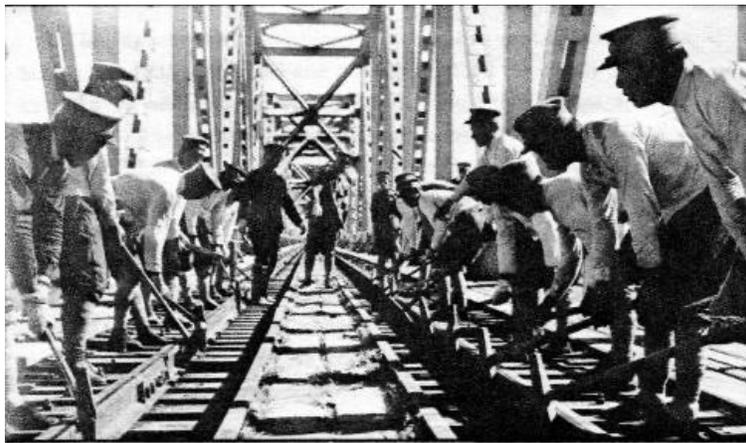


Image 5: Japan Changing Gauge on CER in 1935.<sup>236</sup>

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<sup>231</sup> S. V. Constant, "The Railways of Manchuria" 119-120.

<sup>232</sup> Myers, 105.

<sup>233</sup> Constant, "The Railways of Manchuria," 120-21.

<sup>234</sup> Gross, "The Ties that Bind," 1-2.

<sup>235</sup> Ginsburg, Norton S. "Manchurian Railway Development." *The Far Eastern Quarterly* 8, no. 4 (1949): 398-411. <https://doi.org/10.2307/2049540>. 400

<sup>236</sup> "South Manchuria Railway – Change of Russian Track Gauge in 1936," Gwulo Old Hong Kong, <https://gwulo.com/media/36749> (accessed March 27, 2023). It is much easier to convert tracks from broad to narrow gauge because there is no concern with rail tie width or curve radius. This makes India's Project Unigauge all the more impressive.

Furthermore, Gotō might have chosen the standard gauge for Manchuria because the Japanese themselves were debating whether to switch their country's narrow-gauge tracks to standard gauge. As discussed earlier, the Japanese military complained about numerous problems with trains operating on narrow gauge during the First Sino-Japanese War (1894-1895) and lobbied the government to replace all tracks in Japan with standard gauge.<sup>237</sup> This proposal was almost adopted until the military dropped that demand in exchange for nationalization of the railroads, which occurred in 1905 at the start of the Russo-Japanese war.<sup>238</sup> Therefore, once the war ended, it is likely that the military was only too happy to switch its own narrow gauge tracks in Manchuria to standard gauge.

Also, using anything besides standard gauge in Manchuria meant Japan could not trade easily with the China's network.<sup>239</sup> Gotō was charged with quickly making the SMR profitable enough to pay for Japan's informal empire in Manchuria, which would prove difficult if gauge breaks hindered trade and passenger travel. He could only maximize profits if Japan "linked the region, via its railways, to the world market," and much of the trading network ran through China.<sup>240</sup> Even after Gotō left his position, the Japanese government and military were heavily involved in SMR policies, which was helped by Japan's proximity to Manchuria. For reference purposes, below is a 1928 map showing the SMR and other railway networks in the region (Figure 6).

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<sup>237</sup> Ericson, 261-62, 274-75.

<sup>238</sup> Ibid., 261-62.

<sup>239</sup> See the earlier discussion of gauge break costs in this thesis at 7-11.

<sup>240</sup> Bix, "Japanese Imperialism and the Manchurian Economy, 1900-31," 430.

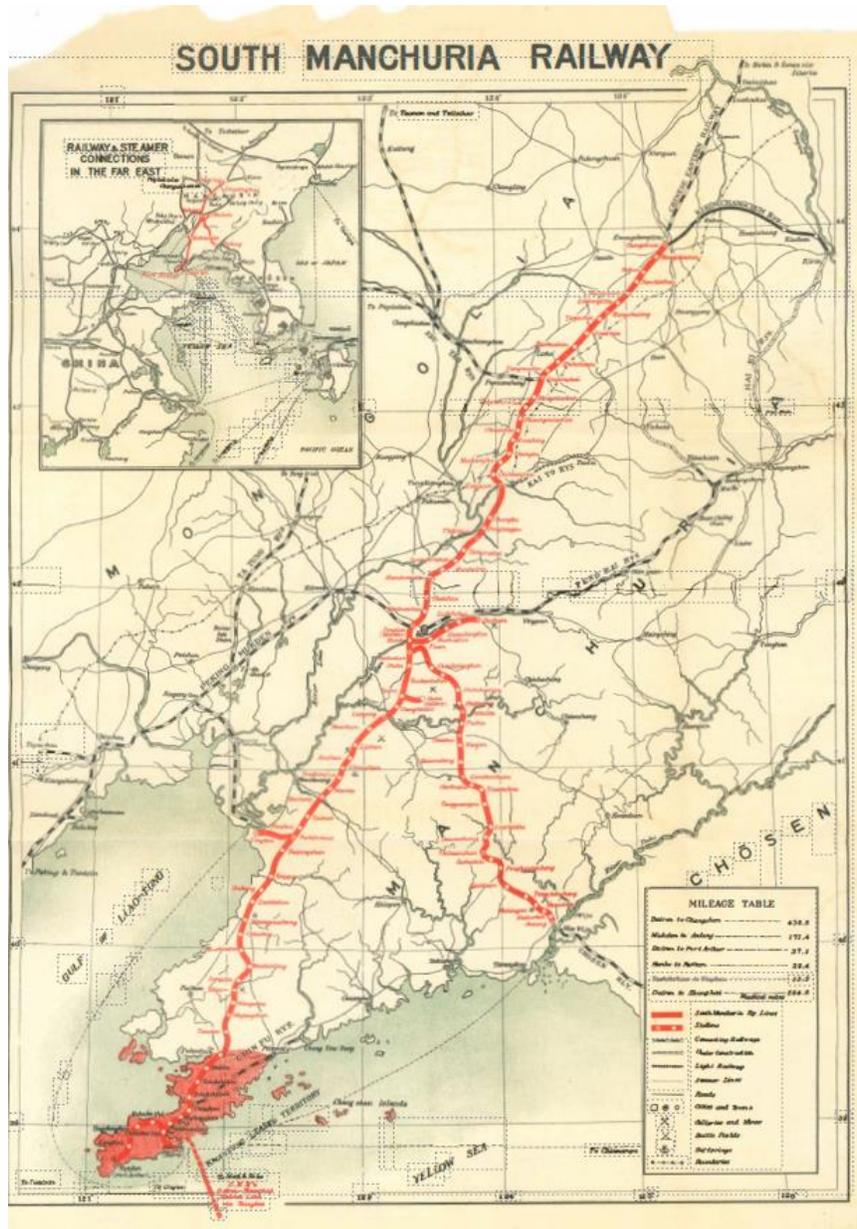


Image 6: Map of South Manchuria Railway (1929)<sup>241</sup>

Importantly, unlike in India, if the SMR lost money, that loss would be paid for by Japanese investors and taxpayers. The government established the SMR as a joint-stock corporation to provide “camouflage” that it was setting up a commercial, non-military

<sup>241</sup> Map insert from Henry W Kinney, *Modern Manchuria and the South Manchuria Railway Company*, Tokyo: The Japan Adventure Press, 1929.

operation.<sup>242</sup> SMR shares offered a six percent dividend guaranteed by the Japanese government, which also owned fifty percent of the stock purchased through dubious accounting methods.<sup>243</sup> The other fifty percent of the stock could only be purchased by the Japanese and Chinese, although there were no Chinese investors because Japan gave them too little notice to place orders.<sup>244</sup> After nationalization of the Japanese railways in 1905, the Japanese were looking for new railroad investments, so the first SMR stock offering was very popular, and “prospective investors subscribed to more than 1000 times the number of shares available.”<sup>245</sup> The stock offering raised 200 million yen, but Japan continued to borrow on foreign markets to raise additional funds.<sup>246</sup> Therefore, the Japanese government and taxpayers, which included SMR stockholders, were invested in SMR’s success. After all, they would have to cover losses if the venture failed—a failure that might invite a return of Russia or other powers to the region.<sup>247</sup>

But, the SMR did not fail. Under indirect Japanese control, the Manchurian economy thrived, even if the peasants did not.<sup>248</sup> As Matsusaka noted, “Nowhere was the railroad harnessed so effectively as an instrument of empire as by the Japanese in Northeast China.”<sup>249</sup> Japan’s version of railway imperialism succeeded, and some credit must go to the standardization of gauge in Manchuria. This standardization occurred because the Japanese had financial and security stakes in the success of the SMR. Japan also had a national, and even

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<sup>242</sup> Matsusaka, *Japanese Imperialism*, 150.

<sup>243</sup> *Ibid.*, 151.

<sup>244</sup> The Chinese government also refused to buy stock so as not to show any support for the SMR. *Japanese Imperialism*, 152.

<sup>245</sup> Matsusaka, *Japanese Imperialism*, 151-52.

<sup>246</sup> Myers, 104.

<sup>247</sup> The fact that the SMR investors and Japanese taxpayers were one and the same makes the guarantee aspect of the investment quite different from the India’s guarantee contracts, where losses were shifted to Indian taxpayers.

<sup>248</sup> Bix, “Japanese Imperialism,” 54.

<sup>249</sup> Matsusaka, *Japanese Imperialism*, 7-8.

international, vision for Manchuria's railroad system, and the its government-maintained oversight of railway policy, despite changes in SMR leadership.

## **Conclusion**

During the course of receiving feedback for this thesis, a question was asked as to whether gauge breaks are a relative, rather than an absolute, problem, depending on the degree to which regional economies are integrated. The simple answer is yes, gauge breaks are a relative problem that will not pose serious issues for lines with different gauges that follow the 'hub and spoke' model or serve narrow purposes, like those built only to transport raw materials from the location of harvest or mining to the final destination (e.g. a port). But the use of different gauges will result in the need to purchase separate locomotives and cars and will create a transshipment point if the lines later merge. As the British discovered from the earliest days of their railroads, moving from a *line* to a *network*, which frequently occurs, is made infinitely harder when gauge breaks are involved.

However, a more nuanced answer to whether gauge breaks are a relative or absolute problem circles back to the story of Russian tires discussed in the Introduction. As long as Russia never engaged in a full-scale war, then it was not unreasonable to use decades-old Soviet tires on trucks that were only required, at most, to drive for short distances on paved roads. Those who decided to keep aging and poorly maintained tires probably took the same localist approach as the earliest promoters of British rail lines. Unfortunately for them, circumstances changed. Russia launched a full-scale invasion of Ukraine, and the Russian army was ordered to reach Kiev quickly. This proved to be an unachievable goal for several reasons, including defective tires.

Bad tires are not always fatal, just like gauge breaks are not always evil. There are exceptions to the rule, such as gauge breaks that create a more efficient railway system, like Japan's Shinkansen or the futuristic monorail (no gauge) track for the Shanghai Maglev train that operates by magnetic levitation.<sup>250</sup> But working within the parameters of the rule and not its exceptions, this thesis argues that at least historically, gauge breaks and transshipment points have been costly, highly inefficient, and aggravating, especially for passengers. They rarely served a useful purpose and were eliminated where possible. The thesis then examined the causes of gauge breaks by studying the development of railways in Britain and Japan, as well as in India and Manchuria, territories under some degree of imperial control. The thesis concludes that gauge breaks were largely a result of—

- Interested parties adopting of a local, rather than national or international, approach to railroad construction (building a line instead of a network);
- Railways being financed by parties who either did not expect, or were not impacted by economic losses and unprofitability of the lines;
- Inconsistent railway policies often influenced by a revolving door of advisors and/or parties with conflicting interests (e.g. proponents of *laissez-faire* competition versus strong regulatory oversight); and
- In India, the inability of those impacted most by the gauge breaks to petition for redress.

The research has also revealed other lines of inquiry. For example, what was the long-term economic and political impact of using Russia's broad gauge on former Soviet satellites?

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<sup>250</sup> Dave Hall, "Maglev trains: why aren't we gliding home on hovering carriages?" *The Guardian*, May 29, 2018, <https://www.theguardian.com/technology/2018/may/29/maglev-magnetic-levitation-domestic-travel> (accessed May 5, 2023).

This question is particularly topical because, recently, Ukraine has decided to switch from broad to standard gauge, in an effort to bring it closer to Western Europe and “emancipate itself from the ‘Russian brother.’”<sup>251</sup> Also, it would be interesting to further explore how the American South settled on the broad gauge, and the extent to which that decision impacted the outcome of the Civil War. Finally, it might prove helpful to research if the long-promised southern route between East Asia and Western Europe, sometimes called the Iron Silk Road,<sup>252</sup> will be possible to finish without gauge breaks—a problem as old as the railroads themselves.

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<sup>251</sup> Frédéric de Kemmeter, “Ukraine wants to connect to Europe in 1.435mm,” *Media Rail*, January 26, 2020, <https://mediarail.wordpress.com/ukraine-wants-to-connect-to-europe-in-1-435mm/> (accessed May 5, 2023).

<sup>252</sup> Sinan Tavsan, “‘Iron silk road’ threatens to sidetrack Russia,” *Nikkei Asia*, October 31, 2017, <https://asia.nikkei.com/Economy/Iron-silk-road-threatens-to-sidetrack-Russia> (accessed May 5, 2023).

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## Images

**Image 1:** Arnold Reinhold, “World RR Gauge Map.agr.png,” Open Railway Map, June 20, 2022, [https://commons.wikimedia.org/wiki/File:World\\_RR\\_Gauge\\_Map.agr.png](https://commons.wikimedia.org/wiki/File:World_RR_Gauge_Map.agr.png) (accessed April 11, 2023).

**Image 2:** Dipak Raychaudhuri, “History & Heritage of Indian Railways,” August 16, 2015, <http://dipakrc.blogspot.com/2015/08/kalighat-falta-railway-kfr.html> (accessed May 2, 2023).

**Image 3:** A.G. Kenwood, “Railway Investment in Britain, 1825-1875,” *Economica* 32, no. 127 (1965): 315. <https://doi.org/10.2307/2552228>

**Image 4:** William James Linton. “The Break of Gauge at Gloucester.” June 6, 1846. <https://collection.sciencemuseumgroup.org.uk/objects/co419665/coloured-engraving-changing-gauge-at-gloucester-engraved-by-w-j-linton-print-engraving> (accessed April 11, 2023).

**Image 5:** Waterlow and Sons, “Map of India Shewing the G.I.P. Railway, Chief Connections and Through Routes, 1911. Image accessed from Geographicus Rare Antique Maps, <https://www.geographicus.com/P/AntiqueMap/indiagiprailway-waterlow-1911> (accessed April 17, 2023).

**Image 6:** “South Manchuria Railway – Change of Russian Track Gauge in 1936,” Gwulo Old Hong Kong, <https://gwulo.com/media/36749> (accessed March 27, 2023). It is much easier to convert tracks from broad to narrow gauge because there is no concern with rail tie width or curve radius. This makes India’s Project Unigauge all the more impressive.

**Image 7:** Map of South Manchuria Railway (1929). Insert from Henry W Kinney, *Modern Manchuria and the South Manchuria Railway Company*, Tokyo: The Japan Adventure Press, 1929.