

# The Implications of the Russian Invasion of Ukraine on the Future of Sino-European Overland Connectivity

## Introduction

In the 1989 movie *Field of Dreams*, Kevin Costner's character, Ray Kinsella, hears the prophetic voice of James Earl Jones whisper to him the famously misquoted line: "if you build it, they will come". In this case, what was being built was a baseball diamond in the middle of a cornfield and those who came were baseball fans seeking to reacquire the innocence of their youth by indulging in America's favourite pastime. While seemingly unrelated to geo-economics, this iconic phrase from a bygone era of American cinema effectively encapsulates the idea that if you build something useful, people are likely to use it. In the context of Sino-European connectivity, what was built was the New Eurasia Land Bridge and those who came were a plethora of European and Chinese traders seeking an alternative means to maritime and air freight transport. In the modern age, railway freight occupies a strategic niche. It is approximately twice as fast as maritime transport and only costs a quarter as much as air transport, making it the perfect middle ground.<sup>1</sup> However, since the historical Silk Road's demise in the beginning of the 16<sup>th</sup> century, trade between Asia and Europe has been dominated by maritime transport, which, until the dawn of aviation, was both the fastest and cheapest way to transport cargo. Ergo, the notion of building a railway and logistics route through a long-disused trade corridor may have appeared to some as pure folly.

The New Eurasian Land Bridge, henceforth referred to as the NELB, is an overland railway and logistics network inspired by the historical Silk Road. It runs from China through Kazakhstan, Russia, and Belarus, before entering the European Union via Poland.<sup>2</sup> The historical gravitas that comes with being the heir to the Silk Road has made it a hallmark of Chinese leader Xi

Jinping's Belt and Road Initiative (BRI), a 4 trillion US\$ infrastructure construction initiative seeking to connect China with Europe, the Middle East, and Africa.<sup>3</sup> Strangely enough, the NELB and Ray Kinsella's baseball diamond have a lot in common. They were both undertaken in the unproven anticipation that when they were built, people would come; and in both cases, they did. Since commercially opening in 2011, freight traffic between China and the European Union has risen from virtually zero twenty-foot equivalent units (TEUs), the standard measurement for freight volume, to 46,000 in 2015, and to 1.46 million in 2021.<sup>4</sup> That year, trade along the NELB accounted for 4% of bilateral trade between China and the European Union and was valued at over US\$ 75bn.<sup>5</sup> This exponential growth in usage was expected to continue; however, unlike the *Field of Dreams*, the NELB may not end happily ever after. On the 24<sup>th</sup> of February 2022, the European continent would be forever changed as the Russian Federation began its invasion of Ukraine. Among many things, the gravity of which cannot be overstated, the invasion threatens the existence of overland connectivity passing through the now heavily sanctioned Russian and Belarusian territories. In response, this piece will endeavour to examine the logistical, political, and economic implications of the invasion on overland Sino-European connectivity with a particular focus on rail connectivity and the NELB. This will be done by analysing the state of the overland trade corridors prior to the invasion, changes to their use following the invasion, and the expected impact to the future of overland Sino-European connectivity following the war's conclusion.

## Sino-European Overland Connectivity Prior to the Russian Invasion of Ukraine

The rebirth of Sino-European overland connectivity after the collapse of the

historical Silk Road can be traced back to the completion of the Trans-Siberian Railway in 1904. This marked the first major rail connection between the Eastern and Western portions of the Eurasian continental landmass.<sup>6</sup> For over a century after its completion, the Trans-Siberian Railway and its peripheral networks in Central Asia served as the primary artery for the overland transportation of goods from the Far East into Europe.<sup>7</sup> However, prior to 2011, trade along these routes into Europe was miniscule; only playing host to a few sporadically chartered trains engaged by European firms.<sup>8</sup> According to a 2006 report published by the American Chamber of Commerce, overland routes between China and the EU existed, but had "no viable share of the commercial market"<sup>9</sup>.

The process of reinvigorating overland trade between Asia and Europe was a surprisingly expedient one, largely driven by market forces derived from the strategic niche that rail freight occupies. This is because, as a general rule, rail freight is approximately twice as fast as maritime freight and four times cheaper than air freight.<sup>10</sup> Yet, the emergence of this strategic niche in the context of Trans-Eurasian rail freight is relatively new. For example, in 2006, shipping a 40-foot container by rail from Shanghai to Hamburg took an average of 36 days and was frequently subject to delays and theft; according to the aforementioned report by the American Chamber of Commerce.<sup>11</sup> As of 2017, due to advancements in rail freight technology, simplified customs procedures, and significant infrastructure investment on the part of China, the average travel time of a 40-foot container on that same route stood at only 16 days, while having the additional benefit of a slight reduction in cost.<sup>12</sup> Comparatively, during the same time span, maritime freight from Shanghai to Hamburg saw a relatively equal reduction in cost; however, due to the implementation

of low-steaming practices to save fuel and reduce pollution, the average travel time increased from 27 to 32 days.<sup>13</sup> Air freight, while much faster than both maritime and rail at only 5 days, remains drastically more expensive. As of 2018, now using the example of a route from Shanghai to Rotterdam, the estimated shipping cost per container stood at US\$ 37,000 for air, US\$ 5,000 for rail and US\$ 2,000 for sea.<sup>14</sup> However, it should be noted that when shipping to an inland location such as Warsaw from Shanghai, the costs of maritime and rail freight are nearly identical at US\$ 4,500 and US\$ 5,000, respectively.<sup>15</sup>

Given rail transport's strategic niche in the context of Sino-European connectivity, its exponential growth in utilisation prior to the Russian invasion of Ukraine should come as no surprise. As previously mentioned, rail freight between China and the EU was virtually non-existent before 2011. The push to reverse this trend began in 2007 with the undertaking of an exploratory process by various European automotive and electronics firms, who used a small quantity of chartered freight trains to test the financial and practical feasibility of shipping certain components overland to their assembly plants in Northern China.<sup>16</sup> Volkswagen, Audi, BMW, Apple, HP, and Acer are examples of firms who were drawn to the first iteration of the New Eurasian Land Bridge since the reduced transit times, with only a modest increase in cost, allowed them to minimise their reliance on inventories.<sup>17</sup> This enabled them to secure more reliable "just-in-time" deliveries and ensure that their finished goods reached distribution centres more rapidly.<sup>18</sup> In 2011, following the success of these trials, market pressures led to the establishment of formal rail freight services between China and the EU with the opening of the Chengdu-Lodz and Chongqing-Duisburg routes, with daily services beginning in 2016.<sup>19</sup> As of February 2022, there are 78 rail lines between China and Europe connecting Chinese manufactures to 180 European cities in 23 countries.<sup>20</sup>

The growth in demand for overland freight service between China and the

EU attracted various intermediaries such as freight forwarders, operators, and facilitators to offer ever-increasing services along key routes, creating a virtuous cycle. Notable intermediaries on the European side include German freight forwarder Deutsch Bahn and its logistics subsidiary DB Schenker who operate along the NELB in the form of a joint venture with Russian Railways, known as Trans-Eurasian Logistics.<sup>21</sup> DHL also became heavily involved, providing logistics services along key rail lines between China and Europe.<sup>22</sup> The Russian firm "United Transport and Logistics Company" (UTLC) is also a major player in this field, offering services for transit through the territories of Russia, Belarus, and Kazakhstan.<sup>23</sup>

What is remarkable about the NELB, and its peripheral routes, is that its growing utilisation was more a symptom of market demand rather than of concerted efforts by any governing entity. Until 2016, the vast majority of routes along the NELB made use of 20<sup>th</sup> century rail infrastructure and saw little to no major infrastructural investment in the early phase of their growth.<sup>24</sup> However, as rail freight's strategic niche as a fast and reliable means to connect European and Asian value chains became apparent, various political authorities began to take notice, particularly in China.<sup>25</sup> In a manner reminiscent of the way Ray Kinsella heard the voice of James Earl Jones telling him to build his ballpark, Chinese leader Xi Jinping heard the call of market demand to invest into expanding the capacity of the NELB. By the end of 2015, near the time when daily rail services along the NELB were formally established, China's Belt and Road Initiative was already fully underway. In an effort to facilitate the continued success of the NELB, various existing infrastructural investments along key routes were amalgamated into the BRI. These included significant investments to boost Kazakh freight capacity by alleviating bottlenecks through projects such as the Korgos Gateway and "Nurly Zhol", Kazakhstan's state infrastructure development program.<sup>26</sup> Moreover, concerted efforts were also made by China to establish alternative routes to the NELB known as the Southern and Middle Corridors.

The former passes south of the Caspian Sea through Central Asia, Iran, and Turkey while the latter cuts across the Caspian Sea through the Caucasus and into Europe via either Turkey or the Black Sea.<sup>27</sup> The Marmaray Tunnel, passing under Turkey's Bosphorus Strait, is a keystone BRI project for both the Southern and Middle corridors and is an essential part of China's plan to transform Turkey into a hub for overland transit from China into Europe, an ambition which Turkey itself shares.<sup>28</sup> Opening in 2019, the tunnel played host to its first Chinese freight train originating from the Xi'an dry port destined for Europe in July of that same year.<sup>29</sup> These alternative routes to the NELB are collectively known as the Central Asia West Asia Corridor (CAWA) and have thus far only been partially completed; nevertheless, they currently provide a slightly longer and more expensive, yet equally traversable route from China into Europe.<sup>30</sup> The significance of this will be apparent in the following section.

### The Impact of the Russian Invasion of Ukraine on Existing Sino-European Connectivity

Having outlined the state of overland Sino-European connectivity before the Russian invasion of Ukraine, this section will endeavour to assess the immediate impacts of the invasion on the aforementioned. Firstly, it is important to note that the tragic and irreparable loss of life caused by this conflict supersedes all else, despite not being mentioned thus far, and should always be kept in mind. In the context of the current conflict, impacts on overland connectivity between China and the EU can broadly be categorised into three types of disruptions occurring within the transitory states of Russia, Belarus, and Ukraine. These are: the disruptions caused by the physical inability of transiting goods through Ukrainian territory as a direct result of the conflict, the fiscal inability of transiting goods through Russian and Belarusian territory due to the imposition of sanctions, and the practical or moral decision to cease transiting goods through Russia and Belarus due to concerns associated with the conflict.

Firstly, it must be noted that despite Ukraine being an eager participant in China's 16+1 mechanism for Eastern European cooperation, a member of the BRI since 2017, and a part of the extended NELB rail network, its individual importance to Sino-European connectivity is rather limited.<sup>31</sup> According to a report from Chinese state media "Global Times", freight rail traffic from China to the EU traversing through Ukraine only accounted for 2% of westbound rail freight trade in 2021.<sup>32</sup> Following the invasion, popular direct services from China to Hungary, which previously transited through Ukraine, have been diverted to alternative routes going either north through Poland or south via the Black Sea Ports at Constanta, Romania, and Varna, Bulgaria.<sup>33</sup> The elevated risk to cargo has completely halted transitory shipments through Ukraine, yet there are still limited services to and from Ukraine itself, albeit at a significant premium, for critically essential goods.<sup>34</sup> However, these services have also been impeded by the massive exodus of refugees who made use of passenger trains to flee, especially in the early days of the war.<sup>35</sup>

Beyond these immediate disruptions, more lasting impacts are likely to be caused by the relentless targeting of critical Ukrainian infrastructure. While seemingly obvious, it must not be forgotten that transportation infrastructure plays a key role in facilitating the delivery of war materials to combat units, thereby making it an important target for enemy forces. To this end, there have already been many documented instances where Ukrainian critical infrastructure, such as railroads, oil depots, bridges, and airports have been destroyed.<sup>36</sup> Moreover, we have also seen examples of auxiliary infrastructure, such as the power plants which facilitate Ukraine's approximately 9,500 km of electrified railways, become targets.<sup>37</sup> So much that as of 12<sup>th</sup> of April 2022, Russia had already caused US\$ 80bn worth of damage to physical Ukrainian infrastructure, with just under half of this sum being attributed to damaged roads and railways.<sup>38</sup> As the war drags on, this figure is expected to increase at an average rate of US\$ 4.5bn per week.<sup>39</sup> After the conflict's conclusion,

all damaged roads, railways, and necessary logistical infrastructure will need to be repaired in order to facilitate any possible resumption in trade flows. However, depending on the new security architecture in the region, the fear of renewed hostilities, and the associated increase in insurance costs for freight shipments, traders could be permanently driven towards other, more secure routes.

While logistically inconvenient, the removal of Ukraine as a transit corridor for overland connectivity between China and the EU is of much less significance than any disruptions occurring in its much larger neighbour, Russia, and its client state of Belarus. In 2021, almost the entirety of overland trade between China and the EU, worth over US\$ 75bn, was facilitated via the NELB through Kazakhstan, Russia, and Belarus. Westward freight shipments from China to the EU mainly contained finished electronics, while 80% of eastward trade was in automotive components sent to manufacturers in China.<sup>40</sup> By simple virtue of its geography, any overland cargo seeking the cheapest and most expedient route between the EU and China must travel north of the Caspian Sea through Russia. Therefore, unlike Ukraine, any disruptions to the overland transport of goods through its territory would be far more impactful to the flow of trade. In terms of sanctions currently affecting Russia and Belarus, the shipment of goods of either Russian or Belarusian origin, except for various essential goods such as certain hydrocarbons, baby food, or medicines, is currently prohibited under U.S and EU sanctions.<sup>41</sup> Notably, these sanctions do not include goods of other origins transiting via rail through Russia and Belarus.

As previously mentioned, Russian Railways is Russia's primary railway operator and infrastructure manager with an effective monopoly on long-haul operational services associated with overland rail freight between China and the EU.<sup>42</sup> Its president, Vladimir Yakunin, is currently sanctioned by the U.S while the company as a whole is included on both the U.S and EU sanctions lists.<sup>43</sup> However, the sanctions against Russian Railways have thus far been limited to

restricting its access to financial markets, meaning that while it is prohibited from raising capital or trading its stock, Western companies are thus far not prevented from engaging its Trans-Eurasian freight services.<sup>44</sup> This extends to its joint venture with DB-Schenker, known as Trans-Eurasian Logistics, operating along the NELB.<sup>45</sup> As of the publication of this paper, goods are therefore still allowed to transit through Russian and Belarusian territory so long as these goods are not of Russian or Belarusian origin. This is exemplified by the fact that DB-Schenker is still offering both eastbound and westbound rail freight services and logistics solutions between China and the EU as of 9<sup>th</sup> May 2022, meaning that Chinese and European goods can still travel via the NELB so long as their journey does neither begin nor end in Russia or Belarus.<sup>46</sup> However, the issue for many is not whether they can still do business with Russian Railways, and along the wider NELB in general, it is whether they should. This is because so long as these freight services are allowed to continue, Russia and Belarus can collect transit fees for goods travelling along their rail networks.

While the impact of sanctions on Sino-European overland connectivity is undoubtedly severe, they have thus far not entirely eliminated the NELB as a viable option for firms seeking to integrate their Asian and European supply chains. However, the uncertainty caused by Russia's invasion of Ukraine has led many firms, service providers, and traders alike to reconsider their commercial arrangements operating along the NELB. For example, logistics providers such as Dutch firm Rail Bridge Cargo and DHL have chosen to cease their facilitatory services along the route.<sup>47</sup> In terms of customers, Zyxel Communications Corporation, one of the largest users of the NELB, has pledged to find alternative modalities to the rail corridor.<sup>48</sup> Moreover, various German automakers, who were crucial in the early development of the NELB, are said to be currently avoiding the route for fear of possible secondary sanctions or having their cargo seized, all but destroying the demand for eastbound trains from the EU to China. Already as of the end of March 2022, freight traffic along the NELB

has declined by over 40% since February 24<sup>th</sup>, all but erasing the significant increase in utilisation seen over the course of the COVID-19 pandemic.<sup>49</sup> In an attempt to help the route weather the storm of sanctions and uncertainty, provincial Chinese authorities, at the direction of the central government, have begun heavily subsidising the routes by covering “war insurance” costs for Chinese traders should their cargo be either seized, destroyed, or returned to China as a result of future sanctions. In effect, this financial aid amounts to a sum of US\$ 1,000 to US\$ 2,500 per container, depending on the route and the relevant provincial Chinese authorities overseeing it.<sup>50</sup> To what end this will salvage Sino-European trade via rail freight is unclear, but it appears as though the route will continue to play host to some degree of trans-Eurasian cargo, mostly from China towards Europe.

#### **Future Implications of the Russian Invasion of Ukraine on Overland Sino-European Connectivity**

In examining the future implications of the Russian invasion of Ukraine, this piece will extrapolate from the impacts which have already been observed to determine what future, if any, overland commercial freight routes, such as the NELB, will have. Before delving any further, it is important to remember that the success of the NELB prior to the invasion was largely market driven. Firms sought to integrate their Asian and European value chains via the strategic niche occupied by rail freight as a faster mode of transport than sea freight and a cheaper one than air freight.<sup>51</sup> Noticing this, subsequent investment and facilitatory efforts by provincial Chinese authorities, in conjunction with advancements in rail logistics, led to the route blossoming into a key commercial artery for Sino-European connectivity.<sup>52</sup> Therefore, firms seeking to maintain the competitive advantage that comes with the overland integration of their value chains would logically aim to do so via alternative routes across the Asian continental landmass. To this end, there are two viable routes befitting this criterion known as the Southern and Middle Corridors; named as such because they

pass south and across the Caspian Sea, respectively, avoiding sanctioned Russian territory.<sup>53</sup> However, the southern route faces similar issues to the NELB in that it passes through Iranian territory, which, under the United States’ strategy of “maximum pressure,” is also heavily sanctioned. So long as this remains the case, the route will remain disused as traders will remain similarly weary as they currently are with the NELB. Yet, there is a potential for its revival given the renewed negotiations of the Joint Comprehensive Plan of Action (JCPOA) to limit Iranian nuclear proliferation that are underway in Vienna. If the negotiations succeed, the result would be the removal of certain sanctions, thereby opening the Southern Corridor. However, even if this were to happen, and the prospects of this are far from certain, various rail linkages would still need to be built or expanded upon before the route could carry significant trans-continental freight.<sup>54</sup>

Unlike the Southern Corridor, the Middle Corridor is not subject to any sanctions-related restrictions as it passes across the Caspian Sea by boat from the Kazakh Port of Aktau to Azerbaijan and then into Europe via Turkey or the Black Sea, thereby avoiding both Russia and Iran.<sup>55</sup> Starting at the Chinese dry port of Xi’an, the Middle Corridor has thus far proven to be the preferred overland alternative for both traders and operators since the Russian invasion.<sup>56</sup> Even prior to the war, the route had already been rising in popularity, accommodating 29,000 TEUs of cargo in 2021, a 52% increase from the year prior.<sup>57</sup> To service this traffic, the aforementioned Dutch logistics provider Rail Bridge Cargo, which recently ceased its operations along the NELB, has begun servicing trans-Caspian routes from Zhengzhou, China, to Duisburg, Germany, along the Middle Corridor.<sup>58</sup> A slew of Chinese rail operators and freight forwarders have also begun operating similar routes, along with Adi Container, a subsidiary of Azerbaijan Railways, which has become a key player along the Middle Corridor.<sup>59</sup> However, despite its increasing popularity, the Middle Corridor is unlikely to be able to accommodate the necessary freight traffic needed to compensate for the decline of the NELB.<sup>60</sup>

As previously mentioned, the Middle Corridor transported approximately 29,000 TEU’s of cargo between China and the EU in 2021, compared to the 1.46 million TEU’s carried by the NELB. This means that the observed 40% decline in China-EU shipments along the NELB since the Russian invasion, roughly 584,000 TEUs per annum, simply cannot be shifted to the Middle Corridor since that would represent an approximate 2000% increase in a single year.<sup>61</sup> According to Middle Corridor Logistics, a freight-forwarding consortium made up of Georgian, Azerbaijani, and Kazakh firms, the Middle Corridor has purportedly seen an exponential increase in demand since the imposition of sanctions against Russia, resulting in severe logistical bottlenecks, particularly at the Kazakh port of Aktau.<sup>62</sup> Efforts are being made to boost the Middle Corridor’s freight capacity, such as the expansion of the ports of Aktau and Baku, yet these are unlikely to provide the necessary increase in the short term.<sup>63</sup>

Beyond its lack of capacity, the Middle Corridor is far less commercially competitive than the NELB. Having to transfer over the Caspian Sea, freight rates are approximately 30% higher than those for the NELB.<sup>64</sup> Moreover, the route is considerably slower than the NELB at an average of 24 days from Shanghai to Duisburg, compared to 14-16 days for the NELB, and is only marginally faster than maritime freight, which for the aforementioned route takes 27-32 days.<sup>65</sup> This means that in the case of the Middle Corridor, the strategic niche offered by trans-Eurasian rail freight has effectively disappeared as it is only slightly faster than maritime freight yet nearly three times as expensive. Should current market conditions persist, it is likely that many traders will simply shift to other modalities, such as sea or air freight. Some traders, particularly those in China, who face less scrutiny for their continued use of the NELB, may continue to send westbound freight trains from China to the EU. However, they will likely need to be further subsidised given the now empty eastbound trains returning to China.<sup>66</sup> Regardless of the outcome of the conflict, it is unlikely that the NELB will soon return to the burgeoning trade route

that it recently was. Yet, because of logistical inhibitions facing the Middle Corridor, we could see a partial return of traders who, once the spotlight on the conflict fades, will seek to utilise the NELB once more, since the competitive advantage it offers remains. For now, however, Sino-European connectivity is in a precarious position. While still commercially viable and legally feasible, it is ethically questionable and highly vulnerable, meaning that all but the most reassured traders and operators will shy away.

It is important to note that while overland connectivity between China and the EU has been negatively impacted, alternative modalities have also suffered as a direct consequence of the decline of the NELB. For maritime freight, bottlenecks at several major Chinese ports driven by China's strict "Zero-COVID" policy have been exacerbated by the sudden increase in predominantly European imports that formerly made use of the NELB but have instead shifted to maritime freight. This sudden increase has created logistical difficulties that have increased shipping times.<sup>67</sup> Due to Russia's decision to cut off its airspace to Western airlines, air freight times and rates have also significantly risen, as planes must now take longer, costlier routes.<sup>68</sup> Moreover, these restrictions are only in place for Western airlines, meaning that non-sanctioned air freight carriers, such as those based in China, have been given a significant competitive advantage by being able to transit both Russian and Western airspace.<sup>69</sup> To consumers, this will manifest itself in the form of increased costs, particularly in the automotive sector, as these firms will either need to make use of far costlier air freight or far slower maritime freight, affecting their production schedules. In the short term, it is likely that European firms, who formerly made use of the NELB to integrate their European and Asian production, will choose one of three options. They will either seek an alternative shipping modality, shift to the Middle Corridor, or stick to the NELB for as long as possible. These will all have significant drawbacks and very few benefits, when compared to their prior arrangements.

## Conclusion

"If you build it, they will come". At the end of Field of Dreams, Ray Kinsella is seen enjoying a game of catch. People came, as he was promised they would, to watch a game of baseball at the field he had worked so hard to build. Similarly, as the whisper of market forces beckoned for the expansion of the New Eurasian Land Bridge, Chinese investors were quick to answer the call, helping the route blossom into a major trade corridor between China and the European Union. Although, as China sat back to enjoy its infrastructural coup de grâce, the Russian invasion of Ukraine and the subsequent onslaught of Western sanctions, appear to have robbed it of its own Hollywood ending. What traders value most is certainty, and war, according to the famous Prussian general Carl Von Clausewitz, is the realm of uncertainty.<sup>70</sup> Since the future of the NELB is closely tied to the outcome of the war in Ukraine, its future is therefore uncertain. What is known, and what we already have seen, is a large number of European traders uninhibited by existing sanctions, and who make up the bulk of the NELB's Eastbound freight, willingly turn to other shipping modalities or alternative overland routes, citing primarily moral objections to the invasion. What is unknown, and what we have yet to see, is whether these traders will return to the NELB once the uncertainty of war gives way to relative peace. Despite the existence of alternative modalities and the creation of new overland corridors, the strategic niche offered by the NELB cannot be effectively reproduced by any of the aforementioned alternatives, as they are inherently less efficient. Market forces drove the growth of the NELB and market forces will be its only form of salvation. For the NELB, and broader Sino-European overland connectivity in general to have a future, the NELB must once again become a commercially appealing option for traders. Simply put, this means that the route must remain usable, and traders must be unafraid to use it, whether they fear for their cargo or reputation. Moreover, the surrounding security environment must return to a point, whatever the outcome of the war, where there is sufficiently low

risk to freight cargo that insurance rates do not undermine its competitive advantage. However, given the current geopolitical environment and the relatively protracted nature of this conflict, these conditions appear unlikely to be met in the near future. This means that while the route will continue to be used in a lesser capacity, mostly for Chinese goods entering Europe, a return to its status quo ante bellum appears unlikely.

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## Endnotes

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