PRUSSIAN ABSORPTION OF U.S. LESSONS IN THE MILITARY USES OF RAILROADS

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JOHN P. KELLEY, LTC, U.S. ARMY
Bachelor of Arts, Washington University, Saint Louis, MO, 1991

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The introduction of the railroad into military operations in the mid-nineteenth century allowed armies to maneuver and extend operations in locations that previously would have been inaccessible to large formations of soldiers. The United States' prosecution of the Civil War set the standard for using this new technology to support operations. Other nations observed the American example, including Prussia, which also had substantial rail assets and a strategic capability gap that locomotives could fulfill. This thesis examined three campaigns of the mid-nineteenth century, the U.S. capture of Atlanta in 1864, the Prussian invasion of Bohemia in 1866, and the Prussian invasion of France in 1870. These three case studies illustrated that the U.S. Army's experiences in the Civil War offered valuable lessons in using railroads that could have addressed strategic risks assumed by Prussia in the prosecution of its wars with Austria and France. However, differences in geography, limitations in time, lack of experience, and divergent approaches to war meant that Prussia only appreciated and absorbed those lessons in part and resorted to past expedients rather than full adoption of the American model.

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Name of Candidate: John P. Kelley

Thesis Title: Prussian Absorption of U.S. Lessons in the Military Uses of Railroads

Approved by:

_____, Thesis Committee Chair
William H. Kautt, Ph.D., F.R.Hist.S.

_____, Member
Harry S. Laver, III, Ph.D.

_____, Member
Benjamin M. Schneider, Ph.D.

Accepted this 8th day of June 2022 by:

_____, Assistant Dean of Academics for
Dale F. Spurlin, Ph.D. Degree Programs and Research

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ABSTRACT

PRUSSIAN ABSORPTION OF U.S. LESSONS IN THE MILITARY USES OF RAILROADS, by LTC John P. Kelley, 135 pages.

The introduction of the railroad into military operations in the mid-nineteenth century allowed armies to maneuver and extend operations in locations that previously would have been inaccessible to large formations of soldiers. The United States' prosecution of the Civil War set the standard for using this new technology to support operations. Other nations observed the American example, including Prussia, which also had substantial rail assets and a strategic capability gap that locomotives could fulfill. This thesis examined three campaigns of the mid-nineteenth century, the U.S. capture of Atlanta in 1864, the Prussian invasion of Bohemia in 1866, and the Prussian invasion of France in 1870. These three case studies illustrated that the U.S. Army's experiences in the Civil War offered valuable lessons in using railroads that could have addressed strategic risks assumed by Prussia in the prosecution of its wars with Austria and France. However, differences in geography, limitations in time, lack of experience, and divergent approaches to war meant that Prussia only appreciated and absorbed those lessons in part and resorted to past expedients rather than full adoption of the American model.

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INTRODUCTION

Background

> As a total phenomenon, its dominant tendencies always make war a paradoxical trinity – composed of primordial violence, hatred, and enmity, which are to be regarded as a blind natural force; of the play of chance and probability within which the creative spirit is free to roam; and of its element of subordination, as an instrument of policy, which makes it subject to reason alone.
>
> —Carl von Clausewitz, *On War*

The century between Waterloo and the Somme saw war transform from an event decided in an afternoon among well-drilled formations on grassy knolls to a multi-year saga of attrition endured by millions huddled in trenches. The Industrial Revolution arbitrated this conversion of human conflict from ritual maneuver to mass carnage. Conscription and the steam engine fed this growth in the breadth and ferocity of combat. The introduction of the railroad enabled the employment of newfound military might across the operational environment.

Revolutionary France's social and political development of *levée en masse* in the late eighteenth century offered nations an unprecedented quantity of troops to mobilize in a time of war.[1] The introduction of representative government built a national identity and a sense of patriotism. The masses gained a vested interest in defending their

[1] MacGregor Knox, "Mass Politics and Nationalism as Military Revolution: The French Revolution and After," in *The Dynamics of Military Revolution, 1300–2050,* ed. MacGregor Knox and Williamson Murray (New York, NY: Cambridge University Press, 2001), 66.

homeland and transformed them into a nation at arms.[2] Conscription channeled the public passion of Clausewitz's paradoxical trinity of war.[3]

Arming these citizen-soldiers with the latest muskets and artillery bequeathed the mobilized masses with exceptional lethality and dominance on the mid-nineteenth-century battlefield. Introducing the minie-bullet and percussion caps and later repeating rifles and breech-loaded artillery increased the range and volume of fire for these formations.[4] This allowed nations to mobilize immense armies with unprecedented destructive potential.

In order to exercise these potent legions as instruments of policy, governments sought proficient measures to sustain the conscripts. The increasing size of armies made it more difficult to feed the assembled soldiers and rendered the tradition of forage or requisition on the march unreliable.[5] Industrialization gave war ministries the practical means to feed the mobilized. By 1857 canned and dehydrated foods had been introduced to provide a means of provision that reduced spoilage and allowed for long-distance transport of rations.[6] However, feeding a large mass of troops over great distances with these provisions triggered a capability gap in logistical support.

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[2] Knox, "Mass Politics and Nationalism as Military Revolution," 67.

[3] Carl von Clausewitz, *On War*, ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1976), 89.

[4] Mark G. Elam, "Transforming Under Fire: The Atlanta Campaign of 1864" (Master's thesis, U.S. Army Command and General Staff College, 2004), 2.

[5] Martin van Creveld, *Supplying War. Logistics from Wallenstein to Patton,* 2nd ed. (Cambridge, UK: Cambridge University Press, 2004), 75-76.

[6] Elam, "Transforming Under Fire," 14.

In all conflicts prior to the mid-nineteenth century, the only method of carrying provisions overland consisted solely of muscle-powered conveyance propelled either by foot or hoof. This organic means of transport had set limitations upon capacity and velocity due to the laws of nature. For example, a Civil War-era supply wagon pulled by six mules could move a two-ton cargo, fifty percent of which would be fodder, at fifteen miles per day for a maximum distance of approximately 300 miles.[7] For a pre-industrial army operating under pristine logistical circumstances, the most provisioning any formation could hope to transport would be ten days of supply.[8] However, the vagaries of weather, terrain, and enemy action would frequently reduce that logistical capacity by as much as forty percent, allowing support for less than a week's worth of operations.[9] If foraging prospects were unavailable, which was not uncommon in mid-nineteenth-century America, the logistical constraint of supply by wagon placed a limit on a commander's operational reach.[10] Quartermasters of these industrial age armies sought a remedy for this shortcoming to increase and maximize the potential of their formations.

The steam engine proffered a mechanical potency to close that capability gap and provide field commanders freedom of action to exploit their massive formations further

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[7] Christopher R. Gabel, *Railroad Generalship: Foundations of Civil War Strategy* (Fort Leavenworth, KS: U.S Army Command and General Staff College, Combat Studies Institute, 1997), 2.

[8] Ibid., 1.

[9] Johnny W. Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865" (Master's thesis, U.S. Army Command and General Staff College, 2002), 30.

[10] Edwin A. Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914* (Philadelphia, PA: J. B. Lippincott Company, 1916), 11.

from their bases of operation. A mid-nineteenth-century freight locomotive could convey payloads as high as 150 tons at a pace five times faster than wagons driven by hooves. This speed allowed more round trips in a given period, which minimized the number of vehicles required to maintain a steady flow of supplies. The reduced travel time combined with the protection and comforts of train transportation ensured that personnel and provisions arrived at the front in better condition than enduring a long cross-country march.[11] This surge in speed and hauling capacity offered an order of magnitude increase in land-based sustainment capability for nineteenth-century armies.[12] Prior to the railroad, the limits of muscle held hostage the pace and range of military campaigns. The innovation of transportation by steam permitted commanders an operational reach that was checked only by their strategy.

The increased opportunities offered by railroads became the key ingredient in maximizing the effectiveness of the conscript armies of the post-Napoleonic age. In the nineteenth and early twentieth centuries, the great powers and those aspiring to greatness sought to take advantage of the pallet of martial prospects enabled by the steam locomotive. The achievements of conscription and industrialization may have facilitated each nation's efforts to mobilize and arm its citizenry. However, such labors only saw fruition via the development of railroads to deploy and maintain those forces in distant areas of operation. The volume and tempo of replenishment by steam train removed the restraints that nature had in time immemorial held over the desires of states and generals.

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[11] Gabel, *Railroad Generalship*, 3.

[12] Ibid., 4.

The capability of rail allowed armies to exercise greater operational reach and nations to fulfill unprecedented strategic aims.

Historical Question

American exploitation of rail in support of the Civil War represented the first historical example of steam locomotives playing a comprehensive and decisive role in prosecuting a major war. There were no equivalent predecessors.[13] While the French used trains to deploy multiple corps to the Italian front for their brief war with Austria in 1859, those rail lines played no role beyond the initial deployment.[14] In a similar transitory vein, the British built a short rail line in Crimea to provide logistical support to their siege of the Russian city of Sevastopol in 1855. However, the line stood as a single improvisation, minor in scale and temporary in nature.[15] Beyond those two examples, the only significant use of rail for military purposes consisted of the Prussian experimentation with trains in annual mobilization exercises starting in 1859, which did not gain widespread recognition until after their stunning victories against Austria and France in the latter half of the century.[16] Thus, at the onset of the Confederate rebellion, the United States had no inclusive model of military rail usage to guide its

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[13] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 13.

[14] Jay Luvaas, *The Military Legacy of the Civil War: The European Inheritance* (Chicago, IL: The University of Chicago Press, 1959), 122.

[15] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 206-207.

[16] Dennis E. Showalter, "The Prusso-German RMA, 1840-1871," in *The Dynamics of Military Revolution, 1300–2050*, ed. MacGregor Knox and Williamson Murray (New York, NY: Cambridge University Press, 2001), 103.

implementation. Instead, the systemic and doctrinal innovations of the American experience set the standard for this new field of mechanized transport.

This precedent of rail usage in the Civil War did not go unnoticed by the great powers of the period. One particular nation, Prussia, would be the first to have occasion to apply lessons from this conflict to their operations. With its wars with Austria and France so close in time to the American triumph-in-arms, the substantial German rail network offered Prussia the opportunity to exercise the strategic value of steam locomotives in warfare. The Hohenzollern monarchy's chief planner, Helmuth von Moltke, and his acolytes on the *Preußische Großer Generalstab,* the Prussian Great General Staff, could have taken lessons from the American struggle to improve their war planning, organizational proficiency, and operational capability.

Moltke did not lack for data to accomplish that goal. In 1863, the Prussian General Staff dispatched a formal observer, Captain Justus Sheibert of the *Preußische Ingenieurkorps*, the Prussian Engineer Corps, to scrutinize technical and operational developments in the war.[17] However, Sheibert was not alone in his observations of the Civil War. Approximately 200,000 native Germans volunteered to serve in the U.S. Army, and a number of them published their experiences. One participant, Otto Heusinger, served from 1861 to 1865 with the 41st New York Infantry Regiment and, in 1869, published a well-written account of his experiences in a book entitled *Amerikanische Kriegsbilder*.[18] Another widely read German combatant was Heros von

[17] Luvaas, *The Military Legacy of the Civil War*, 60.

[18] Ibid., 53.

Borcke. He had his wartime pursuits and reflections recorded in a series of popular articles in *Blackwood's Magazine* from 1865 to 1866. Borcke's commentary concentrated mainly on cavalry tactics and addressed other military disciplines, including the importance and difficulties of logistics.[19] From 1863 to 1865, another German participant, Karl Erdt, reached a broad German audience with his technical articles published in the Austrian military journal *Österreichische Militärische Zeitschrift* and in *Allgemeine Militär-Zeitung*, the most widely-read German military periodical.[20] These publications indicated the existence of a substantial German audience for this subject and that Prussian officers had access to a significant amount of data concerning developments in the Civil War. Moltke and his staff could have utilized that knowledge to improve their doctrine and practices.

Prussia's official observer, Captain Sheibert, provided the General Staff with an all-encompassing review of Confederate military operations in the Civil War. His original mandate had been to examine and record the effect of rifled artillery against fortifications of earth, masonry, and iron.[21] However, his observations comprised a wide array of subjects and provided a unique view of events as he had privileged access to the Army of Northern Virginia.[22] He made the acquaintance of Lieutenant Generals Lee, Stuart, and Jackson and built enduring friendships with many Confederate officers, who would keep

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[19] Luvaas, *The Military Legacy of the Civil War*, 56-57.

[20] Ibid., 53.

[21] Ibid., 60.

[22] Ibid.

him informed of operations long after he departed for Europe. From March 1863 until his departure at the end of that year, Captain Sheibert witnessed fourteen battles, including Chancellorsville, Brandy Station, and Gettysburg.[23] However, he went beyond mere observation and became an active participant serving on Stuart's staff, preparing maps, translating correspondence, carrying messages, and constructing bridges and breastworks.[24] The sum of these experiences gave the young officer the ability to see beyond the ragged appearance and militia background of the war's participants and appreciate their contributions to the development of the art of war.[25]

Sheibert's panoply of Civil War observations included thoughtful analysis of American advances in sustainment, despite his belief that logistics should remain subordinate to maneuver.[26] He viewed the conflict as a product of the industrial age and recognized that mobilization of U.S. resources could eventually defeat the Confederacy. However, he also appreciated the problems of bringing those resources to bear through transportation and supply systems in America's rugged terrain and vast distances.[27] Moreover, he felt that Prussia could profit from studying how the combatants managed

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[23] Frederic Trautmann, ed., *A Prussian Observes the American Civil War: The Military Studies of Justus Scheibert* (Columbia, MO: University of Missouri Press, 2001), xi.

[24] Luvaas, *The Military Legacy of the Civil War*, 62.

[25] Ibid., 72.

[26] Trautmann, *A Prussian Observes the American Civil War*, 17.

[27] Luvaas, *The Military Legacy of the Civil War*, 72, 74.

and repaired their railroads.[28] The accomplishments of the United States Military Rail Road (USMRR) particularly impressed him, which may have contributed to Sheibert's opinion that Confederate cavalry raids to disrupt U.S. rail lines seemed ineffective.[29] These observations on the exploitation of the locomotive gained significant attention from the General Staff. They contributed to Moltke's reorganization of the body to include a Railway Section in addition to the eventual establishment of the *Feldeisenbahnabteilung*, a field railway detachment. [30]

The highest echelons of the Prussian command also appreciated Sheibert's studies of American artillery and fortifications. His expertise in these fields generated a request from the Prussian Chancellor, Otto von Bismarck, to provide him a personal tour of the Danish defensive works of Düppel that their nation's forces overcame in 1864.[31] Attention from such ranking figures indicated that the officer possessed insights of value to the state.

Upon his return to Prussia in late 1863, Sheibert submitted a complete report of his experiences to the Prussian General Staff. He also discussed his findings with key military leaders, including *Generalfeldmarschall* Friedrich Graf von Wrangel, who assumed supreme command of the Austro-Prussian army in the war with Denmark in 1864, and Prince Friedrich Karl, who commanded the Prussian First Army in the

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[28] Luvaas, *The Military Legacy of the Civil War*, 227.

[29] Ibid., 66, 72.

[30] Ibid., 122.

[31] Ibid., 62.

Bohemian Campaign of 1866.[32] In addition, Sheibert received requests to provide lectures to various military organizations and the *Preußische Kriegsakademie*, the Prussian War Academy.[33] He also published several books on his American experiences. Furthermore, he continued his service in the Prussian Army and contributed to victory in their wars with Denmark in 1864, Austria in 1866, and France in 1870, leaving little doubt that Prussian leaders had continued access to his thoughts and ideas on the American Civil War.[34]

Nevertheless, Sheibert was not alone in discussing American military innovations in the German military circles of the 1860s. Starting in 1863, the influential monthly *Preußische Jahrbücher* carried a series of articles on the campaigns of the Civil War. A young artillery officer, Captain Constantin Sander, published the first edition of his history of the war in 1863 and produced a revised and enlarged edition in 1865. At the same time, a brilliant staff member of the *Großer Generalstab*, Colonel Albrecht von Stosch, wrote for the periodical *Die Grenzbothen* a series of articles entitled "The American War from a Military Standpoint."[35] Also, in 1866 a German translation of the report on wartime use of railroads by Brigadier General Daniel C. McCallum, the Military Director and Superintendent of Railroads of the Union Army, first appeared in Prussia along with several related technical papers, pamphlets, and books on the same

[32] Luvaas, *The Military Legacy of the Civil War*, 62.

[33] Trautmann, *A Prussian Observes the American Civil War*, 17.

[34] Luvaas, *The Military Legacy of the Civil War*, 62.

[35] Ibid., 119.

subject.[36] Moltke and his staff began a review of the treatise in the weeks prior to their war with Austria in 1866, and the McCallum report gave them valuable insights on the use of the railroad to support field armies.[37] This report, combined with the available writings of other European observers and journalists, provided a body of data on the American Civil War that German strategists could reference for any pending conflict.

With that in mind, the historical question remains: If the United States offered valuable lessons regarding the military uses of railroads in the Civil War, could Prussia have absorbed them in time to apply that knowledge to enhance the execution of its campaigns against Austria in 1866 and France in 1870?

Historiography

The introduction of the railroad into the military campaigns of the American Civil War (1861-1865), the Austro-Prussian War (1866), and the Franco-Prussian War (1870-71) brought a whole host of opportunities and challenges for these nations and their armies. Historians have studied how each country responded to this groundbreaking technology. However, scholars have not paid as much attention to comparing and contrasting their efforts or examining if either nation could have absorbed and applied the lessons from the other. Scholarship has fallen into three categories, general histories, technical subject analyses, and examinations of lessons offered.

The first type of examination has consisted of general history reviews of conflicts in which the writer considered logistics and railroads within the greater context of an

[36] Luvaas, *The Military Legacy of the Civil War*, 122.

[37] Ibid., 122-123.

event or period. These have placed the roles of sustainment and the steam locomotive within the milieu of all functions, strategies, politics, economics, and societal developments associated with the historical period examined. For example, Dennis Showalter's *Railroads and Rifles* reviewed how Prussian developments in technology impacted their mid-nineteenth century war with Austria. In a more general vein, Quintin Barry's *The Road to Königgrätz* and Geoffrey Wawro's *The Austro-Prussian War* each included the roles that railroads and logistics played as part of their examinations of Prussia's war of 1866. However, by their nature, these histories did not detail the technical aspects of steam locomotives.

The second category of the study examined the technical subjects of railroads and logistics as stand-alone subjects, similar to concentrating on the precise details of other warfighting functions. The first such treatises arose from the mid-nineteenth-century observations of military officers recording their views on these subjects in the American Civil War. The reports of the U.S. Quartermaster General and Sheibert exemplified these early primary source accounts. As subsequent wars produced new instances of the exploitation of rail, historians gained perspective on developing trends. Edwin Pratt set the standard in this regard with his one-volume history, *The Rise of Rail-Power.* He examined the military use of the steam locomotive in the nineteenth and early twentieth centuries, and other authors have frequently quoted his work. Christian Wolmar's *A Short History of the Railroad* offered an excellent summary of rail technology from its earliest beginnings to its latest iterations. His survey is given from a global perspective encompassing corners of the world not typically seen in American texts. Christopher Gabel's *Railroad Generalship* proffered an in-depth analysis of the role of trains in the

Civil War, and Earl Hess' *Civil War Logistics* presented a well-rounded review of the supply efforts and transportation platforms of the war. Finally, Martin Van Creveld's *Supplying War* and Kenneth Macksey's *For Want of a Nail* provided excellent critiques of railroads and logistics in wars across the modern era. The only limitation to these works has been the technical focus that sacrifices a larger historical context that might explain why expertise in train usage was or was not transmitted between nations.

The third area of related historical research centered on the transmission of lessons between nations to improve performance and doctrine. These tomes centered mainly on the three main branches of combat arms in the nineteenth century, infantry, cavalry, and artillery. Arthur Wagner's treatise *The Campaign of Königgrätz* and Jay Luvaas' *The Military Legacy of the Civil War* made excellent arguments on how the experiences in the Civil War offered fertile ground for study by military analysts of contemporary military powers in the nineteenth century. However, these works did not focus or provide much detail on railroad usage, nor did they examine whether the knowledge transmitted between nations was absorbed and applied to follow-on campaigns. That omission became the purpose of this thesis.

The record shows that observations of American action by foreign entities took place during the Civil War. Those experiences were recorded, published, and transmitted to their respective services in their home countries. However, such surface treatment of the data proves nothing regarding education. As with every other aspect of war, the proof of learning lies in its practical application in the classroom of martial experience. This paper will present a trio of case studies, each representative of a nation's handling of rail technology within a conflict contemporary to the other country's experience. From this

examination, the goal is to determine how each state gained a greater understanding and insight into the use of the steam locomotive and whether the transmission of data from one's experience to the other showed signs of fruition in the latter's experience.

Case Studies

Three operations, the Atlanta Campaign of the U.S. Civil War (1864), the Bohemian Campaign of the Austro-Prussian War (1866), and the invasion of France in the Franco-Prussian War (1870) serve as case studies to explore the question of this thesis. The railroad played a critical role in each of these conflicts. All the campaigns consisted of large armies, over 100,000 soldiers, maneuvering overland to engage in combat with a nineteenth-century peer. Thus, these offensives placed significant sustainment demands upon each army's line of communication. Those logistical challenges, in turn, offered opportunities for each military force to illustrate their expertise in the exploitation of railroad technology to satisfy those exigencies.

Thesis Statement

The United States recognized the strategic sustainment value of the steam locomotive and developed a doctrine and organization to utilize this technology to prosecute its campaigns in the Civil War. The execution of these operations offered valuable examples and lessons that the contemporary nation-state of Prussia could have employed to mitigate strategic risks it assumed in the execution of the Bohemian Campaign in 1866 and the invasion of France in 1870.

CHAPTER 2

U.S. CIVIL WAR CASE STUDY: ATLANTA CAMPAIGN (1864)

Introduction

> In the beginning of the war, military railroads were an experiment: and though some light as to their management had been gleaned by the operations of 1862 and 1863, yet so little progress had been made that the attempt to supply the army of General Sherman in the field, construct and reconstruct the railroad in its rear, and keep pace with its march, was regarded by those who had the largest experience, and who had become most familiar with the subject, as the greatest experiment of all.
>
> —Daniel C. McCallum, *Supply of Sherman's Army*

On 2 September 1864, United States Army forces under the command of Major General William T. Sherman occupied the city of Atlanta, Georgia, after a successful four-month campaign that targeted this strategic rail hub of the Confederacy and the army guarding it.[38] To traverse the 138 miles between Sherman's base of operations at Chattanooga, Tennessee, and the campaign's objective, his three field armies executed an unprecedented series of marches, river crossings, and battles across northern Georgia.[39] These actions resulted in the capture of Atlanta and signaled a turning point in the Civil War. Sherman's seizure of the Georgian capital subdivided the Confederacy and removed the South's last major industrial and transportation center from Secessionist control.[40]

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[38] Richard M. McMurry, *Atlanta 1864: Last Chance for the Confederacy* (Lincoln, NE: University of Nebraska Press, 2000), 175.

[39] John R. Scales, *Sherman Invades Georgia* (Annapolis, MD: Naval Institute Press, 2006), 81.

[40] Alan R. Millett, Peter Maslowski, and William Feis, *For the Common Defense: A Military History of the United States from 1607 to 2012* (New York, NY: Free Press, 2012), 211.

This loss further undermined the economy of the Confederacy and vindicated Lincoln's war strategy, illustrating that U.S. forces continued to make steady progress in defeating the rebel forces and occupying key terrain.[41] However, this would have been impossible without rail transportation supporting Sherman throughout the campaign.

To understand the prominent and effective position that the steam locomotive played in supplying the Army in this campaign, we must first examine how the United States embraced this new technology and harnessed it to streamline sustainment for its military forces. An evolution had to occur in how the Army approached logistics before the railroad could play a vital role in the Civil War and the march to Atlanta. The U.S. military had to develop and prioritize a centralized and systematic approach to supply and transportation. Such a thoughtful scheme and organization did not exist in the young nation's earlier military experiences, but the seeds of that stratagem resided in the decades prior to the Civil War.

Once Army planners had elaborated a doctrine and agencies for sustainment, the exploitation of rail transport came as a natural evolution of the American use of other technology and means of distribution. The Quartermaster General incorporated the steam locomotive to fill a capability gap that was recognized and prioritized based on knowledge and experience gained in the preceding half-century of military operations. Even though Army logisticians had not preprogrammed the nation's trains into the mobilization and opening actions of the Civil War, they integrated this mechanical system into their warfighting function, and the Army's leadership embraced the

[41] McMurry, *Atlanta 1864*, 177.

advantages of rail and prioritized its use to prosecute the war. The American recognition of the criticality of train transportation enabled utilization of its full potential and shaped military strategy within campaigns such as the march to Atlanta and became an objective in defining victory.

Need for Logistical Support

The development of the supply agencies that contributed to that final Civil War victory can be traced to the nation's first major war in 1812.[42] During the American Revolution and the nation's early formative years, the United States had relied upon individual agents to establish contracts and manage the acquisition and distribution of necessary supplies for field armies.[43] However, such a scheme came fraught with corruption and inefficiency. The need for better management and the magnitude of the nineteenth-century conflict with Britain forced the War Department to establish specific offices responsible for sustaining the deployed regiments.[44] As a result, the Departments of Quartermaster and Ordnance gained their first experiences in equipping and supplying large bodies of troops during this war.[45] In addition, the founding of the Quartermaster Department created the first authority to coordinate the transportation of supplies to

[42] Charles R. Schrader, *United States Army Logistics, 1775-1992: An Anthology* (Washington, DC: Center of Military History, United States Army, 1997), 97.

[43] Ibid., 99.

[44] Erna Risch, *Quartermaster Support of the Army: A History of the Corps 1775-1939* (Washington DC: Center of Military History, United State Army, 1989), 135.

[45] Schrader, *United States Army Logistics, 1775-1992*, 118.

armies in the field. That responsibility drove the agency to seek out efficiencies and close capability gaps in the movement of military stores.

The Quartermaster Department gained its first challenges in long-range sustainment with the establishment of a chain of forts along the nation's border regions in the first half of the nineteenth century. Territorial expansion and settlement required the maintenance of defenses along the frontier to protect settlers, support Native American interactions, and counter possible European encroachment.[46] Moreover, these military positions required a steady stream of supplies to support their garrisons.

Commanders could not rely upon local acquisition to fill those needs. As had been the case since the first European and colonial armies contended for control of the continent, large portions of American territory remained trackless wilderness in the nineteenth century.[47] With land thinly populated except for isolated settlements, there was frequently no regional infrastructure or resources to replenish a frontier detachment or column on the march. The European practice of obtaining fodder for cavalry mounts and pack animals along the route of advance would prove impossible in the undeveloped expanses of North America.[48] Geography dictated that the young nation's military leaders

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[46] Schrader, *United States Army Logistics, 1775-1992*, 119.

[47] Ibid., 127.

[48] Edward Hagerman, *The American Civil War and the Origins of Modern Warfare: Ideas, Organization, and Field Command* (Bloomington, IN: Indiana University Press, 1988), 45.

could seldom depend upon the Napoleonic custom of foraging for sustainment and instead often had to plan on resupply from bases hundreds of miles distant.[49]

Logisticians sought novel ways to move supplies to the isolated troops to accomplish that goal. Wagons alone could not carry the bulk of stores across the vast, uncharted distances of North America. However, the network of lakes and rivers in the continent's eastern half offered an efficient system of waterways to move what was needed, and the development of steam propulsion provided a way to move upstream efficiently and shorten the timelines for waterborne transits.[50] Steamboats began their service on the nation's rivers in 1811.[51] By incorporating these early paddlewheel steamers into the supply system for frontier forts, Army quartermasters acquired an appreciation for mechanized platforms moving large quantities of material.

The Quartermaster Department faced a new test when confronted with hauling goods in locations not serviced by navigable rivers. In contrast to the eastern half of the continent, acquiring territory west of the Mississippi introduced regions with fewer waterways located to support military outposts. This paucity of traversable rivers in the vicinity of western garrisons made the challenge of provisioning the nation's frontier forts more acute. The plains, deserts, and mountains west of the Mississippi challenged the U.S. Army's logisticians to find new means to deliver supplies.[52]

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[49] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 14.

[50] Schrader, *United States Army Logistics, 1775-1992,* 129.

[51] Earl J. Hess, *Civil War Logistics: A Study of Military Transportation* (Baton Rouge, LA: Louisiana State University Press, 2017), 35.

[52] Schrader, *United States Army Logistics, 1775-1992,* 149.

Despite efforts to construct roads, the distances from supply depots to remote outposts in the western half of North America exceeded the ability of supply wagons to arrive with timely support.[53] In ideal circumstances, a wagon drawn by six horses or mules could carry two tons of cargo, of which half would be fodder, approximately 300 miles at a pace of 15 miles per day. Beyond that point, the amount of sustenance for the animals would begin to exceed the freight hauled. However, many forts were situated distances greater than that limit away from navigable rivers or depots.[54] These garrisons required a more efficient overland delivery system, or they would risk failure in their mission.

Military authorities worried about the difficulties of defending this widening domain. In 1838 Major General Edmund P. Gains proffered a plan to take advantage of the speed of steam locomotives and proposed constructing a system of rail lines to speed mobilization and deployment of troops.[55] In 1852, the Quartermaster General, Thomas S. Jesup, concluded that locomotives' carrying capacity and speed could close the gap in sustaining the nation's military infrastructure.[56] A train driven by steam could move ten times as much cargo as wagons driven by hooves and accomplish the task five times faster.[57] Jefferson Davis, Secretary of War from 1853 to 1857, endorsed Jesup's repeated

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[53] Schrader, *United States Army Logistics, 1775-1992,* 150.

[54] Gabel, *Railroad Generalship*, 2.

[55] Victoria A. Leignadier, "Railroads in the Civil War: A Strategic Perspective" (Master's thesis, U.S. Army War College, 2001), 4.

[56] Schrader, *United States Army Logistics, 1775-1992,* 150.

[57] Gabel, *Railroad Generalship*, 3.

entreaties to back the construction of train tracks across the American West, and the Army Corps of Engineers conducted surveys of possible transcontinental routes.[58]

In the first half of the nineteenth century, territorial expansion and its related geographic challenges spurred the Quartermaster Department to find an innovative means to cover the large distances between supply sources and military positions to sustain deployed forces. Large areas west of the Mississippi lacked access to waterways, and Army logisticians had to contend with the inefficiency of moving supplies by wagon to provision many outposts. The precedent of using steamboats to provide support in the eastern half of the United States recommended using a similar mechanical approach to cover the land-locked expanses in the west. By the mid-nineteenth century, the steam locomotive offered such a solution, and the Quartermaster General secured support to utilize the railroad to sustain outposts far from depots.

Quartermaster Lessons Learned

The conflict that added much of the territory requiring this transcontinental train network also contributed to developing a logistics system that would exploit it. The Mexican-American War (1846 – 1848) gave many Army officers an appreciation for the challenges of supplying field armies over long distances and the need to standardize their approach to sustainment. This early nineteenth-century conflict was the first time the U.S. deployed large bodies of troops, approximately 115,000, far beyond its borders.[59] The

[58] Schrader, *United States Army Logistics, 1775-1992,* 150.

[59] Jack K. Bauer, *The Mexican War 1846-1848* (Lincoln, NE: University of Nebraska Press, 1974), 397.

lines of communication required to support this multitude stretched a thousand miles or more. Such demands gave the Quartermaster Department the opportunity to gain experience sustaining military operations over great distances and the impetus to prioritize, plan, and organize how to support far-ranging combat forces in a future conflict.

The movement of troops to the front highlighted the need for innovation and systemization of transportation. The journey permitted the nascent technology of steam engines to make a meaningful impression on the war's participants. Alongside the early-nineteenth-century debut of steamboat service on the nation's waterways, the first 3,000 miles of train track had been laid by 1840.[60] These developments allowed thousands of American volunteer soldiers to ride a combination of trains and steamboats to traverse the Ohio and Mississippi river valleys enroute to their assembly areas in the vicinity of New Orleans.[61] This journey gave all involved a great appreciation for the possibilities of mechanized transportation.

At the anchorage in Louisiana, the assembled troops awaited passage to Mexico via seagoing vessels. With the Navy charged with blockading the whole of Mexico's east coast, military ships were unavailable to move the force.[62] It fell to Army Quartermasters to secure maritime transports. At first, the Quartermaster Department chartered commercial vessels but later purchased and constructed its own deep-water flotilla to

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[60] Hess, *Civil War Logistics*, 67.

[61] Richard B. Winders, *Mr. Polk's Army: The American Military Experience in the Mexican War* (College Station, TX: Texas A&M University Press, 1997), 114.

[62] Millett, Maslowski, and Feis, *For the Common Defense*, 135.

carry forces and supplies to the theater of operations.[63] These arrangements taught Army logisticians the necessity for a methodical approach to movement.

In addition to gaining these wartime insights on deployment, quartermasters endured hard lessons regarding supply and distribution. The need for robust planning and centralized management came to the fore. Even though the War Department established depots to stockpile food, clothing, and other stores to maintain its armies in the field, the efforts fell short of requirements.[64] Logisticians experienced difficulty distributing rations to troops over the archaic trails winding hundreds of miles across Northern Mexico. The sparsely populated frontier's lack of available contract labor and wagons exacerbated an already austere situation. These deficiencies compelled Colonel Trueman Cross, the Assistant Quartermaster General stationed at Corpus Christi, Texas, to write of the need for "an organized wagon train and a corps of enlisted drivers."[65] In response to this predicament, the government instructed generals to forage for supplies, but this expediency only prompted complaints from the line. Notably, General Zachary Taylor issued orders banning plunder and directing that cash payment be made for all goods acquired along his army's invasion route.[66] Insufficient support from their base of operations caused field armies to struggle to provision their troops, a circumstance that Army logisticians sought to avoid in later conflicts.

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[63] Winders, *Mr. Polk's Army*, 114.

[64] Ibid., 118.

[65] Schrader, *United States Army Logistics, 1775-1992,* 164.

[66] Ibid., 155.

However, rations were not the only inadequacy to overcome. Army warehouses could not provide uniforms for the mass of volunteers, and this shortcoming generated an advance in acquisition. As existing clothing stocks only covered the small peacetime army, the tens of thousands of volunteers marching into Mexico received a stipend to purchase their military clothing on the private market. Such a course created a problem with standardization and did not address the replacement of worn items once the campaign began.[67] Attempts to replenish apparel by contracting with Mexican clothiers or issuing captured enemy uniforms to troops met unsatisfactory results and criticism from the ranks. Upon hearing of the plight of their constituents, Congress passed legislation authorizing the production and issuance of uniforms to all enlisted troops through the Quartermaster Department.[68] This clothing effort, combined with calls from the field for a centralized approach to sustainment, gave logisticians the motivation and knowledge to establish a large-scale systemic plan for meeting the Army's needs for all classes of supply in the Civil War two decades later.

Civil War Logistics

When the Civil War began, the demand for support dwarfed all previous efforts as the Army grew from a pre-war strength of 16,367 to a force twenty-seven times greater in less than four months and a million-strong by 1865.[69] To meet that exigency, the Quartermaster Department established the doctrine of a multi-echelon depot system that

[67] Winders, *Mr. Polk's Army*, 108.

[68] Ibid., 111.

[69] Schrader, *United States Army Logistics, 1775-1992,* 191, 194.

distributed supplies with consistency and sufficiency across multiple theaters to support an array of field armies. The process began in the War Department with bureaus acquiring supplies from contractors and then distributing them through a chain of depots in major cities across the nation. These depots sited in New York, Baltimore, Washington, Cincinnati, Saint Louis, Louisville, and New Orleans moved stores forward to advance depots positioned to support the various geographical theaters called Departments. For example, in the case of the Atlanta Campaign, the depot in Louisville supported Sherman's Department of the Mississippi via two advance depots in Nashville and Chattanooga. From these outlets, supplies proceeded to temporary bases along the army's route of advance, where wagon trains picked up and distributed cargo at the unit level.[70] Thus, American forces developed a doctrinal approach that ensured an accountable and predictable distribution of all classes of supply through all echelons to sustain the nation's warfighting needs in each campaign. This depot chain did not entirely preclude foraging, as Sherman's 1864 march to Savannah later proved. However, for most Civil War operations, the Army planned its campaigns based on maintaining reliable lines of communication while striking at those of the rebels.[71]

While the military experiences of the war with Mexico had already impressed upon its participants the need for consistent replenishment of victuals and clothing, the demand for ordnance in the Civil War further buttressed the requirement for directed sustainment. In particular, the Army's lack of uniformity in small arms contributed to a

[70] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 18.

[71] Gabel, *Railroad Generalship*, 9-11.

reliance on centralized supply. Unlike many European armies of the time, U.S. forces did not use one standard infantry weapon but rather an array of armaments of varying calibers. This arrangement was a symptom of the rapid growth of the Army during the conflict. States struggled to equip the multiplicity of new regiments and, when rifles were unavailable, resorted to issuing obsolete, smoothbore muskets. In addition, the emergent technology of breech-loading rifles and their unique metal cartridges contributed to the kaleidoscope of weapons and ordnance distributed to the troops. Such an assortment of arms placed impediments to redistributing ammunition between units in the field and precluded any assurance that armies could utilize captured enemy stocks. This multitude of calibers (see table 1) formed an insurmountable challenge in supporting a large body of troops through scavenging. Replenishment through the Army's central supply system became the only sure methodology for a field army to maintain its combat power. [72]

Table 1. Types of Civil War Small Arms Ammunition

Ammunition Type	Caliber
Rifled Musket Elongated Ball	.574
Spencer Rifle & Carbine Cartridges	.52
Henry Rifle Cartridges	.44
Smith Carbine Cartridges	.50
Sharps Carbine Cartridges	.52
Burnside Carbine Cartridges	.54
Colt Army Pistol	.44
Colt Navy Pistol	.36

Source: United States War Department, *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies,* series 1, vol. 47, part 1, Reports (Washington, DC: Government Printing Office, 1895), 184.

[72] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 22.

To expedite the flow of materiel in support of combat operations, the Quartermaster Department established a systemic approach to transportation across all echelons. At the field unit level, the course of replenishment from forward logistics bases to individual units depended on the proven, ancient conveyance of muscle and wagons, though with some standardization. Whether pulled by six horses or six mules, the quartermaster wagon possessed the capability to haul an average payload of 2,500 pounds at approximately fifteen miles per day in an organized column. This grouping into trains or convoys occurred through segregation by class of supply to provide accountability and structure to unit sustainment efforts.[73] The order of march sequenced the classes of supply by priority. Carriages carrying unit baggage and small arms ammunition came first, followed by artillery ammunition, rations, forage, and sutlers. Cattle on the hoof followed to provide fresh meat.[74] In the opposite direction, wagons dedicated as ambulances transported the wounded back from forward aid stations for subsequent transport by rail or water to hospitals.[75] This sorting of tactical trains ensured that support addressed the order of need.

It took between twenty and thirty wagons to support a thousand men stationed within a fifteen-mile radius from a forward logistics base.[76] As an army progressed

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[73] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 30.

[74] Schrader, *United States Army Logistics, 1775-1992,* 202, 208.

[75] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 32.

[76] Schrader, *United States Army Logistics, 1775-1992,* 208.

further afield, the added distance and travel time generated both a requirement for more days of supply to be carried and a corresponding loss of freight capacity as the amount of conveyed fodder grew. Based on this dynamic, the practical limit for an army to progress beyond its replenishment source and receive adequate sustainment was ten days' march. The toll of such a move was a doubling or tripling of the ratio of wagons to troops supported.[77] Thus, the advance of armies forced a significant growth in the size of supply trains that successively degraded freedom of maneuver.

This circumstance of diminishing returns drove the implementation of traffic control measures to improve the progression of forces. Each corps advanced via a separate, dedicated thoroughfare to ease congestion and reduce delays on routes. Within its column, the corps reserved the center of the road for wheeled traffic while requiring soldiers and cavalry to march along the sides.[78] Such coordination sought to abridge the effect of logistics upon a commander's scheme of maneuver, reduce backlogs at resupply points, and maximize throughput at the tactical level.

This configuration of depots, bases, and wagon trains constituted an effective concept of support for the multiplicity of campaigns executed across the continent, with just one conspicuous omission. For all this to function, an efficient means of cargo transportation was required at higher levels. Planners drew on institutional knowledge and experience to find the answer to that capability gap. The mechanized transport used

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[77] Hagerman, *The American Civil War and the Origins of Modern Warfare*, 62-63.

[78] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 30.

in the past pointed toward the most proficient and cost-effective solution. While the traditional draught and dray took an outlay of $900 to acquire and $3 to maintain each day to haul a single ton, a rail car costing half as much could haul a load eight times greater and five times faster.[79] Where wagon trains along a road could at most supply a corps over a distance of approximately ten days march, a single rail line could efficiently provision an entire field army over hundreds of miles. These characteristics made railroads difficult to ignore. The speed and capacity of these platforms offered unprecedented opportunities for the movement of troops and supplies. Yet even the superior performance of the locomotive was dwarfed by the capacity of steam-powered watercraft. A single riverboat could haul 500 tons, equating to a day's rations and forage for 70,000 men and 20,000 animals.[80] The impressive technical qualifications of these transportation systems encouraged the Army to embrace both platforms, and steam-powered vehicles on land and water bore the burdens required of the supply system in the echelons above tactical replenishment.[81]

These platforms complimented each other. The Quartermaster Department exploited their differing abilities to operate an integrated and resourceful transportation system.[82] The minimal cost and massive cargo of riverine vessels carried the majority of men and material as far as practical along inland waterways. Geography and meteorology

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[79] Schrader, *United States Army Logistics, 1775-1992,* 207.

[80] Ibid., 206.

[81] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 28.

[82] Hess, *Civil War Logistics*, 64.

served as the only checks to this passage along the nation's rivers and canals. Rail took over to handle the remaining movement. Trains could operate in all weather and across most landscapes, though at a reduced capacity compared to watercraft.[83] Due to these performance distinctions, a marked difference existed in total cargo carried. For example, in the Department of the Mississippi in 1863, railroads transported approximately 76,000 tons, while riverboats handled more than twice as much, 169,000 tons.[84] That observation could mislead one into thinking that locomotives played a less important role, but this would ignore the strategic value of rail's geographic flexibility.[85] This suppleness influenced Civil War commanders and courses of action available that shaped the conflict.[86]

As combatants could not ignore the speed and logistical capacity rail offered, leaders on both sides made possession and operation of railroads a key objective, and there was a substantial inventory of track for them to target. When hostilities began, a robust rail network existed with 30,000 miles of track laid, of which approximately 9,500 miles resided in the states that seceded.[87] The amount of rail in the Confederacy alone made that short-lived "nation" the third-largest in the world for track mileage after the

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[83] Elam, "Transforming Under Fire," 14.

[84] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 28.

[85] Leignadier, "Railroads in the Civil War," 11.

[86] Ibid., 2.

[87] Francis A. Lord, *Lincoln's Railroad Man: Herman Haupt* (Cranberry, NJ: Associated University Press, Inc., 1969), 34.

Northern States and Great Britain.[88] The prodigious mass of American rail nearly equaled the combined total of the rest of the world due likely to the vast expanse of territory.[89] Such an abundance of rail transport meant this system and its components had a prevalence and visibility that invited exploitation. As a result, the railroad assumed an unprecedented position of importance to all involved. Rail junctions became strategic targets, and commanders sought to destroy opponents' rail lines; train tracks set the direction of campaigns.[90]

A Campaign Made Possible by Railroad

No greater example can be found of the steam locomotive enabling and shaping a Civil War campaign than Sherman's offensive to capture Atlanta in 1864. This operation would not have been possible without the logistical capability of railroads.[91] Both the U.S. attackers and Confederate defenders relied upon this transportation system to sustain their forces and prioritized its possession and destruction.[92]

To understand the locomotive's criticality to this campaign, the geographic challenges of the theater require examination. The region of northern Georgia through which Sherman's legions would march was sparsely populated and lacked sufficient

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[88] Hess, *Civil War Logistics*, 70.

[89] Ibid., 68.

[90] Lord, *Lincoln's Railroad Man*, 35.

[91] Elam, "Transforming Under Fire," 18.

[92] J. Britt McCarley, *The Atlanta and Savanah Campaigns 1864* (Washington DC: Center of Military History, 2014), 9.

agriculture to sustain a passing army. A crop shortage in the area in 1864 exacerbated this and forced local families to migrate in search of sustenance. What few crops remained were not ripe enough to harvest until weeks after the offensive began. Furthermore, as the campaign advanced, Confederate forces would strip the land of anything of value to deny their use to the invaders.[93] This landscape of deprivation would deny Sherman's armies forage en route to Atlanta and leave them dependent upon their lines of communication stretching back to Chattanooga.[94]

Moreover, these lines of logistical support would have no high-capacity, waterborne interval. The Army advance from Eastern Tennessee to Atlanta encompassed a long overland march without seaborne or riverine support. Unlike Virginia and other areas along the Eastern seaboard, no ocean flank existed to provide an avenue of advance and resupply.[95] In contrast to areas of operation along the Mississippi River and its tributaries, no major rivers or waterways ran parallel to Sherman's southeastward march towards his objective.[96] Instead, the streams and tributaries of northwestern Georgia ran perpendicular to Sherman's line of advance.[97] Notably, three rivers, the Oostanaula, Etowah, and Chattahoochee, served as the basis of successive Confederate lines of

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[93] McMurry, *Atlanta 1864*, 30.

[94] Ibid., 31.

[95] J. G. Coombs, "The Atlanta Campaign: Principle of the Objective Revisited," (Master's thesis, U.S. Army Command and General Staff College, 1975), 14.

[96] McMurry, *Atlanta 1864*, 27.

[97] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 14.

defense.[98] So the direction of the waterways negated the use of riverboats or barges to facilitate the campaign and created obstacles to hinder forward progression.[99] The landlocked nature of this area offered no geographic shortcuts or fast-track advances but rather bound its combatants to move and sustain themselves via land.

Unfortunately, this concision of transportation options carried over to the available landward choices. For sustainment, the region offered no desirable substitutes for the single track of the Western & Atlantic Railway that ran the full length of the 138-mile trajectory from Chattanooga to Atlanta.[100] Nor was there a well-developed road network to support an army marching towards Georgia's capital. With the only alternative being wagons traversing undeveloped dirt lanes, Sherman's armies were restrained from taking any significant deviations from the rail route. Rain would turn any such lines of communication into mud-choked bottlenecks, leaving the one rail line as the only reliable method of movement for a high volume of materials and personnel in that corner of Georgia.[101] This restriction was not lost upon the thoughts of the Union commander as he prepared for the campaign.

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[98] John MacDonald*, Great Battles of the Civil War* (New York, NY: Chartwell Books Inc., 2014), 160.

[99] Coombs, "The Atlanta Campaign: Principle of the Objective Revisited," 13.

[100] McMurry, *Atlanta 1864*, 28.

[101] Hess, *Civil War Logistics*, 175-176.

Campaign Preparations

In March 1864, upon assuming command of the Military Division of the Mississippi, which controlled the three armies preparing to march upon Atlanta, Sherman confronted the greatest challenge of the campaign, how to supply a force of over 100,000 men and 35,000 animals set to maneuver across more than 100 miles of hostile territory.[102] He would have to resolve this logistical conundrum quickly, as Grant expected Sherman's forces to commence their offensive by early May to synchronize with his planned drive towards the Confederate capital of Richmond, Virginia.[103] Grant, who had recently assumed command of all U.S. Army forces, had imparted to his subordinate his intent that their armies strike the Confederacy simultaneously that spring to prevent their opponent's armies from reinforcing each other.[104] That meant Sherman had just seven weeks to determine his sustainment requirements and prepare his force to move across northwestern Georgia.

Fortunately, for the Army, Sherman possessed a background of particular applicability to this situation. As a young lieutenant, he had been assigned to posts in Alabama and Marietta, Georgia, and possessed a familiarity with these geographic constraints.[105] In addition, his past military career had included a stint as a supply

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[102] Duncan K. Major and Roger Fitch, *Supply of Sherman's Army During the Atlanta Campaign* (Fort Leavenworth, KS: Army Service Schools Press, 1911), 10.

[103] MacDonald, *Great Battles of the Civil War*, 156.

[104] McCarley, *The Atlanta and Savanah Campaigns 1864*, 8.

[105] Coombs, "The Atlanta Campaign: Principle of the Objective Revisited," 5.

officer.[106] That prior duty inculcated him with a knowledge of and appreciation for logistics, so much so that Army leadership considered Sherman for appointment to the position of Quartermaster General at one point.[107] As a result, Sherman possessed the ability to analyze and determine the required logistical prerequisites to execute this campaign. He concluded that U.S. forces needed to improve their rail capacity in eastern Tennessee to ensure adequate throughput of supplies and stockpile a month's worth of provisions at the advance depots to ensure an adequate contingency at the start of the offensive.[108]

To accomplish these goals, Sherman calculated that he needed a minimum of 130 rail cars arriving at Chattanooga each day with ten tons of cargo apiece to meet required supply objectives.[109] However, the 60 serviceable locomotive engines and 600 rail cars then available in eastern Tennessee were insufficient to sustain that volume of traffic.[110] In late March and early April, the most they could accomplish was only 65 to 80 cars of supply each day.[111] As a result, Sherman determined that the vehicle inventory had to increase to a minimum of 100 locomotives and 1,000 rail cars to meet the calculated

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[106] McMurry, *Atlanta 1864*, 26.

[107] Risch, *Quartermaster Support of the Army*, 335.

[108] Major and Fitch, *Supply of Sherman's Army During the Atlanta Campaign*, 13-14.

[109] Ibid., 17.

[110] Ibid., 18.

[111] Elam, "Transforming Under Fire," 17.

throughput goals.[112] To gain these additional rail assets and maximize the capacity of existing train traffic, he initiated several logistical and administrative changes.

On April 6, 1864, the headquarters of the Military Division of the Mississippi published General Order No. 6., which banned all civilian passenger and private freight traffic from riding the rails into Nashville and Chattanooga. Upon arrival at the first stop in Eastern Tennessee, all troops would march the remaining distance to their duty stations. All horses, cattle, and livestock would be herded along the region's dirt roads. In addition, all military units within 35 miles of Nashville and 20 miles of Chattanooga would distribute their supplies by wagon and no longer rely upon the rails. The order was a draconian move that triggered numerous appeals for relief from local citizens to Lincoln, but they failed. General Order No. 6 doubled the rate of supply accumulation at the front.[113]

However, even this ultimatum was insufficient to build the required rail capacity for the coming operation.[114] Therefore, Sherman gained permission from the Department of War to seize and retain all locomotives and rail cars that arrived in his theater from outside locales.[115] This move brought the Division of Mississippi's total rail numbers up to 140 train engines and 1,500 cars.[116] By late April, this increased capacity combined

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[112] Major and Fitch, *Supply of Sherman's Army During the Atlanta Campaign*, 18.

[113] Ibid., 15-17.

[114] Ibid., 17.

[115] McMurry, *Atlanta 1864*, 28-29.

[116] Elam, "Transforming Under Fire," 17.

with General Order No.6 resulted in a throughput of 193 rail cars of supplies per day and a buildup of the required one-month surplus at Chattanooga.[117]

Sherman had met his logistical prerequisites. He had prepared his armies to begin their march to Atlanta on 7 May, just three days after Grant's force forded the Rapidan River in Virginia to begin his campaign.[118] As a result, the U.S. armies could move in concert against their enemy. Sherman's preparations enabled this auspicious start and highlighted the critical role that railroads played in the campaign and the priority U.S. leaders attached to sustainment and rail.

The U.S. Military Railroad

The evident criticality of using railroads to support field forces combined with the complexity and vulnerability of the system's trackage, rolling stock, and infrastructure mandated a new organization to oversee this strategic asset.[119] An agency to manage and maintain the rail network was a prerequisite for Sherman's march to Atlanta, without which such a campaign would be infeasible.[120] The Quartermaster Department created the USMRR to meet that demand.[121]

Early in the conflict, U.S. leaders recognized that the federal government needed to ensure the efficient use of rail transportation systems for the war. Disputes over

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[117] McMurry, *Atlanta 1864*, 29.

[118] MacDonald, *Great Battles of the Civil War*, 156.

[119] Lord, *Lincoln's Railroad Man*, 35-36.

[120] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 19-20.

[121] Ibid.

shipping rates, inadequate maintenance, and scheduling difficulties on commercial lines hampered employment.[122] On 31 January 1862, Congress authorized the Lincoln administration to seize control of and operate any railroad needed to fight the war. The threat of seizure hanging over railroad companies helped the Secretary of War, Edwin Stanton, negotiate a standard shipping rate for personnel and freight a few weeks later and encouraged a spirit of cooperation between rail executives and the government for the duration. In practice, the government rarely commandeered lines in U.S. territory, and, when done, authorities quickly relinquished control after the need had passed. Officials had no interest in permanent control of railroads in States loyal to the U.S. government.[123] Though reluctant to use that power in loyal territory, the legislation provided the basis for government management of track in former rebel domains. The USMRR served as the agent to fulfill the supervisory role and utilize the newly captured infrastructure.

The rail lines that came into the possession of federal forces as they reconquered Confederate territory required significant oversight and improvement to come into service.[124] Confederate forces stripped equipment of value from the railyards and demolished facilities to deny their use to the U.S.[125] To remedy this situation, the War Department sought to appoint a superintendent of all such trains and tracks that came

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[122] Hess, *Civil War Logistics*, 74-75.

[123] Ibid., 86.

[124] Ibid., 87.

[125] Risch, *Quartermaster Support of the Army*, 396.

under the control of federal forces. Secretary Stanton appointed Daniel C. McCallum, an executive of the Erie railroad, to this position in 1862 and placed him under the Quartermaster General. McCallum received a commission as a colonel and later brevet promotions to brigadier general (in 1864) and major general (in 1865) to enhance his authority.[126]

McCallum took possession of the rail lines in former-rebel territories and supervised their repair and operation. The captured locomotives transported personnel and supplies for U.S. forces as they advanced further and acquired more terrain.[127] Through these means, the federal government acquired more transportation assets. By the end of the Civil War, the USMRR had become the world's largest railroad conglomerate, operating fifty lines with 2,600 miles of track, 433 train engines, and 6,605 rail cars.[128]

To manage this consortium of captured rail, McCallum established the USMRR.[129] This organization operated, maintained, repaired, and improved the network of lines. The USMRR had two sections. The Transportation Department supervised the daily functioning, scheduling, and regular upkeep of the tracks, depots, and locomotives, while the Construction Corps repaired and upgraded the lines and related infrastructure.[130] The latter department played a crucial role in ensuring that rail traffic

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[126] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 17.

[127] Risch, *Quartermaster Support of the Army*, 396.

[128] Hess, *Civil War Logistics*, 95.

[129] Major and Fitch, *Supply of Sherman's Army During the Atlanta Campaign*, 29.

[130] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 20.

continued unabated in support of armies such as Sherman's as they advanced deep into hostile territory.[131]

To understand the Construction Corps' part in military operations, one must examine the state of rail lines at that time. When the Civil War commenced, the nation may have had a large amount of track. However, it was not threaded together as one national system but instead represented a patchwork of hundreds of privately built lines of differing gauge widths with few connections. If passengers and freight had to transit from one company line to another, this required offloading and reloading between the two. Few "union stations" existed that brought together lines of differing gauges for such transfers.[132] In addition, commercial companies built all the tracks as cheaply as possible.[133] While entities in Europe ran double tracks to ease scheduling and allow for simultaneous movement in opposite directions along the same route, American lines were all singular between their destinations, with only a minimal number of sidings to allow trains to pull off for passage of other locomotives. The result was that all commercial lines repurposed for U.S. military usage required substantial improvement to meet wartime demands.[134]

Beyond the need to upgrade lines to support military requirements, tracks in war zones could also face sabotage and destruction by raiders. This threat propelled the

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[131] Schrader, *United States Army Logistics, 1775-1992,* 210.

[132] Hess, *Civil War Logistics*, 68.

[133] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 15.

[134] Hess, *Civil War Logistics*, 74-75.

construction of defensive works to fend off such incursions. Both sides raided rail networks. Confederate forces, realizing the importance of rail lines for any U.S. invasion of their territory, made disruption and destruction of those lines a key objective from the outset.[135] Starting as early as July 1861, rebel saboteurs attacked trains operating in support of U.S. forces in Missouri.[136] The Confederates wrecked 100 miles of the North Missouri Railroad.[137] That same summer, "Stonewall" Jackson destroyed 42 locomotives and 300 train cars of the Baltimore and Ohio Railroad in Martinsburg, VA.[138] As the Army advanced into Tennessee and Mississippi in 1862, rebel attacks against railroads became more extensive and organized, targeting vulnerable choke points such as train trestles. These coordinated attacks prompted General Don Carlos Buell to order his engineers to construct earthworks and timber stockades at key bridges to position military guards.[139] This fortification process inspired one engineer officer, William E. Merrill, to develop blockhouses stout enough to resist rebel artillery. These Merrill Blockhouses set the standard for defending tracks that supported U.S. incursions, such as Sherman's advance on Atlanta.[140] However, the construction of fortifications could never prevent all

[135] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 27.

[136] Hess, *Civil War Logistics*, 235.

[137] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 29.

[138] Festus P. Summers, *The Baltimore and Ohio in the Civil War* (Gettysburg, PA: Stan Clark Military Books, 1993), 96.

[139] Hess, *Civil War Logistics*, 236.

[140] Ibid., 240.

sabotage. The need to repair and reconstruct damaged tracks, bridges, and other rail infrastructure became a priority for the USMRR throughout the war.[141]

This necessity for restoring lines made inoperable due to enemy action came to a head for the U.S. in the spring of 1862. The destruction of the Fredericksburg Railroad by Confederate forces delayed the movement of the federal army of the Department of the Rappahannock.[142] This army under General Irvin McDowell was to cooperate with the Army of the Potomac under General George McClellan to support McClellan's Peninsular Campaign to capture the rebel capital of Richmond, Virginia.[143] On 24 April 1862, the Secretary of War, Edwin Stanton, requested a civilian railway engineer, Mr. Henry Haupt, who had recently served as the Chief Engineer of the Pennsylvania Railroad, to report to Washington, D.C., to lead the effort to repair this railway devastation.[144] Haupt accepted and reported to McDowell the next day.[145] Using untrained soldiers, the engineer rebuilt three miles of track in three days, a train trestle 120 feet long and 30 feet high in 15 hours, and a railroad bridge spanning 414 feet and rising 82 feet above the Potomac Creek in two weeks.[146] By 19 May 1862, trains began

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[141] Hess, *Civil War Logistics*, 242.

[142] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 29.

[143] Lord, *Lincoln's Railroad Man*, 68.

[144] Ibid., 53-54.

[145] Ibid., 68.

[146] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 30.

running into Fredericksburg.[147] Witnessing this success, Secretary Stanton authorized Haupt on 28 May 1862 to form a permanent construction force that became the Construction Corps of McCallum's USMRR.[148]

As an organization, the Corps began as troops with no experience in railroad construction, but as time passed, Haupt remedied this shortcoming by building a permanent cadre. He issued the Corps' first regulations on 11 June 1862 to govern their operations, and after interviewing the individual soldiers to determine their past occupations, Haupt organized them into squads based on their skills.[149] He then increased his pool of laborers with contrabands, formerly enslaved people enthusiastic about helping the U.S. cause, and acquired the expertise of a small group of civilian carpenters and railroad repairmen.[150] So by 1863, Haupt had formed a 300-man nucleus that would grow to 10,000 as the war progressed.[151]

This evolution of the USMRR Construction Corps reached its zenith under McCallum when Grant appointed him as general manager of all railways in government possession in the Military Division of the Mississippi on 4 February 1864.[152] McCallum used the structure created by Haupt as the prototype for an agency of 6,000 construction

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[147] Lord, *Lincoln's Railroad Man*, 77.

[148] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 31.

[149] Lord, *Lincoln's Railroad Man*, 97.

[150] Ibid., 97, 99.

[151] Ibid., 100.

[152] Major and Fitch, *Supply of Sherman's Army During the Atlanta Campaign*, 30.

personnel to support Sherman's advance into Georgia.[153] On 11 February 1864, he appointed Colonel William Wright to command this enlarged Construction Corps.[154] McCallum subdivided Wright's Corps into six divisions, each supervised by a Division Engineer and able to operate independently to support military operations. A typical division consisted of 777 men organized into seven subdivisions, the two principles being the track-layers and bridge-builders, each consisting of 356 personnel.[155] Organized in this way and fully equipped to operate independently, a division with its tools, camp equipment, and wagons could move to any location as needed to support a field army.[156]

The commander of those supported armies, Sherman, had experiences that informed him of the value of Colonel Wright's mission. After the fall of Vicksburg, Mississippi, in July 1863, Grant had dispatched Sherman to subdue the Confederate army holding Jackson, Mississippi. In a foreshadowing of events in Georgia a year later, Sherman led a Union army to a state capital defended by a rebel army commanded by Joseph Johnston and destroyed the rail lines connected to that city as part of the operation.[157] The destruction of these rail assets was the greatest up to that point in the conflict. U.S. forces destroyed 40 miles of track north of Jackson, 60 miles south of the city, and 10 miles east. Summarizing the neuralization of his objective, Sherman

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[153] Major and Fitch, *Supply of Sherman's Army During the Atlanta Campaign*, 30.36.

[154] Ibid., 33-34.

[155] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 32-33.

[156] Major and Fitch, *Supply of Sherman's Army During the Atlanta Campaign*, 36.

[157] Hess, *Civil War Logistics*, 237-238.

reported, "Jackson ceases to be a place for the enemy to collect stores and men from which to threaten our great river."[158] It was an accomplishment that he repeated in February 1864 against Meridian, Mississippi. At that Southern rail hub, Sherman's troops destroyed 60 train trestles, 19 locomotives, 28 freight cars, and 80 miles of rail line.[159] Those operations impressed upon Sherman the importance of countering such destruction.

In his preparations for moving into Georgia, Sherman prioritized support for Wright to ensure the Construction Corps could repair what the rebels could wreak. He directed a stockpiling of replacement ties, bridges, and rails at Chattanooga and developed plans to move those materials forward to field sites along his route of advance. Locomotives and flat cars loaded with these construction resources were pre-staged and ready to respond when disruptions occurred. In addition, an entire infantry division was stationed in a network of Merrill Blockhouses to defend the repair crews.[160] While Sherman knew he could not forestall the rebels, he could minimize the disruption by preparing a rapid and effective response.[161]

These investments in Wright's Corps paid handsome dividends in the operation that followed.[162] For the 120-day duration of the Atlanta campaign, Confederate actions

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[158] Hess, *Civil War Logistics*, 238.

[159] Ibid.

[160] McMurry, *Atlanta 1864*, 29.

[161] Hess, *Civil War Logistics*, 244.

[162] McMurry, *Atlanta 1864*, 29.

disrupted rail traffic for a total of 20 days, with no single disruption lasting more than four. USMRR crews remedied most instances of damage in a few hours and rebuilt only ten miles of track destroyed by enemy action throughout the four-month advance.[163] The only delay in logistics was an interruption in the mail.[164] Of greater priority was the upgrading of existing lines to sustain the high volume of logistics traffic for the advance. The Construction Corps re-laid 115 miles of track, installed nineteen miles of new sidings, and added 45 water tanks to support movement along the Nashville and Chattanooga Railroad. As Sherman's armies advanced into northern Georgia, the Corps rebuilt 22 ½ miles of the Western & Atlantic Railroad and 4,081 lineal feet of bridges.[165] All of these efforts by the USMRR ensured the feasibility of the Atlanta Campaign and that logistics would not disturb the plans. Sherman expressed confidence from the beginning that the railway would be "all right" in supporting his armies' march.[166]

March on Atlanta

On 7 May 1862, Sherman launched the campaign to capture Atlanta and initiated a new method of warfare where the railroad was the linchpin for supply.[167] As already noted, the U.S. advance into Georgia would not have been possible without logistical

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[163] Hess, *Civil War Logistics*, 243-244.

[164] Ibid., 247.

[165] Major and Fitch, *Supply of Sherman's Army During the Atlanta Campaign*, 41-42.

[166] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 34.

[167] MacDonald, *Great Battles of the Civil War*, 156.

support provided by locomotives. Possession of rail was an operational objective for both sides and decided the outcome of this struggle.

The generals had faced a similar dilemma a year earlier and played comparable roles in the quest to control the Mississippi state capital.[168] In that engagement, Sherman had developed the strategy and tactics he would employ to seize Georgia's seat of government. First, the U.S. armies repeatedly moved to threaten the Confederates' rail link to their supply source. That compelled the rebels to retreat out of their positions and, in so doing, allowed federal forces to advance toward the campaign objective. Then when the invasion force arrived in the vicinity of Atlanta, Sherman's troops would make a circuit around the city to cut each track sustaining the defenders and make holding the capital an untenable endeavor.[169] The key to this strategy was that the attacker had to possess a force large enough to demonstrate before and distract the main body of his opponent while dispatching a second sizeable element to turn their flank and threaten their lines of communication.

For this enterprise, the U.S. had endowed Sherman with sufficient forces. The Commander of the Military Division of the Mississippi had at his disposal an army group composed of three field armies totaling 113,000 troops with 254 artillery pieces. The Army of the Cumberland had the bulk of Sherman's combat power, with 75,000 soldiers organized into three infantry corps and one corps of cavalry. The Army of the Tennessee came next in size and possessed 25,000 infantry formed into two corps, while the

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[168] Hess, *Civil War Logistics*, 237-238.

[169] Ibid., 244.

smallest of the three armies, the Army of the Ohio, comprised just 13,000 personnel arranged in one infantry corps and one cavalry division.[170] With these three subordinate commands, Sherman had the capacity and flexibility to carry out his intended maneuvers.

To oppose U.S. moves, the Confederacy had one field force under the command of Joseph Johnston. This defense consisted of 55,000 soldiers and 144 guns, organized into two infantry corps and one cavalry corps.[171] Thus, U.S. forces outnumbered the rebels in northern Georgia by approximately two to one at the campaign's outset. However, in May 1864, Jefferson Davis approved the incorporation of 20,000 troops from the Army of Mississippi to Johnston's command, significantly improving the odds.[172] Nevertheless, a disparity remained between the U.S. and Confederate armies, with at least a 1.35 to 1 advantage over the rebels.[173] That disproportion encouraged Johnston to remain on the strategic defensive and only engage Sherman's armies when position and terrain could favor his force and compel his enemy into costly frontal assaults.

This passivity would be a source of criticism for Johnston and eventually lead to his ouster by Davis.[174] Surrendering the initiative to the invaders allowed Sherman to

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[170] McCarley, *The Atlanta and Savanah Campaigns 1864*, 8.

[171] Ibid., 10.

[172] Ibid.

[173] McMurry, *Atlanta 1864*, 181.

[174] Ibid., 139.

formulate and carry out his plans without interference from his adversary.[175] From May through July, Sherman's forces repeatedly approached a fortified position held by Johnston and then turned the Confederate left flank to threaten the rebel rail link. The rebel army was forced to retreat first from Dalton, then Resaca, followed by Cassville, Dallas, and Kennesaw Mountain, allowing federal forces to advance the battle line by 100 miles at a minimal cost.[176] Over the first six weeks of the invasion, U.S. casualties only totaled 12,000 versus 9,000 for the defenders. As a point of comparison, the contemporary operation of the Wilderness Campaign in Virginia cost both combatants a combined total of 32,000 soldiers in just two days.[177] Only on 27 June at Kennesaw Mountain did Sherman attempt a full-scale engagement between the armies, but after suffering 3,000 casualties for no advantage, he again ordered a move around the rebels' flank.[178] One optimistic U.S. soldier made a remark that was emblematic of much of the campaign when he stated that the rebel fortifications were too strong to assault, but "we flanked them though, and they had to skedaddle."[179]

By early July, Sherman's armies approached the Chattahoochee River, the last major obstacle between the invaders and their objective.[180] Once again, the rebels

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[175] McMurry, *Atlanta 1864*, 184.

[176] MacDonald, *Great Battles of the Civil War*, 160.

[177] McMurry, *Atlanta 1864*, 111.

[178] MacDonald, *Great Battles of the Civil War*, 160.

[179] McMurry, *Atlanta 1864*, 111.

[180] MacDonald, *Great Battles of the Civil War*, 161.

assembled impressive earthworks that appeared unassailable, but this time, Sherman decided to turn the right flank of Johnston's defense. Beyond a hope for tactical surprise, one key factor that led to this decision was that the geography of the passage on the rebel right would place federal forces in a better position to defend their lifeline, the Western & Atlantic Railroad.[181] So even in this last maneuver before investing the city, the criticality of maintaining lines of communication held sway. The result was a replay of the previous months. Johnston's forces fell back from their prepared defenses along the Chattahoochee on 10 July and, with those steps, triggered his replacement a week later.[182] Davis appointed John Bell Hood to succeed the cautious Johnston, hoping that the fiery new leader would reverse the rebel fortunes.[183]

The new Confederate commander attempted to fulfill this mandate with assaults that would only further weaken his defense. In a series of attacks on 20, 22, and 28 July, Hood futilely sortied from Atlanta and lost 12,000 men for no gain for his diminishing command.[184] Realizing he could not best Sherman's besieging forces through direct strikes, on 10 August, the rebel commander dispatched Joseph Wheeler with 4,000 cavalry to ride north and attempt to cut the Western & Atlantic Railroad, which kept the U.S. army supplied.[185] However, Sherman's planning and investment in defense of this

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[181] McMurry, *Atlanta 1864*, 115.

[182] McCarley, *The Atlanta and Savanah Campaigns 1864*, 44.

[183] MacDonald, *Great Battles of the Civil War*, 161.

[184] Hess, *Civil War Logistics*, 245.

[185] McCarley, *The Atlanta and Savanah Campaigns 1864*, 62.

track made Wheeler's raid ineffective. All that the Confederate cavalry incursion accomplished was to wreck a total of two miles of track, two bridges, and two water tanks that the USMRR remedied in a few days.[186] Hood's gambit failed and left him with fewer troops to man Atlanta's fortifications, a factor that enabled Sherman's subsequent plans.

Sherman mimicked his attack on Jackson, Mississippi, the year prior and attacked "his enemy's line of transport."[187] The strategy for Atlanta would be "to make a circuit, destroying all its railroads."[188] There were four. He held one already, the Western & Atlantic, and on 18 July dispatched General McPherson with three corps of infantry eastward to sever a second, the Georgia Railroad. That left two that ran south of the city, the Atlanta & West Point line and the Macon & Western.[189] The outcome of the siege pivoted on these.

Sherman twice attempted to cut the two Southern rail lines through cavalry raids on 13 July and 18 August.[190] Neither applied enough force to take sufficient track out of commission. It would require a determined movement of infantry to affect the necessary devastation, and Hood's self-depleting attacks in late July and early August allowed the Sherman to strip forces away from the siege to accomplish this goal. Sherman had six of

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[186] Hess, *Civil War Logistics*, 246.

[187] Ibid., 238.

[188] McCarley, *The Atlanta and Savanah Campaigns 1864*, 44.

[189] McMurry, *Atlanta 1864*, 141-142.

[190] Ibid., 119, 166.

his seven infantry corps wheel to the south to destroy the rail connections.[191] By 1 September, his troops had broken all the lines and forced the Confederates to vacate Atlanta that same day. U.S. forces occupied the abandoned objective the following morning.[192] Sherman and his armies had gained the triumph, but railroads had decided the outcome.

Conclusion

The campaign to capture Atlanta illustrated how the railroad evolved from a logistical expedient into an essential objective to ensure victory. Sherman's march through northern Georgia and subsequent victory could not have occurred without the sustainment capability of the steam locomotive, but that was not a novel development of the campaign. The priority that trains and tracks assumed for the armies vying over Georgia's capital and for much of the American Civil War derived from a half-century of experience, organizational growth, and doctrinal elaboration. All of those prerequisites had to be in place for the capability of rail to be appreciated and necessitated.

The United States and its Army had to undergo a series of challenges to desire the organized and directed supply model that would require a locomotive. The conflicts and geographic expansion of the country in the first half of the nineteenth century proffered an array of stumbling blocks that the young nation had to overcome. The adversities of each episode built a growing body of logistical knowledge. The distances to traverse encouraged innovation and an openness to exploring technology. The inefficiency and

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[191] Hess, *Civil War Logistics*, 248.

[192] MacDonald, *Great Battles of the Civil War*, 166.

disorganization of moving and supporting troops in situations that were far from ideal drove a requirement for professionalism and institutional development. These experiences made the Army into an organization that prioritized sustainment and supply and sought solutions for capability gaps. One answer to the Army's queries was the railroad and its ability to span geography and efficiently connect strategic depots to the nation's advancing armies.

That harnessing of locomotive power to solve logistical constraints produced an awareness amongst military leaders of its value and its ability to extend their operations. Trains and tracks became vital assets to be protected or destroyed. Agencies such as the USMRR and its Construction Corps had to be established to maintain this key mechanism and ensure its worth and effectiveness. This technology became the centerpiece around which opposing armies maneuvered. Generals drew their campaign plans with rail lines as essential ingredients.

In the case of the Atlanta Campaign, the antagonists pursued avenues to threaten their foe's lines of communication. Each sought to retain the Western & Atlantic Railway and deny its use to the other. In the end, the severing of all rail lines into Atlanta triggered the capitulation of the Confederate defense. Thus, the railroad became the enabling tool of operational maneuver and the qualifying goal for operational success. That elevation of rail in the eyes of Civil War commanders like Sherman signaled that the United States Army had evolved beyond the pre-Industrial focus of plotting movements on a battlefield to embracing the more holistic and modern view of neutralizing an adversary's ability to wage war. Such a lesson would have been of incalculable value to strategists contemporary with the Civil War combatants.

CHAPTER 3

AUSTRO – PRUSSIAN WAR CASE STUDY: BOHEMIAN CAMPAIGN (1866)

Introduction

> The transport of reinforcements, provisions, and other requirements of the Army need not be included in this sketch.
>
> –Henry M. Hozier, *Campaign of 1866 in Germany*

In 21 days, from 16 May through 5 June 1866, the Kingdom of Prussia transported 197,000 soldiers, 55,000 horses, and 5,300 wagons via rail from mobilization depots to tactical assembly areas in preparation for war against the Austrian Empire.[193] By the end of June, 254,000 troops would march into Austrian-controlled Bohemia, constituting the largest strategic deployment of the *Königlich Preußische Armee*, Royal Prussian Army, since the Napoleonic Age.[194] Such an accomplishment would have been impossible without the railroad.[195] The *Preußische Großer Generalstab*, the Prussian Great General Staff, achieved this feat through careful planning and close cooperation with civil authorities and commercial railway companies.[196] The gathering of forces went

[193] Henry M. Hozier, *Campaign of 1866 in Germany* (Berlin, DE: Topographical and Statistical Department of the War Office, 1872), 24.

[194] Geoffrey Wawro, *The Austro-Prussian War: Austria's War with Prussia and Italy in 1866* (Cambridge, UK: Cambridge University Press, 1996), 8.

[195] Ibid., 18.

[196] van Creveld, *Supplying War*, 83.

so smoothly that a rumor began that the Chief of the General Staff, Helmuth von Moltke, passed his time reading a book on his sofa during the mobilization.[197]

Yet, that successful first step marked the only usage of the railroad that the official chroniclers of Prussia's war with Austria deemed worthy of mention. While the official account of the conflict by the Prussian General Staff records the transportation actions taken to concentrate the armies of the Hohenzollern monarchy during those fateful first weeks, the tome remains silent regarding the employment of trains for any other purpose in the seven weeks of hostilities that followed.[198] Instead, the accounting of logistics and the efforts to utilize the steam locomotive to support the 1866 campaign in Bohemia is only referenced by parties other than Moltke's staff, who did not wish to publicize the provisioning efforts that followed their triumphal opening moves.

To understand their editorial choice, an examination of how the Prussian army addressed logistics in the mid-nineteenth century is necessary. At this point in history, the military planners of this German kingdom lacked practical experience in supplying a large army over any substantial distance. The previous large deployment of their forces had consisted of Prussian battalions marching to the sound of the guns at Waterloo two generations earlier.[199] In the intervening half-century, Prussian arms had gone untested except for a campaign against Denmark in 1864 that had involved just a fraction of the

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[197] van Creveld, *Supplying War*, 84.

[198] Hozier, *Campaign of 1866 in Germany,* 507.

[199] Christopher Clark, *Iron Kingdom: The Rise and Downfall of Prussia, 1600-1947* (Cambridge, MA: Belknap Press, 2006), 510.

military strength that invaded Bohemia two years later.[200] This prolonged idleness left the architects of Prussian strategy with no organic reference to address operational sustainment and vulnerable to underestimating the potential for railroads to aid such an effort.

Planning sustainment and incorporating technological innovation into that plan introduced challenges to the Prussian military. These factors inserted new and untested dynamics into the execution of their campaign against Vienna's armed forces. The ability of Moltke's planners to develop a successful concept of support integrating the steam locomotive remained hostage to their inexperience with this new medium and their prioritization of maneuver over operational logistics.

Subordination of Sustainment

The last time a Prussian army advanced to a foreign battlefield en masse, the Napoleonic concept of foraging off the land and the ancient doctrine of resupply by fortress magazine held sway.[201] In 1866, Prussia still stockpiled provisions in the strongholds along its frontiers. For their combat operations against Denmark two years earlier, their logistic plan depended on quartermasters purchasing their provisions locally.[202] Then upon moving forward into Jutland, their forces were resupplied from a

[200] van Creveld, *Supplying War*, 79.

[201] Geoffrey Parker, ed., *The Cambridge History of Warfare* (Cambridge, UK: Cambridge University Press, 2005), 202.

[202] Dennis E. Showalter, *Railroads and Rifles: Soldiers, Technology and the Unification of Germany* (Hamden, CT: The Shoe String Press, Inc., 1976), 50.

magazine established in Kiel.[203] The idea that a quartermaster or any member of the General Staff would have any input in operations against the Danes was a wholly alien concept to that war's Supreme Commander, *Feldmarschall* Friedrich von Wrangel. The Prussian marshal declared that participation of Moltke's staff was unnecessary and their "damned clerking" was a nuisance and a burden.[204] Such an assertion indicated that mid-nineteenth-century Prussian officers did not place a high value on sustainment planning.

In 1864, one such officer, Captain Justus Scheibert, whom the General Staff dispatched to observe the American Civil War, noted that Union General Grant appeared to have the movement of his armies limited by a dependence on maintaining lines of communication to railheads and seaports.[205] In contrast, the Confederate Army's lack of a developed system of replenishment appeared to him to offer their formations greater freedom of maneuver. In Scheibert's opinion, the Confederates "turned poverty into luxury: few stores into many graces of movement."[206] The young Prussian recounted that Confederate General Lee said, "Old Caesar always has the right words. He hits the nail on the head when he calls baggage trains impedimenta!"[207] Lee's statement led Captain Scheibert to form his own conclusion: "Packaged and preserved foods, and the elaborate

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[203] van Creveld, *Supplying War*, 79.

[204] Walter Goerlitz, *History of the German General Staff: 1657-1945* (New York, NY: Frederick A. Praeger Publishers, 1953), 83-84.

[205] Trautmann, *A Prussian Observes the American Civil War*, 17.

[206] Ibid.

[207] Ibid.

means of moving and complicated ways of issuing them: thus, feeding the men adds up to hindrance, obstruction, impedimenta indeed."[208]

This opinion of logistics hindering operational prosecution did not fall into the minority among Scheibert's peers. Many Prussian officers believed supply questions to be unworthy of a soldier's attention and, similar to *Feldmarschall* Wrangel, referred to such matters as *Beamtensachen* or clerks' work.[209] These leaders held maneuver to be the valued priority that all other concerns paid due. Such an opinion was encapsulated in *Bewegungskrieg*, the Prussian concept of mobile warfare or war by movement.[210]

This preeminence of maneuver can be seen as a by-product of a type of war that Friedrich Wilhelm, Prussia's Great Elector of the seventeenth century, referred to as *kurtz und vives*, short and lively. The Hohenzollerns had long advocated that their nation fight conflicts that were resolved quickly and decisively.[211] This preference was derived from this German state's geographic weakness and general poverty. Situated in Central Europe, surrounded by larger, more populous nations, and possessing few physical obstacles to slow an incursion, Prussian geography proffered a more prominent exposure to invasion than the other great powers of Europe. This liability led the French writer Voltaire to dismissively refer to the Hohenzollern monarchy as a "kingdom of border

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[208] Trautmann, *A Prussian Observes the American Civil War*, 17.

[209] Showalter, *Railroads and Rifles*, 69.

[210] Robert M. Citino, *The German Way of War from the Thirty Years' War to the Third Reich* (Lawrence, KS: University Press of Kansas Press, 2005), xiv.

[211] Ibid., xiii.

strips."[212] Foreign powers during the Thirty Years War of 1618 to 1648 had repeatedly violated those borders, and the resulting destruction left an inescapable sense of vulnerability in the Prussian outlook on war.[213] The Prussian economy added to this woe by lacking the resources and manpower to prosecute a protracted war of attrition against their more well-heeled neighbors.[214] These challenges encouraged Prussia's leadership and military to seek out means of delivering a fierce, annihilating blow in the shortest time possible to gain a concise resolution to any conflict. War plans were based on the concept of *Bewegungskrieg*, the swift movement of military forces, to gain that decisive conclusion.[215] This prioritization of maneuver tended to subordinate other more ponderous disciplines such as logistics and intelligence that would be imperative for long-term, long-range operations.[216] With such thoughts dominating the Hohenzollern mind, comprehensive, high-volume logistics remained a novelty to the Prussian general staff when their nation initiated new hostilities.

Development of Rail

Beyond the lack of priority given to logistics planning, the early-nineteenth-century Prussian high command did not readily embrace the innovation of the steam

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[212] Wawro, *The Austro-Prussian War,* 13.

[213] Clark, *Iron Kingdom*, 66.

[214] Citino, *The German Way of War from the Thirty Years' War to the Third Reich*, 311.

[215] Ibid., xiv.

[216] Ibid., xiv-xv.

locomotive out of fear that such an innovation could abet their opponents. When this new technology appeared in Prussia in the 1830s, the heirs of Frederick II imagined that railroads would endanger their frontier fortress system and facilitate enemy invasion.[217] Prussia's war minister in 1841, Herman von Boyen, believed the incorporation of railroads and their timetables into mobilization efforts would hold the state's war plans hostage to an inflexible and automatic system. His fear was an ironic foreshadowing of Imperial Germany's plight at the start of World War One.[218] The promotion of this new technology by German luminaries such as industrialist Friedrich Harkort, banker Ludolph Camphausen, and economist Friedrich List fell on deaf ears within army circles.[219] A study by the general staff in 1835 concluded that the construction of paved roads should take precedence and not be supplanted by rail lines.[220] The limited cargo capacity of early trains undermined their desirability as a troop transport. In 1836, the pamphlet *Uber die Militärische Benutzung der Eisenbahnen* noted that an embryonic train system would take 25% longer to deliver an army corps to a given destination than if the troops marched there on foot. Under existing conditions, the pamphlet argued it would take a corps with all assigned personnel and equipment twenty days to traverse fifty-two miles

[217] van Creveld, *Supplying War*, 82.

[218] Showalter, *Dynamics of Military Revolution*, 101.

[219] Ibid.,100.

[220] van Creveld, *Supplying War*, 82.

by rail while such a move on foot only required sixteen.[221] Thus, the general staff did not invest considerable attention in this novel means of transportation in its formative years.

It would take the 1850 mobilization for a possible war with Austria to spotlight the need for incorporating railroads into Prussia's war plans. Prussia had hoped an ample show of force in May 1850 would deter Austria from escalating relations into conflict. The plan began with a mass mobilization of a half-million troops, including the regular army, the reserve, and the *Landwehr* (provincial militia).[222] The challenge occurred in the second step, transporting Prussia's accumulated military forces to the border assembly areas. To intimidate their would-be opponent, these troops needed to arrive at the Austrian border en masse before Vienna could deploy its army to confront them. However, marching Prussia's soldiers to the frontier would take weeks. Having multiple army corps, each numbering at least 30,000 troops, attempt to road march on a common axis would require the use of paths and cross-country detours that would slow the advance to a crawl.[223] The general staff identified this protracted movement as a capability gap and looked for a means to shorten the timeline.[224]

The answer to the Prussian army's dilemma lay in mid-nineteenth century railroads. Technological improvements since the 1830s had increased the speed and carrying capacity of steam locomotives enough to allow a train to transport battalions six

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[221] Showalter, *Railroads and Rifles*, 26.

[222] Showalter, *Dynamics of Military Revolution*, 101.

[223] Dennis E. Showalter, *The Wars of German Unification,* 2nd ed. (London, UK: Hodder Arnold, 2004), 61.

[224] Showalter, *Dynamics of Military Revolution*, 102

times faster than the men could walk to their objective. Thus, the general staff decided to change their conclusions from fifteen years earlier and utilize railroads to transport their forces to the border.[225]

However, their planned use of railroads to intimidate Prussia's adversary did not survive execution. Because the general staff had made no detailed arrangements or preparations regarding how the rail systems would be utilized, scheduling trains and loading regiments became a haphazard affair. Units became separated from their equipment. Troops and supplies piled up at railheads. Battalions shuttled randomly between stations and found no provisions to sustain their soldiers when they finally arrived at their assembly areas. The results varied between tragedy and farce. However, Austria's simultaneous execution of troop movement by rail to its frontier with Prussia went smoothly and became a proof of principle. Thus, their would-be opponent's success convinced the Prussian general staff that the inclusion of railroads in deployment efforts had merit but would require more detailed planning on their part.[226]

Despite deciding upon the use of steam locomotives in their mobilization plans, the Prussian General Staff remained hesitant to integrate the railroad into their training. The staff did not publish its first policy letter for the use of trains in large troop movements until 1858.[227] Planners did not incorporate the locomotive into a major

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[225] Hajo Holborn, "The Prusso-German School: Moltke and the Rise of the General Staff," in *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, ed. Peter Paret (Princeton, NJ: Princeton University Press, 1986), 287.

[226] Showalter, *Dynamics of Military Revolution*, 101-102.

[227] Showalter, *Wars of German Unification*, 66.

mobilization exercise until 1859.[228] This hesitancy within the general staff of the 1850s was derived from their view of the steam train as primarily an instrument of defense directed towards reinforcing threatened sectors and maintaining communications between Prussia's frontier fortresses.[229] These staff officers lacked a doctrinal framework for integrating new technology into their campaign plans and offensive operations. Their education at the *Kriegsakademie* (War College) did not address technological advances such as railroads.[230] It would take the elevation of Moltke as the Chief of the General Staff in 1857 to trigger the inclusion of railroads into Prussia's warfighting doctrine.[231]

Moltke had long advocated for the use of trains. He had studied the technology before a single track had been laid in Germany and had become a believer in its potential to deploy forces and overcome geographic limitations.[232] In 1841, Moltke began a three-year tenure on the board of the Berlin-Hamburg Railway and even went so far as to risk his life savings investing in the venture. He wrote articles and essays supporting the line and published a comprehensive guide on the choice of railway routes in 1843.[233] Moltke envisioned what the future could be with steam locomotives. In 1850, in his capacity as

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[228] Showalter, *Dynamics of Military Revolution*, 103

[229] Ibid., 102.

[230] Samuel J. Lewis, "Königgrätz," in *US Army Command and General Staff College, H100 Syllabus and Book of Readings* (Fort Leavenworth, KS: USACGSC, July 2016), 313.

[231] Showalter, *Dynamics of Military Revolution*, 102.

[232] Holborn, "The Prusso-German School," 287.

[233] Quintin Barry, *The Road to Königgrätz, Helmuth Von Moltke and the Austro-Prussian War 1866* (Solihull, UK: Helion & Company Ltd., 2010), 50-51.

chief of staff of Prussia's VIII Corps, he incorporated railroads into the corps' field exercises.[234] Upon his appointment to lead the General Staff, he changed his nation's military structure and doctrine to take advantage of this technology.[235]

One essential transformative step involved reorganizing the Prussian General Staff to improve the management of the mobilization process. In 1864, inspired by the innovative example of the American Civil War transmitted to him by Sheibert, Moltke established a Railway Section within the general staff dedicated to railroad planning and operations.[236] To supervise this new agency, Moltke selected a dynamic staff officer and expert on railways, Major Hermann von Wartensleben.[237] In 1861, Wartensleben had been Moltke's hand-picked representative for Prussia on the commission to coordinate military use of German railways amongst the states of the German Confederation, the association of the 39 German-speaking states of Europe.[238] The Railway Section officer and his newly-created staff would be responsible for developing the plans and timetables for the movement of Prussian troops by rail.[239] It had its first real test that same year by arranging the movement of Prussian units to the province of Holstein in support of the

[234] Showalter, *Wars of German Unification*, 66.

[235] Holborn, "The Prusso-German School," 287.

[236] Luvaas, *The Military Legacy of the Civil War*, 122.

[237] Showalter, *Railroads and Rifles*, 59.

[238] Barry, *The Road to Königgrätz,* 54.

[239] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 104.

war with Denmark.[240] Prussia sent two army corps consisting of over 35,000 soldiers and 110 artillery pieces to join the coalition fighting the Danes.[241] These troops and their equipment arrived in the theater via rail with relatively few delays and, at the end of hostilities, returned home by the same means without issue, proving the worth of Wartensleben and his staff.[242]

The war with Denmark revealed that coordination with railway companies was critical for the military use of the rail lines.[243] The army needed the companies' cooperation for the operation, loading, and unloading of the trains.[244] To facilitate that support, Moltke recommended in 1866 the establishment of a two-person Executive Commission consisting of a General Staff representative and a representative of the Prussian Ministry of Trade.[245] He selected Wartensleben as the General Staff's representative, and Mr. Theodor Weishaupt represented the Trade Ministry.[246] The commission was based in the Prussian capital of Berlin and managed the military's usage of the national railway system. The body controlled the rail lines leading into a theater of operations. The commission's military member ensured that the army's movements on

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[240] Showalter, *Railroads and Rifles*, 49-50.

[241] Barry, *The Road to Königgrätz,* 86.

[242] Showalter, *Railroads and Rifles*, 50-51.

[243] Ibid., 50.

[244] Hozier, *Campaign of 1866 in Germany,* 505.

[245] Showalter, *Wars of German Unification*, 149.

[246] Hozier, *Campaign of 1866 in Germany,* 505.

the tracks received priority. The civilian representative sought to prevent the military from making technically impossible demands upon the railways.[247] In addition, the commission issued orders to similarly configured subordinate commissions responsible for administering each of those lines. Each auxiliary commission consisted of a military officer and a representative of the railroad that operated that line, who were expected to execute the Executive Commission's directives and manage every aspect of the transportation of military personnel and supplies along the track. This mandate included supervising the trains and stations, scheduling the stops, and arranging provisioning for those transported, which represented a significant number of responsibilities for each commission.[248]

Beyond the supervision of the mobilization process, Moltke also made specific changes in preparation and execution. The new technology of the telegraph would transmit mobilization orders instead of using couriers, reducing notification times from five days to one.[249] The war ministry mandated that benches in all passenger rail cars and partitions in freight cars be removable to convert from commercial to military usage quickly.[250] When mobilization commenced, trains would be reserved to transport a particular battalion, squadron, or battery from the embarkation point to the final destination, ensuring unit integrity during movement. In 1859, the army began training

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[247] Showalter, *Railroads and Rifles*, 60.

[248] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 104, 108.

[249] Showalter, *Dynamics of Military Revolution*, 103.

[250] Wawro, *The Austro-Prussian War,* 17.

troops on the loading and unloading of boxcars and initiated large-scale annual exercises to practice assembling forces and utilizing rail lines. That summer, Prussia's V Corps completed a practice mobilization in the province of Posen, incorporating those new training priorities, and accomplished the task in 29 days. The general staff considered the feat commendable due to the remote and undeveloped nature of the province, which had few roads or telegraph lines. The introduction of railroads into these annual field exercises contributed to the smooth deployment of expeditionary forces to Denmark in 1864.[251] These accomplishments exemplified the success of Moltke's efforts to integrate rail technology into the planning and preparation for Prussia's wars.

Logistical Doctrine and Development

The next step in his integration effort comprised developing logistical systems and doctrine that included the railroad's role in mobilizing, deploying, and sustaining Prussia's army. Moltke dictated that rail would transport troops to the assembly areas from which they would march into the theater of operations.[252] Supplies and reinforcements would follow along the same lines. At the railheads, each army corps' train battalion would rendezvous with the supply locomotives to have cargo transferred into wagons for transport and distribution to their supported command. As the mobilization of 1850 had illustrated, a single line of communication could not effectively sustain more than 30,000 troops or one army corps.[253] Thus, the movement of provisions

[251] Showalter, *Dynamics of Military Revolution*, 103

[252] Goerlitz, *History of the German General Staff 1657-1945*, 76-77.

[253] Showalter, *Wars of German Unification*, 61

by the trains battalion's wagons would follow the pattern of one supply train per road per corps.[254] With this concept, the Prussian general staff developed a doctrinal process for utilizing rail transport in conjunction with horse-drawn wagons of the corps trains battalions to support their deployed forces via established lines of communication.

Fulfilling this doctrine required a change in the organization and procedures of the Prussian Army and how it sustained itself. The Prussian Army had relied upon forage and local requisition for its needs in the campaigns of the Napoleonic age and earlier.[255] Those past field forces had support elements that consisted of provisioning columns, field bakeries, remount depots, and ambulance wagons. However, there was no formal organization responsible for managing the supply service.[256] In the half-century that preceded Austria's war, Prussia's peace-time formations had their logistical needs met by an intendance service while in garrison. These were military officials who answered to the Ministry of War and purchased supplies from local contractors, similar to the agents who provisioned the armies of the United States prior to the War of 1812.[257] In addition, in this period, the Prussian General Staff held no supply responsibilities and focused on map-making, war-gaming, and historical research.[258] Senior army officers looked upon

[254] Showalter, *Dynamics of Military Revolution*, 102.

[255] Parker, *The Cambridge History of Warfare*, 9.

[256] van Creveld, *Supplying War*, 77.

[257] Showalter, *Railroads and Rifles*, 69.

[258] Showalter, *Dynamics of Military Revolution*, 102-103.

logistics as *Beamtensachen* or clerks' work.[259] As a result, in the first half of the nineteenth century, the Prussian Army's sustainment process lacked direction and had no central governing authority equivalent to the U.S. Army's Quartermaster General.

As part of a series of army reforms in the wake of Prussia's poor performance at mobilization in 1850, the Ministry of War recommended the creation of a logistical organization to address each army's supply needs. Accordingly in 1853, King Frederick Wilhelm ordered each corps to appoint an officer and staff section dedicated to quartermaster duties and engage them in annual training exercises to hone their logistical skills. In 1856, Prussia established formal trains battalions to supply each corps and administer each command's remount depot, field hospitals, and bakeries.[260]

In the 1860s, the growth of the Prussian Army and the introduction of railroads into Prussian doctrine spurred further reforms. To meet the perceived threats of foreign powers, the Prussian Army tripled in size from 100,000 in 1850 to 300,000 a decade later.[261] By 1866 the field force consisted of nine corps, each comprising approximately 30,000 troops.[262] To meet the sustainment demands of the growing army, in 1860, Motke reorganized the trains battalions as an independent *waffe* or arm of the army and gave them an inspector-general who held the responsibility of training and nominating the commanders for the battalions. However, similar to the garrison intendance service, the

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[259] Showalter, *Railroads and Rifles*, 69.

[260] van Creveld, *Supplying War*, 78.

[261] Wawro, *The Austro-Prussian War,* 17.

[262] Spenser Wilkinson, *The Brain of an Army: A Popular Account of the German General Staff* (Westminster: Archibald Constable & Co., 1895), 36.

inspector-general answered to the Ministry of War rather than the General Staff.[263] However, Moltke's reorganization only assigned 292 personnel to each corps trains battalion.[264] With this small roster, the battalion was expected to load and distribute via wagon four-days provisions to 30,000 men along with the fodder for the corps' 6,000 horses and the ammunition to resupply the corps' small arms and 96 artillery guns.[265] Such minute logistical tails for such large formations did not bode well for the Prussian army's sustainment capability.

In 1866 in the months just prior to the war with Austria, one further development occurred that would affect the army's ability to sustain itself. That Spring, Daniel C. McCallum, who had directed the USMRR during the American Civil War, published a report of that organization's efforts in the conflict. Moltke and his staff read the publication and recognized the value of the USMRR's construction corps to maintain and extend rail lines. This American example inspired the creation of a similar organization in the Prussian Army.[266]

In May 1866, Moltke established the *Feldeisenbahnabteilung*, a field railway detachment, with a basis-of-issue of one per field army.[267] He assigned a detachment to

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[263] van Creveld, *Supplying War*, 79.

[264] Kenneth Macksey, *For Want of a Nail: The Impact on War of Logistics and Communication* (London: Brassey's Ltd., 1989), 28.

[265] Wilkinson, *The Brain of an Army*, 38.

[266] Luvaas, *The Military Legacy of the Civil War*, 122.

[267] Ibid.

each of the three armies that invaded Bohemia.[268] While intending to model the unit after a construction corps of the USMRR, each detachment entailed just over 100 personnel, far fewer than the 777 of its U.S. counterpart.[269] The detachment consisted of Pioneer engineers consisting of four officers and 125 soldiers.[270] Furthermore, the army allotted each of these detachments just four horse-drawn wagons to transport all the tools and materials that the laborers could not carry on their backs. In contrast, the Prussian Army assigned each similarly sized field telegraph detachment a dozen or more wagons to carry their wire and communication equipment.[271] The detachment's small size and its limited amount of transport restrained the rail unit's capacity to support the field armies to which they were assigned.[272]

While Moltke attempted to create an adequate sustainment system for Prussia's armies, time limitations and a lack of institutional experience compromised his efforts. Though he had access to data from the American Civil War, the information only became available in the final months before going to war with Austria. It allowed him to take action upon it only in a very short window before hostilities commenced. Furthermore, the absence of logistical knowledge and experience within the Prussian Army meant Moltke had no organic template to follow or against which to test his theories. As a

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[268] Macksey, *For Want of a Nail*, 25.

[269] van Creveld, *Supplying War*, 91-92.

[270] Edward Newdigate, *The Army of the North German Confederation* (London, UK: Henry S. King & Co., 1872), 36, 60.

[271] Ibid., 60.

[272] Macksey, *For Want of a Nail*, 25.

result, the agencies and systems that the Prussian General Staff created to support their field forces had inherent inadequacies and would face significant challenges in the Bohemian campaign.

War with Austria

An examination of how major operations unfolded in Bohemia and the challenges in that theater demonstrates how these supporting units and Prussia's plans for steam locomotives would come to fruition during the war with Austria. By the mid-nineteenth century, planners in Prussia and Austria predicted that war would be inevitable between their nations. As early as 1857, Moltke had begun working on contingency plans for such an engagement. He had finalized a proposal for a concentration of the Prussian Army for probable Austrian hostilities by the spring of 1860.[273] Whether Moltke or his Austrian counterpart would have the ability to execute their preferred schemes depended on the time required for the mobilization and assembly of their military forces. However, a prompt, successful mustering mattered little if the concentration of troops took place in the wrong location to meet the operational goals. Thus, determining the locale of decisive action became the next factor of importance.

In 1866, that critical terrain centered on the Austrian province of Bohemia, which today consists of the Western half of the Czech Republic. Bohemia abutted the Prussian province of Silesia to the north and the Austrian-allied Kingdom of Saxony to the west. This location provided Austrian forces a central point of concentration to carry out a

[273] Charles D. Daves, "The Battle of Königgrätz: The Evolution of Operational Art," (Master's thesis, U.S. Army Command and General Staff College, 1988), 7.

variety of courses of action, including an invasion of Silesia or threatening the Prussian capital of Berlin. Thus, this territory formed a vital strategic interest in the conflict, and both nations chose to conduct their main efforts in this location.[274]

The Prussian rail network provided access to this potential front line via five separate lines terminating at Halle, Torgau, Görlitz, Freyburg, and Neisse. At eight trains daily, Prussia could move an army corps of approximately 30,000 troops and their equipment along each track and assemble a corps over two weeks at each of the five termination points along a 300-mile arc on the Bohemian border.[275] In contrast, the Austrians only possessed one line to support operations in their province. Moltke estimated that this single track into Bohemia would mean his Austrian counterpart would require 45 days to assemble 200,000 soldiers there. At the same time, he could concentrate his forces along the frontier in only 25.[276]

In addition to the discrepancy in rail access, differing mobilization processes proved to be pivotal in assembling forces and conducting operations. The Prussian mobilization plan consisted of activating and concentrating active and reserve troops in districts, each centered on a corps headquarters, and then deploying from their mobilization sites via dedicated rail lines to assembly areas along the frontier.[277] However, the Austrian model had a more decentralized approach, with troops from

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[274] Barry, *The Road to Königgrätz,* 156.

[275] Hozier, *Campaign of 1866 in Germany,* 22, 506.

[276] Barry, *The Road to Königgrätz,* 149.

[277] Daves, "The Battle of Königgrätz," 13-14.

different provinces traveling significant distances to unite with their battalions and regiments in tertiary locations. The Austrian Empire's dominion over a multiplicity of non-German peoples bred a fear of insurrection within the Hapsburg monarchy.[278] The Austrian mobilization plan separated troops from their home provinces to ensure that the military formation within a region had no connection to the local population. Thus, if called upon to suppress a revolt, the troops would have no personal connection to the militants they might engage.[279] While such a system may have supported internal security, this dispersed scheme of muster added weeks to the assembly process. That additional time and the limited rail access in Bohemia resulted in the Austrian mobilization taking six weeks in contrast to three for Prussia. Even though Austria initiated its concentration of troops on 21 April 1866, three weeks prior to its opponent, Prussia still had the ability to amass combat power faster in the theater and take the initiative in operations, placing Austrian forces on the defensive.[280]

When Moltke accomplished his celebrated swift mobilization in early June 1866, he chose to take the offensive and ordered an advance into Bohemia on 23 June to engage and defeat the Austrian army at the earliest opportunity.[281] He organized his invasion forces into three armies programmed to advance along separate axes into Austria. The Army of the Elbe was positioned the furthest west in the vicinity of Halle and Torgau. It

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[278] Barry, *The Road to Königgrätz,* 175.

[279] Ibid., 177.

[280] Daves, "The Battle of Königgrätz," 10.

[281] Barry, *The Road to Königgrätz,* 227.

consisted of 46,000 troops organized into three divisions, the equivalent of a reinforced corps. The First Army, occupying the central position of the front in the vicinity of Görlitz, comprised 93,000 soldiers arranged in three infantry corps and two cavalry divisions. Finally, the Second Army, located the furthest east in the vicinity of Freyburg and Neisse, contained 115,000 combatants in four infantry corps and one cavalry division.[282] This allotment of forces resulted from mission requirements and the dispersal of assembly areas produced by the five dispersed railheads along the frontier. Moltke hoped to unite these armies in the vicinity of Gitschin, a town approximately 50 km inside the Austrian border and equidistant between his First and Second Armies' lines of advance. From there, he would determine the location of Austrian forces and advance to engage the enemy in a decisive battle.[283] That engagement occurred on 3 July 1866, amongst a collection of hills and forests between the Elbe and Bystřice Rivers, approximately 40 km southeast of Gitschin and 8 km northwest of the town of Königgrätz.[284]

At that site, the Austrian Army of 240,000 fortified itself along a line of hills just to the west of the Elbe River.[285] The Austrians had arrived slowly at this locality because they could not concentrate sufficient forces along the border in time to defeat the separate Prussian Armies as they crossed into Bohemia. As a result, only a fraction of Austria's

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[282] Wawro, *The Austro-Prussian War,* 54-55.

[283] Ibid., 125.

[284] Daves, "The Battle of Königgrätz," 27.

[285] Wawro, *The Austro-Prussian War,* 202.

forces could engage the invaders in isolated delaying actions along the frontier. These encounters resulted in numerous defeats that produced 30,000 casualties and sapped the morale of Vienna's troops.[286] Their hope for defeating the Prussians at Königgrätz rested on the presumption that Moltke's troops would conduct frontal assaults upon their prepared positions and suffer decimation by pre-registered artillery.[287]

However, two factors led to the undoing of the Austrian plan. First, the Prussian army had a unique and effective infantry weapon that became a force multiplier on the battlefield.[288] Second, the Prussian armies' separate axes of advance allowed the Second Army to approach the Austrian position from the oblique and turn the enemy flank.[289] This pair of elements contributed to a swift and decisive Prussian victory.

In 1866, the Prussian Army was the only major military force on the European continent armed with a breech-loading rifle. The Dreyse *Zündnadelgewehr*, or "needle rifle," was named after its long needle-shaped firing pin. This breechloader fired a bullet encased in a paper cartridge that its unique firing pin would pierce. Moreover, the weapon's bolt-action allowed the soldiers from any posture to fire and reload at a rate four times faster than the muzzleloaders utilized by most other European armies.[290] This weapon allowed Moltke's soldiers to deliver a devastating rate of small-arms fire against

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[286] Daves, "The Battle of Königgrätz," 25.

[287] Wawro, *The Austro-Prussian War,* 213.

[288] Daves, "The Battle of Königgrätz," 38.

[289] Wawro, *The Austro-Prussian War,* 97.

[290] Ibid., 21-22.

the Austrian troops. Those rifle volleys counterbalanced the defender's advantage in artillery and contributed to a significant difference in battle casualties, 24,000 Austrian losses versus only 9,000 for Prussia.[291]

However, this firepower advantage alone would not have secured the victory. The decisive point in the battle of Königgrätz occurred when the Prussian Second Army approached the west-facing Austrian position from the north and turned their right flank.[292] Yet, this successful maneuver only happened due to a combination of missteps. The Second Army arrived separately upon the battlefield to deliver its coup de grâce because it suffered delays due to border skirmishes with Austrian forces and poor communication with the other two Prussian armies. The difficulty in contact resulted from the loss of telegraph capability once units crossed into Bohemia. Despite possessing detachments tasked with maintaining that critical signal system, Prussia's armies never regained that capability while maneuvering to meet the main Austrian force and endured lags in reacting and coordinating its forces. Even Moltke bore this communication blackout because he chose to advance his headquarters forward to Gitschin without telegraph support.[293] He and his field commanders placed the entire campaign at risk by choosing to direct operations via the vulnerable and inefficient mode of messaging by

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[291] Wawro, *The Austro-Prussian War,* 274.

[292] Ibid., 245.

[293] Arthur L. Wagner, *The Campaign of Königgrätz: A Study of the Austro-Prussian War in the Light of the American Civil War* (Fort Leavenworth, KS: U.S. Infantry and Cavalry School, 1889), 98.

mounted couriers.[294] Unfortunately, Moltke's poor decision-making regarding communication was also mirrored by his failure to exploit technology in how he executed logistical support for the field armies.

Logistics of Königgrätz

Keeping with the maxim that no plan survives contact with the enemy, Prussia's concept of sustainment for its forces and its plan for utilization of railroads in that effort collapsed once Moltke's troops crossed the Austrian frontier. Among the many factors that contributed to this failure, the four most significant were the lack of roads in Bohemia, the inability of Prussian forces to extend rail lines, the inability of the trains battalions to move supplies, and the lack of supervision for the rail lines.

As noted in the logistical equation of Prussian doctrine, a single road was generally limited to supporting no more than a single 30,000-man corps to maintain an adequate rate of advance.[295] However, Moltke's field armies were maneuvering in a locale dominated by agriculture with few roads. Only two major thoroughfares paralleled their axis of advance. Thus, each line of communication had to support a body of troops over three times greater than its practical capacity.[296] This physical bottleneck resulted in insufficient throughput capability to sustain the needs of the invasion force.

To compound that lack of throughput, the meager resources of the railway detachments, particularly for transport, did not allow them to build or extend rail lines to

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[294] Wagner, *The Campaign of Königgrätz*, 98-99.

[295] Showalter, *Wars of German Unification*, 61.

[296] van Creveld, *Supplying War*, 81-82.

move the railheads closer to the armies. Moreover, the units' deficit in materials prevented them from constructing emergency loop lines or sidings to enhance the effectiveness of existing tracks.[297] This lack of capability made an impact even at the highest echelon of command. For example, on 2 July, Moltke demanded the construction of emergency lines along the captured Dresden to Prague railway to make it usable by Prussian forces. However, no actions of consequence ever took place prior to the termination of the campaign.[298] Thus, rail networks could not be extended to support the forward movement of maneuver forces, and distances grew beyond the capacity of the trains battalions' horse-drawn wagons to distribute between railheads and front lines.

To compound these distribution limitations further, Moltke did not prioritize the transportation of supplies over these constrained road networks. Instead, he prioritized teeth over tail and gave the combat arms elements first right of movement along the roads.[299] As a result, supply wagons became subordinated to the movement of other unit types and frequently became separated from the units they were directed to support. In addition, unit commanders would often overrule military police assigned to control movement and created traffic congestion that left some supply trains stranded for days along routes.[300] The result was that most logistics units could not complete missions.

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[297] Macksey, *For Want of a Nail*, 25.

[298] van Creveld, *Supplying War*, 85.

[299] Macksey, *For Want of a Nail*, 25.

[300] van Creveld, *Supplying War*, 80.

With wagons unable to move towards their supported units, trains battalions could not readily return to the railheads to pick up inbound supplies. Yet, even if they could make it back, insufficient labor existed to transfer the thousands of tons of supplies from rail car to wagon.[301] The general staff's doctrine and campaign plans held no specific organization accountable for unloading the supplies at the railheads and included no stipulation for field commanders to offer up personnel to aid in this vital task. Thus, a backlog of immense proportions developed. Hundreds of rail cars sat idle for weeks, becoming temporary storage depots filled with rotting provisions.[302]

This congestion was exacerbated by the loss of central direction for the railways when hostilities began. As the armies advanced into Bohemia, Moltke moved his headquarters forward and took with him to the field the one person who understood and could supervise the complex transport system, Wartensleben, his staff rail expert. Moltke's decision removed the Railway Section officer from the Executive Commission in Berlin, and Wartensleben's absence halted that body's ability to manage rail operations after mobilization.[303] Without oversight, civilian companies continued production and shipment of goods to fulfill their military contracts regardless of the army's needs. Railroads accepted the shipments, rushed supplies forward to the railheads, and delivered provisions in excess of any known requirement and without consideration of how the cargo would be unloaded or stored. Even when trains were unloaded, empty rail cars

[301] Macksey, *For Want of a Nail*, 25.

[302] van Creveld, *Supplying War*, 84.

[303] Ibid.

remained behind, with those still waiting to be unburdened of their freight. With no direction from Berlin, no plan existed to retrieve delivered boxcars, and locomotives continued to arrive and add to the congestion.[304] The provisioning for the First Army illustrated this problem well. As its formations maneuvered in Bohemia, the bread for its troops was being baked hundreds of miles to the rear in Berlin and then shipped forward to accumulate and rot along the Austrian border.[305] This situation was duplicated across the whole operation, and by the end of the seven-week campaign, 18,000 tons of provisions went to waste, sitting in forgotten boxcars along the frontier.[306]

All of those lost supplies impacted the prosecution of the war. Because troops did not receive provisions, Moltke authorized local requisitions by corps, but local areas in Bohemia had limited capacity to feed large bodies of troops. Villages and farms had been abandoned, and the retreating Austrians had taken wagons and other useful implements. This desolation left the invading armies with limited options, and on multiple occasions, their soldiers went without food affecting operational readiness and capability.[307]

One notable effect of this hunger concerned how the battle of Königgrätz concluded. While the turning of the Austrian flank by the Second Army had resulted in Austrian retreat by late in the afternoon and thus ensured victory, no pursuit of the retreating enemy occurred, and Prussian forces disengaged by 6:00 pm. At 6:30 pm,

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[304] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 105.

[305] Citino, *The German Way of War from the Thirty Years' War to the Third Reich*, 170.

[306] van Creveld, *Supplying War*, 84.

[307] Ibid., 80.

Moltke dispatched the following order: "Tomorrow is a general rest day. The troops will only move in so far as is necessary for the comfort or the re-formation of the corps."[308] Far from conducting an aggressive campaign and seeking a swift termination of hostilities in the spirit of *Bewegungskrieg*, the Chief of the Prussian General Staff issued a message surrendering the initiative and allowing his adversary a reprieve. This odd finish allowed his Austrian opponent to retreat intact despite multiple hours of daylight remaining on that summer evening and an entire day afterward. One factor that likely contributed to this intransigence was the need to deal with the thousands of wounded who could not be readily transported to a hospital. It took Moltke's soldiers three days to collect the casualties from the battlefield.[309] However, Moltke's decision may also be explained by the observation of one nineteenth-century chronicler. U.S. Army First Lieutenant Arthur L. Wagner noted in his 1889 book on the battle that the Prussian troops experienced a long day of marching and fighting, and "many had been entirely without food."[310] Such a factor occurring at such a critical moment broadcasts the significance of those Prussian railcars filled with unused provisions.

Allowing the Austrians to retreat that day could have had catastrophic effects on the campaign and the course of the war. Moltke allowed his opponent to fall back and refit to continue the fight. As Lieutenant Wagner noted, the casualties suffered by the Austrians were half the rate of those suffered by forces in a typical Civil War

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[308] Daves, "The Battle of Königgrätz," 31.

[309] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 92.

[310] Wagner, *The Campaign of Königgrätz*, 71.

engagement. Like the Army of Northern Virginia under General Lee, the Austrians could have resumed battle though they did not avail themselves of that opportunity in the weeks following Königgrätz.[311] If they had continued to resist, Prussia's inability to resupply her field armies with ammunition could have caused a disastrous outcome for the invaders due to the road and rail congestion. Where Moltke offset food shortages eventually through local requisition, no such remedy existed for shells and bullets. For the duration of hostilities, his armies could only utilize the combat loads they carried. Those stocks would likely have been exhausted if further Austrian engagements had occurred.

A key reason the Prussians completed operations at Königgrätz without an ammunition shortage was the accuracy and effectiveness of the Dreyse needle rifle. The weapon's bolt-action allowed a rifleman to fire from the prone position and maintain his firing posture while reloading, which increased the odds of shots staying on target and reduced the need to expend additional rounds. Lieutenant Wagner noted that the rifle's accuracy could be seen in the number of Austrians killed due to a single shot to the head.[312] In addition, the economy in ammunition expenditure is illustrated in the fact that throughout the entire campaign the two hundred thousand Prussian infantry in Bohemia only expended 1.4 million rifle cartridges, an average of seven per soldier, which barely dented the *landser's* combat load.[313]

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[311] Wagner, *The Campaign of Königgrätz*, 72.

[312] Ibid., 82.

[313] van Creveld, *Supplying War*, 81.

Furthermore, the Prussian tactical reliance on rifle fire over cannon conserved expenditure of ammunition for artillery. However, Lieutenant Wagner noted that the Prussian dependence on small arms might have had more to do with a general slowness and underutilization of their artillery batteries rather than a directed strategy.[314] A notable example of this ineffectiveness was that Prussia's First Army failed to locate suitable firing locations for 80 of its guns and thus never brought them into action at Königgrätz.[315] That represented over 26 percent of the First Army's total artillery strength not firing.[316] Such fumbling likely contributed to the conservation of shells and alleviated some of the shortcomings of Moltke's supply trains. However, having one's campaign saved by such operational anomalies is not the hallmark of great planning.

Conclusion

Despite the Prussian Army researching and developing plans and doctrine for a concept of logistical support and the incorporation of locomotives for their Bohemian campaign, it is clear they fell short upon execution. The inability to deliver food and ammunition to their field armies once hostilities began illustrated a misreading of the logistical capabilities needed and a lack of prioritization and oversight by their chain of command.

The general staff's lack of practical experience in these areas likely contributed to these missteps. Moltke did break critical ground in supporting the use of rail in the

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[314] Wagner, *The Campaign of Königgrätz*, 95.

[315] Daves, "The Battle of Königgrätz," 29.

[316] Hozier, *Campaign of 1866 in Germany,* 569-579.

mobilization of his armies, but he and his subordinates had not yet gained an appreciation of the difficulties involved with using that technology to supply their forces once they took to the field. Inside the borders of Bohemia, their scheme of logistics collapsed, and they fell back upon unreliable stopgaps for sustainment and communication, risking mission failure as a result.

The campaign in Bohemia revealed that the Prussian Army had considerable room for improvement in the execution of logistics and developing railroads' role in that effort. With such shortcomings in sustainment and rail usage, it is understandable why the authors of Prussia's official account of the 1866 conflict would be reluctant to record their post-mobilization logistical actions.

CHAPTER 4

FRANCO – PRUSSIAN WAR CASE STUDY: INVASION OF FRANCE (1870)

Introduction

> The alleged perfection of Germany's arrangements when she went to war with France in 1870-71 is merely one of the fictions of history, so far as her military rail transport is concerned.
>
> –Edwin A. Pratt, *The Rise of Rail-Power*

On another summer day four years after the conclusion of hostilities between Prussia and Austria, *Generalfeldmarschall* Helmuth von Moltke again presided over the deployment of his nation's military forces. Once more, the armies of the Hohenzollern monarchy crossed the frontier to engage a foreign adversary and seized the operational initiative through efficient use of the German rail network. Beginning with the royal mobilization order on 15 July 1870, 380,000 troops arrived by train in three designated assembly areas, and they were prepared to advance across the border by 3 August, just 19 days later.[317] Moltke had not just replicated his previous deployment success of 1866 but significantly improved upon it in scale and speed. That accomplishment had been a product of study and preparation applied by the *Preußische Großer Generalstab*, the Prussian Great General Staff, since the cessation of hostilities with Austria. Unfortunately, this building on recent experience also carried forward past mistakes.

While Prussia had capitalized on its use of locomotives to concentrate troops along its adversary's border, utilization of this platform for sustainment remained out of

[317] T. N. Dupuy, *A Genius for War: The German Army and General Staff, 1807-1945* (McLean, VA: The Dupuy Institute, 1984), 96.

reach for its planners.[318] The knowledge gained from Moltke's campaign in Bohemia did not translate into improvements in their practice of sustenance or greater exploitation of rail technology. The failures to provision at Königgrätz did not shock the *Großer Generalstab* or awaken them to consider lessons offered by the recently concluded American Civil War. Instead, the relatively quick victory gained in 1866 appears to have reinforced existing practices and led to a repetition of these actions in 1870 with only minor adjustments.

Planning for Repetition

Moltke did hold great respect for history and upheld a standard of professionalism as a soldier. He could admit that not everything had proceeded as planned in his campaign against Austria in 1866. Moltke could see errors had been made, and some improvement could be gained in organization, materials, and doctrine.[319] He initiated an after-action review and sought some changes for the Prussian military to prepare for the next conflict.[320] However, his scope of change could be seen more as evolutionary rather than revolutionary, building on what worked rather than seeking a radical overhaul. The war with Austria had ended in victory, so that tended to affirm for Moltke that his original priorities were correct rather than warranting drastic alteration.[321]

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[318] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 10.

[319] Dupuy, *A Genius for War,* 89.

[320] Ibid., 91-92.

[321] van Creveld, *Supplying War*, 106.

The General Staff's priority in the preceding conflict had been the speed of mobilization, which was only made possible through the efficient planning of its railway section.[322] In 1867, Moltke expanded the staff of that agency.[323] The success in assembling forces along the frontier with Austria had given rail planning a level of prestige and an expectation of doing greater things.[324] He charged the upgraded department to work with railway authorities in developing a comprehensive transportation plan for the next possible war. This planning resulted in recommendations that codified the logistical expediencies hastily put in place to support the war with Austria. The Railway Section's proposals became the Route Service Regulations published by royal decree on 2 May 1867.[325] These protocols standardized several practices associated with military use of the railroads, such as the spacing of rest stops for troops traveling by rail and dictating the locations of railheads for the disbursement of supplies. In addition, the document formalized the functioning of the Executive Commission and subordinate Auxiliary Lines Commissions that had failed to supervise the rail lines in the post-mobilization stage of the Bohemian Campaign.[326] The regulations created the position of Inspector-General of Communications to address the failure of the lines commissions. This position was a general officer who answered to the

[322] van Creveld, *Supplying War*, 90.

[323] Dupuy, *A Genius for War,* 92.

[324] Showalter, *Wars of German Unification*, 242.

[325] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 105-106.

[326] Ibid., 106-107.

Prussian General Staff. Moltke expected the position to fulfill a role equivalent to the U.S. Superintendant of Railroads in the Civil War. However, Prussia expected this officer to manage the functioning of the rail lines and the whole of the logistical functions necessary to support its field armies. This position had oversight of the movement of provisions, the maintenance of roads and telegraphs, the construction of hospitals and barracks, the delivery of postal mail, and the incarceration of prisoners of war. The extensive array of duties placed the office more on par with the U.S. Quartermaster General. However, the 1867 regulations failed to create an organization comparable to the U.S. Quartermaster Corps. Instead, the position received a handful of subordinate officials and staff to fulfill a mandate that required thousands to accomplish in the Civil War.[327] Such an oversight was reminiscent of the under-resourcing of the trains battalions and railway detachments by Moltke prior to the Austro-Prussian War. With such deficits, this supervision scheme added no safeguards to prevent failure in managing rail transportation and logistics for the next war.[328]

The General Staff sought to improve the rail system's performance by executing numerous war games to test proposed mobilization plans. Beginning in November 1867, the Prussian Army conducted exercises in transporting its divisions to assembly areas. In the first iteration, the effort required 32 days. In the following year, they worked it down to 24 days. The Railway Section continued fine-tuning until, by 1870, assembling the army along the frontier required only 20 days, a remarkable feat of planning and

[327] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 108-109.

[328] Macksey, *For Want of a Nail*, 31.

organization.[329] Though conspicuously, all of this practice only addressed the movement of formations and not the hauling of provisions to support them, a repetition of the logistical blind spot of 1866.

Another aspect of the rail system that Moltke sought to improve was the capability of the *Feldeisenbahnabteilung*, the field railway detachment. Consisting of only 129 personnel and having just three such units assigned to operations in 1866, the *Feldeisenbahnabteilungs* demonstrated the ability only to carry out minor repairs on captured lines. They could not build new tracks such as emergency loop lines or sidings.[330] Their inability to open rail traffic from Dresden to Prague to support the Prussian march on Vienna had been a point of concern for Moltke during that campaign.[331] To enhance the unit's capability, he doubled the personnel in each detachment and increased their deployable allotment from three *Feldeisenbahnabteilungs* to six for the next war.[332] This expansion meant that the total number of personnel available to build and repair lines was on par with a construction division of the USMRR in the Civil War.[333] However, the USMRR deployed several construction divisions to a theater when more than one field army required support.[334] Moltke's total complement of

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[329] Showalter, *Wars of German Unification*, 243.

[330] Macksey, *For Want of a Nail*, 25.

[331] van Creveld, *Supplying War*, 85.

[332] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 127.

[333] Ibid., 122.

[334] van Creveld, *Supplying War*, 36.

Feldeisenbahnabteilungs was adequate for maintaining the rail lines in support of a single field army but not for multiple such forces. This shortfall made maintaining lines across a broad offensive front a challenge and impacted Prussia's logistical efforts in France.[335]

Moltke did desire to address the inadequacies of sustainment in the Bohemian campaign and advocated for amendments to that discipline.[336] After the cessation of hostilities with Austria, Moltke appointed Brigadier General Albrecht von Stosch to analyze the logistical system in the recent conflict and make recommendations for improvement.[337] Stosch realized that the central distribution of provisions from within Prussia to the armies in the field had been a failure, with thousands of tons of victuals left to rot unused along the railheads.[338] While bread had been baked in Berlin and shipped hundreds of miles forward in a failed attempt to feed troops in Bohemia, he proposed a more decentralized approach for the next war.[339] Stosch planned to rely upon mobile field bakeries and butcheries to prepare rations for troops on the march.[340] While this proposal had merit, it still needed a reliable transportation system to deliver raw foodstuffs to be prepared and then a methodology to distribute the rations.[341] Adoption of a depot system

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[335] Macksey, *For Want of a Nail*, 29.

[336] Dupuy, *A Genius for War*, 89.

[337] Showalter, *Wars of German Unification*, 244.

[338] Macksey, *For Want of a Nail*, 25.

[339] Citino, *The German Way of War from the Thirty Years' War to the Third Reich*, 170.

[340] van Creveld, *Supplying War*, 104.

[341] Ibid., 90.

similar to the supply scheme of the U.S. Army in the Civil War could have provided an organized and dependable means of delivering flour and cattle to those mobile facilities along with fulfilling other sustainment needs.[342] Instead, Stosch embraced the principle of local requisitioning of food and fodder along a formation's route of march to make good on any shortcomings in distribution.[343] He decided to institutionalize the expedient that Prussia had executed to remedy the failure of its supply network in Bohemia. Such a decision profoundly impacted the later stages of the war with France.[344]

Despite this focus on local purchase over centralized distribution, the General Staff still recognized that the corps trains battalions were inadequate to transport a formation's supplies no matter the source of replenishment. In 1866, the complement of 292 personnel in a trains battalion could not transfer and haul the material for its corps.[345] However, in 1870, Moltke increased its table of organization to 1,664 personnel with 670 wagons and over 3,000 horses.[346] This expansion placed the Prussian trains battalion on par in size and capability with its U.S. counterpart of the Civil War era.[347] If given a replenishment source within an adequate range and accorded appropriate supervision and

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[342] Sokolosky, "The Role of Union Logistics in the Carolina Campaign of 1865," 18.

[343] Showalter, *Wars of German Unification*, 245.

[344] van Creveld, *Supplying War*, 101.

[345] Macksey, *For Want of a Nail*, 28.

[346] Ibid.

[347] Schrader, *United States Army Logistics, 1775-1992,* 208.

priority, the supply trains of Moltke's armies could carry and tactically distribute the necessary provisions for their supported formations.[348]

However, the trains battalions did not receive such priority. In the General Staff's planning for the next conflict, the seeds of future problems existed. Their mobilization exercises included no rehearsal of sustainment.[349] In addition, the movement by echelon to assembly areas placed supply and transportation elements for each formation in the last trains to arrive. Because locomotives were prioritized to carry combat troops, the rail schedules included no capacity to deliver provisions or quartermaster personnel.[350] Thus, combat units arrived in designated operational zones with no food other than what they carried and no troops dedicated to providing life support, unloading supplies, or distributing goods. Each corps was expected to begin its march with little organic transportation to carry supplies and munitions forward. Such equipment and horses arrived with the trains battalions at the end of the mobilization process.[351] Before hostilities even began, Moltke's planners placed logistical deficits upon their armies.

Even once supply columns became available, the Prussian Army did not prioritize them in operational plans. Just as Stosch institutionalized the expedient of field requisition to supplant problems with distribution, Moltke's staff sought to resolve the past traffic congestion for the corps' trains battalions by redirecting the supply convoys

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[348] van Creveld, *Supplying War*, 103.

[349] Ibid., 90.

[350] Macksey, *For Want of a Nail*, 28.

[351] Showalter, *Wars of German Unification*, 245.

rather than prioritizing their movement.[352] The support columns were removed from the maneuver units' routes and forced onto secondary roads and trails.[353] In so doing, planners further reinforced the bias of prioritizing teeth over tail in transportation.[354]

This continued demotion of sustainment elements increased as plans did not consider the necessary support functions to keep the wagons rolling. Little provision was given for repair facilities when wheels or axles broke, and the poor state of the paths the trains battalions navigated made that a significant factor.[355] Even the pioneer detachments that could have improved or repaired these rough routes were backloaded in deployment plans and arrived too late to remedy the situation.[356] The logistical columns, by design, had to overcome numerous challenges without easy resolution. The plans to capitalize on maneuver preordained the wagons falling far behind their supported formations.[357]

Just as in 1866, the Prussian Army laid its plans to advance in 1870 based on prioritizing maneuver over all other factors. In the eyes of Moltke and the Prussian General Staff, such ordering had been the war-winning strategy for the last conflict. While Prussia's planners did apply some past lessons to preparations for the next war, their plans also ensured a repetition of past errors. Despite the gift of time and recent

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[352] van Creveld, *Supplying War*, 80.

[353] Showalter, *Wars of German Unification*, 245.

[354] Macksey, *For Want of a Nail*, 28.

[355] van Creveld, *Supplying War*, 104.

[356] Showalter, *Wars of German Unification*, 245.

[357] van Creveld, *Supplying War*, 97.

practical experience, Prussia's armies marched into France with few changes from the provisioning challenges they faced in their last campaign.

Teeth over Tail

On 15 July 1870, the mobilization plan conceived by Moltke came to fruition.[358] Trains from all over Prussia and their German Confederates began moving thousands of soldiers to three assembly areas in the Rhineland of western Germany to present the bulk of Prussia's military might to France.[359] In a nod to strategic risk, Moltke held back 95,000 troops as a national reserve to deal with threats from other quarters, such as Austria. The remainder formed three armies, the First Army consisting of 60,000 combatants near Trier, the Second Army of 175,000 near Kaiserslautern, and the Third Army of 145,000 in the vicinity of Landau.[360] With these formations, Moltke hoped to overwhelm the French field forces and reproduce a victory comparable to four years earlier.[361]

In another similarity to 1866, the mobilization plan replicated the previous war's difficulties in sustainment. The Prussian trains battalions fell in the final echelons to arrive per the deployment schedule. As tens of thousands of soldiers arrived in their

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[358] Dupuy, *A Genius for War*, 96.

[359] Showalter, *Wars of German Unification*, 244.

[360] Dupuy, *A Genius for War*, 96.

[361] Citino, *The German Way of War from the Thirty Years' War to the Third Reich*, 189.

assembly areas along the frontier, no supply service existed to provide life support.[362] The plan to provide rations from mobile bakeries set up in Cologne, Koblenz, Bingen, Mainz, and Saarlouis fell apart when no transport means existed to move supplies to and from the bakeries. This lack of provisioning forced the army commanders to requisition wagons and victuals from the local economy to feed their troops before taking one step outside their borders. Even these expedients proved insufficient as shortages developed due to so many personnel requiring sustenance in such a concentrated area. When complaints arose, Moltke dismissed them and stated that the Railway Section's plans and timetables would not be altered.[363] The Prussian General Staff had decided to prioritize the speed of assembly over the logistical needs of the assembled.

This lack of emphasis on sustainment carried forward as Prussia's armies advanced into France in August 1870. Supply columns had to operate on separate, less developed routes than the roads upon which maneuver elements traveled.[364] As wheels broke, few resources were available for repair.[365] This lack of maintenance led to the loss of thousands of road vehicles. For example, the First Army's pre-war count of 2,000 wagons depleted down to a mere twenty by 17 October.[366] So wagon trains began falling further behind those they were supposed to support. As commanders came to rely upon

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[362] Macksey, *For Want of a Nail*, 31.

[363] van Creveld, *Supplying War*, 90.

[364] Showalter, *Wars of German Unification*, 245.

[365] van Creveld, *Supplying War*, 104.

[366] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 112.

local requisition and forage, they considered their trains battalions irrelevant to their sustainment and ceased tracking their whereabouts. Army headquarters issued no orders to their forgotten echelons of logisticians and left them behind. Weeks passed as supply trains sought out their assigned commands, and as a result, they played no role in supporting the opening battles of the campaign.[367]

Fortunately for Prussia, this abandonment of their lines of communication did not thwart tactical or operational success in the first weeks of the conflict. Starting on 4 August 1870, Moltke's armies successfully engaged their French counterparts in battles at Wissembourg, Spicheren, Wörth, Mars-La-Tour, and Gravelotte. They drove the main French force, the Army of the Rhine, into Metz to endure a siege that forced their capitulation.[368] Also, the Prussians engaged and defeated France's second major formation, the Army of Châlons, at Sedan on 1 September and captured Emperor Napoleon III, ending his regime and triggering the rise of a new provisional French government to carry on the conflict.[369] Repeating his exploit against Austria in 1866, Moltke neutralized the field force opposing his invasion within a few weeks. He accomplished this without developed lines of communication or support from his railheads. However, unlike his triumph in Bohemia, his opponent did not immediately sue for peace and instead required a protracted struggle of which these opening battles

[367] van Creveld, *Supplying War*, 104.

[368] William Carr, *The Origins of the Wars of German Unification* (London, UK: Longman House, 1991), 204.

[369] Ibid., 205.

were just one part. With that development, the factors that had allowed for Moltke's success thus far in the French campaign changed.

To appreciate this transition in operational dynamics, examining the unique elements of the campaign's opening phase is necessary. In the invasion's first month, several circumstances of fortune allowed Prussian armies to triumph without logistics interrupting operations. These fortuitous factors fell into two categories, time and geography.

The first contributing issue centered on the season of the campaign and the speed of resolving the initial clashes. The operational timeline encompassed the harvest season, and by default, this maximized the agricultural bounty available in the region of maneuver.[370] Ripened crops and fattened livestock significantly reduced the plight of Prussian quartermasters feeding their charges on the march. Furthermore, the rapid subjugation of French field forces brought the capture of substantial military supplies that helped relieve some of their logistical shortcomings.[371] French rations, tents, and blankets were just as useful as German ones. Thus, Moltke's troops fell into an unexpected windfall of resources.

Moreover, this abbreviated period of maneuver translated into lower-than-predicted ammunition consumption. Moltke's infantry only expended 56 cartridges per soldier for the entire war, slightly less than the quantity carried on each person.[372]

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[370] van Creveld, *Supplying War*, 107.

[371] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 113.

[372] van Creveld, *Supplying War*, 102.

Similarly, each field artillery piece only fired an average of 199 shells for the entire duration of hostilities, and each corps began the campaign with a basic load of 157 rounds per gun. When one considers that every battery did not fire in every battle, consumption fell well within the limbers of each formation.[373] With such unanticipated parsimony, the quick cessation of maneuver meant replenishment of munitions never rose to a priority.

Adding to these timed premiums, the factor of location played an equally significant role in relieving the deficits of logistical planning for Moltke's advancing columns. Because Napoleon III's generals chose to give battle so close to the frontiers, with many engagements occurring within 40 miles of the border, Prussia's armies had to march for only a few days prior to combat, resulting in a minimal expense of initial resources.[374]

Moreover, once replenishment became necessary, field commanders could utilize the traditional approach of requisition and forage as their columns marched through one of the most bountiful agrarian regions in Europe.[375] The French countryside held more than enough produce to supply the Prussian formations on the move. The journey of Moltke's Second Army from Metz to the Loing River, south of Paris, illustrated this point clearly. Along the army's 200-mile line of march, its quartermasters had access to 100,000 tons of flour and a similar volume of fodder from the local economy, an amount

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[373] Macksey, *For Want of a Nail*, 29.

[374] Ibid., 28.

[375] van Creveld, *Supplying War*, 107.

well above demand. The men and horses of the formation only consumed 6,500 tons during their movement.[376] However, such abundance receded when columns halted and forces gathered at a single location.[377] Happenstance had allowed Moltke's campaign to avoid such a dire stasis in the bucolic first month.

Providence was on the side of Prussia in the opening phase of the campaign. Many factors that Moltke's planners did not control alleviated their failures in logistical preparation. If the French farmlands had not had a successful harvest or Napoleon's armies had waited to give decisive battle further inside their territory and prolonged combat, these unforeseen advantages supporting Prussia's offensive could have evaporated.[378] However, as with all things based on fortune, at some point, the benefits did run out, and the final stage of the campaign revealed the shortcomings of Moltke's strategic choice to emphasize teeth over tail.

Seige of Paris

After subjugating the French field force, Moltke determined that the *schwerpunkt*, the campaign's center of gravity, had become France's capital, and resolution of the conflict required its capture. However, elaborate fortifications protected the city and precluded a direct assault.[379] Thus, Moltke determined the most practical approach to be

[376] van Creveld, *Supplying War*, 107.

[377] Macksey, *For Want of a Nail*, 29.

[378] van Creveld, *Supplying War*, 99.

[379] Showalter, *Wars of German Unification*, 302.

a siege and starvation of its occupants.[380] The armies of Prussia enveloped Paris and barricaded its approaches in September 1870.[381] The effort to invest the city consumed 200,000 troops.[382] Such an assembly of manpower presented Prussia's logisticians with an unprecedented demand for provisions. While the whole of the French countryside could sustain columns advancing on a broad front, concentrating forces in the valley of the Seine limited their prospects for rations.[383] Moreover, the defenders of Paris had denuded the vicinity of resources to support the city's defense and denied anything of value to the invaders. They forced the abandonment of farms and villages and moved crops and livestock out of reach of Moltke's quartermasters.[384] Little remained for requisition.

Also, the Prussians lacked transport to distribute available provisions. The armies had lost most of their wagons during the advance.[385] Planners had not incorporated maintenance of these transportation platforms into the invasion scheme, leaving supply trains with no recourse when a wheel or axle broke. The logistical columns abandoned 90 percent of their carriages due to breakdowns without remedy.[386] Thus, at the gates of

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[380] Dupuy, *A Genius for War*, 107-108.

[381] Showalter, *Wars of German Unification*, 282.

[382] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 349.

[383] van Creveld, *Supplying War*, 101.

[384] Showalter, *Wars of German Unification*, 312.

[385] van Creveld, *Supplying War*, 101.

[386] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 112.

Paris, the Prussian armies had a capability gap in sustainment that endangered the longevity of their siege.

To add to these logistical challenges, Bismarck pressured Moltke to bombard the city to hasten an end to the siege rather than await capitulation via the occupants' starvation.[387] The Prussian Chancellor worried that the possibility of an Austrian or British intervention in the war would increase as time passed.[388] On 9 September, Moltke ordered batteries of heavy siege guns and mortars to be brought forward for the bombardment of the French capital.[389] However, the weight of these cumbersome weapons of war and the size and quantity of ammunition to feed them required rail transportation to deploy the guns from Germany to the siege lines.[390] No track existed to accommodate such movement. The bombardment had to wait until the *Feldeisenbahnabteilungs* could establish a rail line.

A timely extension of the railroad would have alleviated Prussia's logistical and operational challenges at this point in the campaign. A single line held the capability to deliver what the besieging forces required.[391] The consumption rate for the entire Prussian invasion force consisted of only 100 tons of food and fodder per day, well

[387] Carr, *The Origins of the Wars of German Unification*, 205-206.

[388] Goerlitz, *History of the German General Staff 1657-1945*, 92.

[389] van Creveld, *Supplying War*, 101.

[390] Showalter, *Wars of German Unification*, 328 and 330.

[391] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 348-349.

within the carrying capacity of a locomotive.[392] However, the Prussian General Staff had made no plan or preparation to advance a railhead in pace with the campaign. French fortresses along the frontier blocked the expansion of rail lines from assembly areas within Germany.[393] Moltke's planners made no accommodation for the quick reduction of these fortifications and instead focused on maneuvering around them in keeping with the Prussian concept of *Bewegungskrieg*, war by movement.[394] To maintain the speed of advance, the General Staff did not focus on extending and maintaining lines of communication and chose to rely upon local requisition for support. The invading armies bypassed French resistance points, but Prussia paid a price for leaving those obstacles behind. The forts' continued presence blocked sustainment efforts for the invasion as operations extended into the winter.[395]

This operational oversight was unusual, considering four years earlier, Moltke had spotlighted in a memorandum the challenge of Austrian fortresses blocking lines of communication during the Bohemian campaign.[396] Despite that foresight, his armies did not reduce the problematic forts until the autumn after the defeat of the opposing field forces. The surrender of the French garrisons, notably at Toul on 25 September and

[392] van Creveld, *Supplying War*, 105.

[393] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 128.

[394] Showalter, *Wars of German Unification*, 282-283.

[395] Macksey, *For Want of a Nail*, 31.

[396] van Creveld, *Supplying War*, 105.

Strasbourg on 28 September, belatedly allowed the railheads to advance.[397] However, the French destruction of railroad bridges and tunnels along the Marne Valley in the intermediate time delayed the extension of rail to Paris until late November.[398]

Even when a railhead was established for the besieging armies, the trains' management and the track's reliability remained questionable. The Prussian General Staff had made no provision to operate rail lines in the captured territory. Unlike the U.S. Superintendent of Railroads, the Prussian Inspector-General of Communications had no transportation corps to operate captured locomotives. The refusal of French rail workers to serve the invaders forced Moltke to import 3,500 German civilians to man the locomotives and operate the rail lines.[399] However, train crashes and derailments repeatedly interrupted service due to the low quality of construction and repairs executed by the inexperienced *Feldeisenbahnabteilungs*.[400] Unlike the USMRR, Moltke did not select knowledgeable civilian railroad managers to supervise the railway construction units. Instead, he assigned the operation of the detachments to military engineers, who had no familiarity with railroad infrastructure.[401] As a result, field-expedient and incomplete work by the *Feldeisenbahnabteilungs* could not stand up to weather and standard working conditions. In one glaring example, rail construction crews took 48

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[397] Showalter, *Wars of German Unification*, 287.

[398] van Creveld, *Supplying War*, 95.

[399] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 131.

[400] Ibid., 130.

[401] Ibid., 123, 126.

days to install 22 miles of track near Metz, but autumn rains undermined the line and forced extensive repairs.[402] In contrast, a USMRR construction division supporting Sherman's march on Atlanta in 1864 laid a 25-mile section of track in just seven and a half days with no subsequent need for an overhaul.[403] Having to correct their own mistakes added to the time and resources required for Prussian rail builders to complete their work and keep lines in operation.

Such poor craftsmanship by German forces also added to the ease by which *Francs Tireurs*, French saboteurs, could contribute to rail service interruption.[404] This sabotage created another demand unforeseen by Prussian planners, the need to guard hundreds of miles of track. Moltke detailed an entire army corps to protect the railway at one point.[405] Examination of rail operations in the U.S. Civil War provided the Prussian General Staff with ample warning that an invading army needed to assign substantial forces to secure its lines of communication.[406] Unfortunately, Moltke's staff chose to focus on subjects other than securing their lines and instead learned that lesson during the execution of their operation.

This German preference for extemporization carried over to the sustainment of the siege forces around Paris. The large body of Prussian troops arrayed about the city

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[402] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 216.

[403] Ibid., 35.

[404] Ibid., 129.

[405] van Creveld, *Supplying War*, 95.

[406] Macksey, *For Want of a Nail*, 31-32.

required regular provisioning to maintain their health. The primitive field conditions and exposure to the elements made Moltke's army vulnerable to illness.[407] Lice, typhus, dysentery, and smallpox infected his formations.[408] In October 1870, Moltke dictated an extraordinary measure to secure provisions for his siege forces before winter. He directed field commanders to detail thousands of combat troops to bring in the French harvest, transport the foodstuffs, and process the raw staples into rations with captured French machinery.[409] As a result, a significant portion of Prussia's combat units suspended operations for two months. These soldiers took part in victualization, a practice not seen in a European military campaign since the eighteenth century.[410] Having to resort to such an old expedient to sustain its soldiers reveals that the Prussian Army was not operating as a modern military force.[411]

While Moltke occupied his *landsers* with manufacturing rations and ordered the *Feldeisenbahnabteilungs* to extend a rail line to Paris, chaos ensued on the German rail network back in Prussia.[412] Due to the General Staff not establishing a depot system to organize, store, and ensure distribution of the provisions arriving in the theater by train,

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[407] Macksey, *For Want of a Nail*, 31.

[408] Showalter, *Wars of German Unification*, 288-289.

[409] van Creveld, *Supplying War*, 101.

[410] Macksey, *For Want of a Nail*, 31.

[411] van Creveld, *Supplying War*, 108.

[412] Ibid., 94.

loaded rail cars began to accumulate along the western frontier of Germany.[413] Manufacturers and contractors continued to push materials forward, and railroads moved the cargo regardless of the ability of railheads to receive them.[414] The Inspector-General of Communications lacked the personnel to track and control the freight streaming into the theater of operations.[415] The resulting congestion became a replay of 1866 but on a much larger scale.[416] As locomotives arrived, insufficient labor existed to unload the cars, and rail lines became backed up for hundreds of miles.[417] Motionless trains extended from the frontier back to Frankfurt and Cologne. In one glaring example, 16,000 tons of supplies intended for delivery to the Second Army sat rotting in 2,322 idle rail cars.[418] The thousands of immobilized boxcars triggered a nationwide shortage of rolling stock and forced the curtailment of rail services across Prussia. As the months passed, the resulting degradation in commerce increased consumer prices and impacted living standards. Civilians complained to the government, and Chancellor Otto von Bismarck and War Minister Albrecht von Roon criticized Moltke for his handling of operations.[419]

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[413] Showalter, *Wars of German Unification*, 245.

[414] van Creveld, *Supplying War*, 105.

[415] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 108.

[416] Ibid., 111.

[417] Van Creveld, *Supplying War*, 94.

[418] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 112.

[419] Macksey, *For Want of a Nail*, 31.

The pre-war choices to prioritize maneuver over logistics and ignore proposals to improve rail operations took on national implications as the war stretched into winter.

Fortunately for Moltke and the Prussian Army, the track to Paris was completed on 22 November.[420] Supplies were finally able to flow forward. The batteries of siege guns, initially ordered in September, were transported to the front line.[421] Over the next month, the Prussian siege force built stockpiles of ammunition for the heavy weapons, and the bombardment of Paris began on 5 January 1871, four months after investing the city.[422] The defenders of the French capital requested an armistice on 22 January, which went into effect six days later.[423] Thus, the final act of the war was held hostage for months while waiting for the railroad's arrival, a contingency that pre-war planners had chosen to ignore.

The choice by Moltke's staff to embrace requisition and forage had an impact on operations when his armies became immobile in the final phase of the Franco-Prussian War. Field commanders had their operations limited by logistics. Feeding their armies required redirection of combat power to assume sustainment activities. This expedient and the months lost awaiting completion of a rail connection and the subsequent degradation of the national rail network represented unforecasted costs to Prussia in pursuit of her strategic goals. Experience and lessons abounded from the Civil War to

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[420] Pratt, *The Rise of Rail-Power in War and Conquest 1833-1914,* 128.

[421] Showalter, *Wars of German Unification*, 330.

[422] Dupuy, *A Genius for War,* 108.

[423] Carr, *The Origins of the Wars of German Unification*, 206.

foretell the challenges an army faced when immobilized by siege operations and how thoughtful management of railroads could alleviate some of those problems. More pre-war analysis by the Prussian General Staff could have set different priorities and minimized or avoided these losses incurred by this stasis.

Conclusion

In the years preceding the war with Austria, Moltke and his planners on the General Staff had lacked practical experience in supporting the deployment of combat power and maintaining a modern army in the field. However, significant data existed concerning sustainment in the largest of contemporary conflicts, the Civil War. While no significant interval of time existed to absorb those lessons and put organizational changes into practice prior to the Austro-Prussian War of 1866, that constraint did not apply to the Franco-Prussian War of 1870. Moltke and his staff had four years to implement operational improvements based on observations of the recent American conflict along with their own. The Prussian General Staff gained first-hand knowledge of the challenges inherent in the movement, maneuver, and logistics of large formations in war from the Bohemian campaign. This experience granted Prussian planners a baseline from which to draw lessons and a frame of reference to understand instructive examples from other nations. The General Staff wrote an after-action review and analyzed their shortcomings in the conflagration with Vienna. The years that followed offered ample time for the reorganization of formations and the training and rehearsing of personnel to correct recognized deficiencies. The factors of experience and time no longer served as impediments to Prussia establishing a modern logistics system and maximizing the use of rail in their next conflict.

Yet, the General Staff's examination of past operations and their four years of preparatory time did not result in effective and efficient logistical support for the armies in 1870. Rather than prioritizing change, victory over Austria built a complacency for the expedients of 1866 and laid the groundwork for repeating those actions in the war with France. Prussia did not plan for echelons of depots interconnected by expanded or repurposed rail systems and regular deliveries of goods via supply trains arrayed behind advancing corps and armies. Instead, Moltke's planners expected field commanders to assume again the responsibility of provisioning their troops and rely on providence to satisfy shortcomings. Thus, when Prussian forces crossed the French border, foraging parties fanned out throughout the countryside to requisition staples, while hundreds of train cars accumulated at railheads along the German frontier, full of wasted goods. It seemed a small price to pay for quick tactical success, but the conflict with France did not proceed along the course of the war from four years earlier.

Continued French resistance after the opening battles and the need to subdue the French capital presented new factors that required an organized concept of sustainment and long-range support by rail to continue the prosecution of hostilities. However, the General Staff had not planned for an extension of track in pace with the campaign. Without any preparation for this course of action, the execution of such a rail line took months to accomplish, which incurred high costs for Prussia. As a result of the extended timeline, commanders had to redirect combat power to sustainment rather than offensive operations, and the civilian economy of Prussia suffered deficiencies. Such sacrifices could have been minimized or prevented with contingency planning based on lessons from past conflicts.

The presumption that France would capitulate via decisive battle and that providence along the march would provide adequate sustenance for the campaign's duration turned out to be flawed and revealed a dangerously undeveloped concept of modern war by the Prussian General Staff. Far from showing itself as an innovative and efficient fighting force, Moltke's army in the Franco-Prussian War demonstrated blindness to logistics, relying more on good fortune than sound planning to gain victory. Such archaic preconceptions represented significant obstacles to overcome before lessons on organized sustainment via rail technology could ever be absorbed and implemented by the Prussian Army.

CHAPTER 5

CONCLUSION

Risks Assumed

> European military writers generally, and those of the Continent especially, still fail to recognize in the developments of our war, the germ, if not the prototype, of military features which are regarded as new in Europe.
>
> – Arthur L. Wagner, *The Campaign of Königgrätz*

Captain Justus Scheibert deposited within the library of the *Preußische Kriegsakademie*, the Prussian War Academy, his observations of the operations of the American Civil War.[424] That information, combined with the German translation of McCallum's report on railroad use in the Civil War and the data from other observers published in journals and news publications, existed as a body of knowledge available for use by the *Preußische Großer Generalstab*, the Prussian Great General Staff.[425] In the mid-nineteenth century, the Civil War held the position of the largest combined arms conflict in recent memory and populated conversation among the political and military classes of Europe. The developments and lessons of the Civil War, especially the extensive use of railroads as exemplified in Sherman's march on Atlanta, existed as an opportunity for education and reference. These examinations could have contributed to the discourse and planning of military operations upon the European continent, notably the exploitation of trains in such campaigns. The American Civil War could have provided valuable lessons in utilizing the new technology of the steam locomotive to

[424] Trautmann, *A Prussian Observes the American Civil War*, 17.

[425] Luvaas, *The Military Legacy of the Civil War*, 122.

execute Prussia's wars with Austria in 1866 and France in 1870. A methodical logistics plan utilizing supply depots connected by rail lines to support those conflicts could have alleviated significant and avoidable risks that Moltke assumed in his prosecution of each war.

Despite the Hohenzollern monarchy's victory in both wars, analysis of the conflicts indicates that the Prussian architect of the invasion took a number of critical gambles that could have posited a dramatically different outcome. Moltke's advances upon Vienna and Paris did not stand as preordained victories but instead held vulnerabilities that, if exploited, could have resulted in decisive defeat. In each case, these risks centered around his decision to proceed across the frontier and maneuver within his opponent's territory without adequate lines of communication to support his field armies. This lack of logistical capacity arises from reliance on forage and requisition rather than extending Prussian rail lines or repurposing captured tracks to sustain his field armies. In contrast to Sherman's methodical advance along the Western and Atlantic Railway to seize Atlanta, Moltke chose to surge forward in each war without a reliable means to replenish Prussia's invasion forces.

The decision to prioritize maneuver over logistics produced several avoidable challenges. First, the Prussian troops deployed in Bohemia and France had to rely upon local requisition to obtain food. This Napoleonic method of forage could serve as a workable solution for a small force of a few thousand like Zachary Taylor's column that invaded northern Mexico two decades earlier.[426] However, Moltke conducted his

[426] Schrader, *United States Army Logistics, 1775-1992,* 155.

invasions with over a quarter-million troops. No matter how bountiful the targeted farmland, feeding a host that large while concentrated in one area would outstrip local resources in a matter of days and require a dispersal of units to seek fertile pastures, a dangerous course of action in the face of a concentrated opponent. Moltke understood the importance of centralized supply based on pre-war preparations to provision via railheads. However, he decided in each campaign to move beyond those logistical hubs with no reliable means to project that sustainment capacity forward. The immediate effects included frequent shortages or absences of rations and an added burden on each field commander to search for new sources of sustenance. These factors compromised Moltke's offensive capability by occupying a portion of his army's combat power in provisioning and shifting his subordinates' focus away from combat operations. If Austria had conducted other general engagements after Königgrätz or the defenders of Paris had effectively sortied against their besiegers, the dispersal of Prussia's forces for logistical tasks left the invaders vulnerable to tactical defeat or attritional loss that could have affected each war's outcome.

Yet, food did not represent the most critical potential shortage for Prussian operations. Ammunition could have been the true Achilles' heel of Moltke's expeditions. The unique nature of the Dreyse needle rifle's cartridges meant that only resupply from Prussia could replace depleted combat loads for their small arms. If French or Austrian forces had prolonged hostilities and conducted sharp delaying actions as exemplified by the armies of the Confederacy in the Civil War, the resulting expenditure of arms and munitions could have left the invading host in a precarious position. For example, the Austrian Army had suffered casualties at Königgrätz that totaled less than 20% of its

effective combat power, a rate equivalent to that suffered by field armies of the Civil War that continued operations.[427] The American conflict presented numerous examples of what the Austrians and French could have done to attrit Moltke's forces. Prussia risked depletion and loss of its primary field force if intense resistance similar to Atlanta or Petersburg had occurred.

Even if the Prussian army survived such engagements, the prolonging of either campaign represented a strategic national risk that Moltke compounded by invading without a reliable rail connection to allow redeployment to counter any new threats. As the Bohemian Campaign only involved two great powers, Prussia and Austria, other European nations of significance, notably France, stood ready to intervene and seize an opportunity to exploit any vulnerability. A French crossing of the Rhine while hostilities continued in Bohemia would have been a considerable strategic threat. The only Prussian field force available to have resisted the whole of France's military forces would have been the Army of the Maine, which consisted of only 60,000 troops organized in two corps.[428] In the war with France in 1870, despite Moltke holding 95,000 soldiers in reserve to meet a second opponent, Chancellor Bismarck still recognized and worried about such external threats and pressured Moltke to bombard Paris to hasten the end of hostilities.[429] Each war ended before such dangerous prospects could come to fruition. However, Moltke had no guarantee of either campaign concluding when it did. Austria

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[427] Wagner, *The Campaign of Königgrätz*, 72.

[428] Hozier, *Campaign of 1866 in Germany,* 514-515.

[429] Carr, *The Origins of the Wars of German Unification*, 205-206.

and France could have each prolonged hostilities beyond their historical termination points. The Prussian decision to proceed without reliable rail support illustrated a gamble of immense proportions and deleterious possibilities, all of which could have been avoided with prior planning based on recent American experiences.

Obstacles to Absorption

The wars with Austria and France revealed a reluctance on the part of Prussian planners to exploit the technological innovation of the steam locomotive for logistics. The opportunities for such exploitation were broadcast by the success of American Civil War campaigns, exemplified by Sherman's march on Atlanta. The U.S. Army's development of doctrine and agencies to operate depots and railroads set the nineteenth-century standard for military logistics. The data from these American accomplishments was collected and published by observers. The lessons to be garnered concerning logistics and the use of the railroads for military sustainment were available to the Prussian General Staff. Moltke and his officers read the reports produced by Sheibert and McCallum and expressed an appreciation for the American innovations in the use of rail. As a result, the General Staff created doctrine that incorporated the locomotives into mobilization and sustainment, and some processes and organizations modeled after Civil War precedents were subsequently adopted. The *Feldeisenbahnabteilungs* and the Inspector-General of Communications were examples of American-inspired implementations. However, Prussia's efforts were incomplete applications of the lessons offered in this regard. The multi-echelon, American depot system and the robust staffing of the U.S. Quartermaster Corps and the USMRR were not duplicated by Moltke. After mobilizations were completed against Austria and France, the Prussian army, in both

cases, reverted to practices and contingencies resembling the eighteenth century rather than the industrial age.

Four obstacles may explain Prussia's partial absorption of Civil War logistical precedents and willingness to abandon modern sustainment practices in its wars. Disparities in geography, limitations in time, lack of experience, and divergent approaches to war contributed to differing views by the United States and Prussia concerning railroads and sustainment.

First, the necessity to feed U.S. armies and frontier forts over vast expanses of trackless wilderness had no parallel in the western half of the European continent. High population density and centuries of agricultural development in the locales of Germany, France, and Austria meant that food and fodder were available to support large armies operating in those regions, even if only for a short period. For example, the average population density of the mid-nineteenth-century French countryside was 140 people per square mile, an order of magnitude greater than the 17 per square mile of the United States.[430] As a result, the U.S. Army had a strong motivation from its earliest beginnings to build an effective means to sustain their troops and make such plans integral to their campaigns. Prussia, by contrast, did not traditionally have such a necessity govern its operational planning or dictate its priorities.

Second, the North American continent's long overland distances and ocean boundaries determined that any war fought by the United States would involve a significant length of time to execute. On many occasions, this could be years. Such long

[430] Hess, *Civil War Logistics*, 8.

intervals allowed the U.S. Army to develop and perfect practices such as a supply depot system to support its forces. Prussia, by contrast, was situated close to multiple rival nations that could present a significant strategic threat in a matter of weeks. Moreover, wars involving Prussian forces were generally short and happened in quick succession. Thus, Prussia rarely had the time to experiment and prove new ideas during conflicts or in the short intervals between wars. An example of this time constraint is Moltke's brief window to absorb lessons from the American Civil War between that conflict's termination and the beginning of hostilities with Austria in 1866. Furthermore, the short duration of the wars with Austria and France left Prussian leaders with no time to review, alter, and prove these new practices during operations.

Before initiating hostilities with Austria in 1866, Prussia had gone a half-century without deploying its army in a major war. That lack of martial experience during the Industrial Age meant Prussian military leaders in the mid-nineteenth century had no recent experience by which to judge developments in warfare by contemporary nations. The lens through which Prussian observers and senior officers digested and analyzed outside conflicts such as the American Civil War was colored by Napoleonic traditions rather than more modern views. In contrast, the United States' conflict with Mexico in the 1840s built a body of institutional knowledge regarding supply distribution that gave the U.S. Army an appreciation for new practices that would enhance its sustainment capabilities during the Civil War.

The three components of geography, time, and experience contributed to a key fourth factor, the development of different national outlooks on war. With the benefit of no continental peer to challenge its sovereignty and possessing the geographic space to

absorb setbacks, the United States approached war methodically and meticulously. U.S. campaigns were typically ponderous but consistent advances and not lightning strikes. U.S. Army generals prioritized steadiness and organization as ingredients for operational success. However, such characteristics did not often lead to quick military resolutions and stood in stark contrast to Prussia's *Bewegungskrieg*. The war by movement that Moltke and his Prussian forebears advocated grew out of the tradition of Prussia's geographic vulnerability. Situated in the center of Europe and ringed by potential foes, Prussia required expedient execution and resolution of any conflict to avoid exposure to threats from other quarters. Prussia relied upon the nimble responsiveness of its military forces to ensure its survival, a goal achieved by accepting risks that other nations would likely not countenance and by sacrificing other warfighting functions to ensure such speed. Due to that outlook, Prussia embraced the velocity of the steam locomotive to expedite mobilization but did not fully exploit the platform for logistics. The speed trains added to strategic deployment reinforced *Bewegungskrieg*. Similarly, the General Staff viewed the subordination of logistics to maneuver and the adoption of foraging as a workable expedient. Lacking experience in modern, industrialized war to counter their outlooks, Moltke and his planners held no inhibitions to abandoning their rail network after mobilization and conducting operations with the support of age-old but deficient sustainment practices.

The United States' differing approach to war developed a sustainment doctrine and organizational structure that enabled its armies to maintain unprecedented operational reach. The exploitation of the steam locomotive in conjunction with steam-powered water transport established lines of communication that permitted its forces to maneuver in

locales previously inaccessible to large formations due to logistical limitations. Founding a substantial, autonomous organization to construct and manage those train tracks enabled field armies to make advances in depth without risking a loss of support. Prioritization of supply movement along roads ensured those expeditions could continue beyond their railheads without compromising their sustainment. This system of efficient, high-capacity replenishment directed by quartermasters and supported by the USMRR allowed commanders unprecedented freedom of action and the ability to exercise their divisions in the field indefinitely. With such developments and lessons, the American military broke new ground in logistics that multiplied combat power and ensured sufficient force could be brought to bear upon objectives. Thus, the United States sought to apply its might via thoroughness and efficiency, while Prussia relied upon expediency to accomplish its goals.

With such strategic dissimilarity, a rationale can be seen in Moltke only absorbing the American model in part. He grasped how railroads could enhance the movement of forces and exploited their use for mobilization. However, Moltke did not have an equal compulsion to prioritize their use for sustainment. Prussia's geographic position fostered an approach to war that emphasized quick execution and short duration, and its theaters of operation had not precluded forage. Moreover, the preceding half-century of martial inactivity deprived Prussian leaders of having experiences that would counter the priority of *Bewegungskrieg*. Gaining a prompt battlefield decision in the wars with Austria and France remained Moltke's priority, and he had no hesitation in subordinating other concerns, such as logistics, in meeting that goal. With that lens in place, Prussian planners lacked the urgency to establish the logistical systems and institutions utilized by

U.S. forces in the Civil War, and inexperience blinded them to the risks assumed by the omission. Compounding this problem, Prussia was constrained in time to establish and develop the bodies and procedures necessary to regulate and support the railroads adequately. Neither of its conflicts was of a duration that allowed the systems to mature in the crucible of operations. Such challenges led to an incomplete application of rail technology in war prosecution, a corresponding assumption of avoidable risks, and a reversion to antiquated and deficient means of support. Rather than illustrating a developed understanding of modern war, the Prussian use of railroads in its campaigns against Austria and France symbolized an affirmation of its past beliefs.

Recommendations

Though the subsequent reichs of Germany, Prussia's successor state, showed improvements in rail usage over the performances in 1866 and 1870, indications of a German preference for maneuver at the cost of logistics remained. Whether one examined the prosecution of the Schlieffen Plan in 1914 or Operation Barbarossa in 1941, the evidence of strategic and operational overreach feeds the argument that the *Großer Generalstab* may have continued to struggle with the lessons offered by the U.S. Quartermaster General and the U.S. Military Rail Road in the Civil War. Further research along the lines of this thesis but with a longer view of history may reveal a pattern of greater proportion.

On a related note, a broadening of study to look at the possible impact of American rail doctrine on other major military powers of the nineteenth and twentieth centuries could illuminate an extensive legacy of American influence. The plentiful

supply of foreign observers following the advances of Civil War armies may have transmitted lessons on a scale unforeseen.

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