Josiah Gorgas and the Richmond Ordnance Industry: The Arsenal of the Confederacy

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JOSIAH GORGAS AND THE RICHMOND ORDNANCE INDUSTRY:
THE ARSENAL OF THE CONFEDERACY

by

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B.A. August 1992, Christopher Newport University

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ABSTRACT

Josiah Gorgas and the Richmond Ordnance Industry: The Arsenal of the Confederacy.

J. Michael Moore
Old Dominion University, 1996
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This study determines that Richmond, Virginia was the center of the Confederate domestic ordnance industry, and Josiah Gorgas, the Confederate Chief of Ordnance mobilized the city’s industrial potential. Richmond’s government ordnance facilities and private companies manufactured artillery, shoulder arms, ammunition, tools, and other ordnance materials that prolonged the war. In addition, Richmond became the center for Confederate ordnance research. Despite serious logistical problems, Gorgas supplied the Confederate Army’s demand for arms and ammunition until 1865. Finally, Gorgas’s mobilization of Confederate industry remains instructive for any nation going to war. These conclusions are based on extensive research of the National Archives’ collection of Ordnance Bureau records, the Virginia State Library’s and the Harvard University’s collections of Richmond business records, and several published primary resources.
ACKNOWLEDGMENTS

Several individuals aided my thesis research and I wish to thank them for their efforts. Mr. Chris Kolbe of the Virginia State Archives assisted my understanding of the Tredegar Company Records' organization and served as a great source on Richmond history. In addition, Mr. Michael Meier of the National Archives provided valuable assistance with the Ordnance Bureau Records and secured several letterbooks from storage. Furthermore, Ms. Linda McCorkle of Harvard University assisted my research of the R. G. Dun & Company Records in the Baker Library. Moreover, Dr. D. Alan and Dr. Anne B. Harris liberally loaned me several rare books from their library, and were supportive of my research and writing process. Mr. Tom Hughes of Washington’s Headquarters State Historic Site in Newburgh, New York also generously photocopied and mailed me a copy of the Richmond Naval Laboratory’s Day Book. Most importantly, my uncle and aunt, Mr. Larry L. and Mrs. Dorothy M. Crabtree, welcomed me into their home for three separate week-long research sessions at the National Archives. My parents, Mr. James M. and Mrs. Martha C. Moore, also provided vital moral and financial support during my studies.
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INTRODUCTION

Civil War scholarship focuses mainly on the role of slavery in the conflict, the significance of numerous battles, and the decisions of its chief participants. The subject of Confederate logistics, however, has only been investigated since the end of World War II and remains a specialized field. Many topics that remain unexplored can contribute to the historiography of the monumental Confederate effort to equip its armed forces. Josiah Gorgas’s mobilization, integration, and standardization of Confederate ordnance production, and Richmond’s contribution to the war effort is one of those topics. Gorgas¹ aided the

¹Gorgas, a Pennsylvania native, graduated from West Point in 1841 and served in the U.S. Ordnance Department for twenty years. He fought in the Mexican War and assisted the placement of the heavy artillery during the siege of Vera Cruz. In 1853 Gorgas married Amelia Gayle whose father (John Gayle) had been a judge, U.S. Congressmen, and governor of Alabama. Gorgas resigned his captain’s commission in 1861 due to a Southern wife and political views. Confederate General P. G. T. Beauregard suggested to President Jefferson Davis that Gorgas was a first-rate candidate for the new post of chief of ordnance. On April 8, 1861, Gorgas was commissioned a major and appointed the Confederate Chief of Ordnance. See Frank E. Vandiver, Ploughshares Into Swords: Josiah Gorgas and Confederate Ordnance (Austin: University of Texas Press, 1952), 3-9, 15-18, 38, 57; United States, War Department, Compiled Service

The journal model used is A Manual for Writers of Term Papers, Theses, and Dissertations.
Richmond ordnance industry's struggle against national supply problems, and provided competent leadership for the Ordnance Bureau. The historiography of Confederate logistics is limited, and this study makes a significant contribution to that field.

Lester J. Cappon's "A Note on Confederate Ordnance Records" (1940) decried the lack of research on Confederate ordnance production and listed the National Archives' collection of Ordnance Bureau Records. Cappon outlined the Confederacy's ordnance shortages in 1861, and praised Josiah Gorgas for sustaining the Confederate Army despite serious supply problems. In addition, Cappon noted Gorgas's industrial expansion and Richmond's vital role in ordnance production. Moreover, Cappon emphasized that the existing scholarship on Gorgas and the Ordnance Bureau consisted of memoirs by former ordnance officers.²

Frank E. Vandiver's Ploughshares Into Swords (1952) pioneered the study of Confederate ordnance production and Gorgas's leadership of the Ordnance Bureau. He discussed Gorgas's buildup of the ordnance industry, the chief subordinates who aided the Ordnance Bureau's efficiency, and the agents who procured foreign ordnance supplies. Vandiver

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believed Gorgas was a logistical genius who combated labor, raw material, and transportation problems and still kept the Confederate Army supplied with arms and ammunition. Future historians agreed with Vandiver’s interpretation of Gorgas’s vital role in the Confederacy. Vandiver, however, never examined Richmond’s role in this ordnance network, Gorgas’s vital direction of Richmond’s ordnance production, or Richmond’s private companies that provided ordnance material for the Richmond Armory, Arsenal, and Laboratory. Moreover, Vandiver never covered Gorgas’s quality control efforts and the results of defective ordnance supplies.

Both Clement Eaton’s A History of the Southern Confederacy (1954) and Emory M. Thomas’s The Confederate Nation: 1861-1865 (1979) recognized Gorgas and the Ordnance Bureau’s contribution to the Confederate war effort. Furthermore, Eaton and Thomas recognized the strategic value of Richmond’s Tredegar Iron Works, and covered Gorgas’s efforts at stimulating Confederate industrial growth. Both authors criticized the Confederate railroad system’s transportation and distribution of vital supplies for the field armies. Confederate transportation problems also hindered the shipment of raw materials to Richmond, which decreased ordnance production.

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3 Vandiver, Ploughshares Into Swords, 104, 145-46, 204.

Richard D. Goff’s *Confederate Supply* (1969) critiqued the three supply bureaus, and argued that Gorgas was the only bureau chief who created a viable foreign supply system. Goff praised Gorgas’s establishment of a domestic ordnance network, and believed the Ordnance Bureau was the best organized supply bureau. Similar to Vandiver, Goff concluded that Gorgas received adequate foreign and domestic ordnance supplies for the Confederate Army’s requirements. In addition, Goff asserted that neither the Quartermaster Department nor the Commissary Department enjoyed the same success, and Gorgas faced the worst shortages of the supply bureaus in the war’s first winter.5

Emory M. Thomas’s *The Confederacy as a Revolutionary Experience* (1971) detailed the wartime industrialization, which transformed the South’s agrarian economy. Thomas also focused on the broader issue of centralized governmental authority with the demands of total war. In the defense of states’ rights, the Confederacy became a police state with conscription, martial law, and impressments. Moreover, Thomas argued that Gorgas encouraged Southern industrialization with the establishment of domestic ordnance installations. He also believed the War Department exerted a large influence over the economy with government

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contracts and draft exemptions for certain skilled laborers. Indeed, Gorgas used draft exemptions for leverage against the Tredegar Iron Works and Richmond's smaller iron firms.

George Green Shackleford's *George Wythe Randolph and the Confederate Elite* (1988) examined the important influence of the Confederacy's third secretary of war. Although this work is outside of the historiography of Confederate supply, Shackleford discussed Gorgas's important relationship with George Wythe Randolph. Shackleford believed Randolph, unlike his two predecessors, organized the War Department into an efficient government agency and recognized Gorgas's considerable talents. Although a member of an old Virginia aristocratic family, Randolph believed in a meritocracy, and Shackleford asserted that Gorgas represented the epitome of the new Confederate elite. Shackleford termed Gorgas a technocrat who sought the centralization and organization of the Confederate economy and war effort.

Contemporary scholarship has continued to investigate Confederate ordnance production. Theodore P. Savas's "The Life Blood of the Confederate War Machine: George Washington Rains and the Augusta Powder Works" (1990) detailed the

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accomplishments of one of Gorgas’s best subordinates and the importance of the Confederacy’s large powder works. The Augusta Powder Works manufactured the majority of the gunpowder issued to the Confederate Army. Most importantly, Savas challenged Vandiver’s interpretation of Gorgas’s centrality in the Ordnance Bureau, and believed that further research was going to uncover that the Ordnance Bureau’s successes resulted from the work of Gorgas’s subordinate officers.8 This study addresses this historiographical debate.

Beyond Confederate ordnance production, Josiah Gorgas’s life remains of interest for contemporary scholars. Sarah Woolfolk Wiggins’s "Josiah Gorgas: A Victorian Father" (1986) noted the great interest Gorgas showed in his children’s upbringing. Gorgas was especially interested in his eldest son William Crawford Gorgas, who worked with Dr. Walter Reed against yellow fever and later became the U.S. Surgeon General. Furthermore, Wiggins’s The Journals of Josiah Gorgas, 1857-1878 (1995) examined Gorgas’s antebellum, wartime, and postbellum life. Frank E. Vandiver’s The Civil War Diary of General Josiah Gorgas (1947) focused on Gorgas’s wartime journal, and Vandiver omitted parts of some entries in deference to Gorgas’s descendants. Wiggins edited the entire Gorgas journals and

reinserted the entries originally omitted by Vandiver.⁹

The historiography of Richmond's iron industry is limited, but two historians have contributed to this subject. Kathleen Bruce was the first scholar who wrote about Richmond's antebellum iron industry and its later role in the Civil War. Bruce's article "Economic Factors in the Manufacture of Confederate Ordnance" (1925) highlighted Richmond's antebellum iron and coal industry, and the Tredegar Iron Works' vital role in ordnance production and experimentation. Her later work, *Virginia's Iron Manufacture in the Slave Era* (1931) further detailed Richmond's antebellum iron and coal production, and Anderson's mobilization of Tredegar's resources for military production. She also provided valuable background material on the first Richmond iron businesses established in the 1830s and 1840s.¹⁰ Bruce, however, does not cover their contributions to the Confederate war effort.

Charles B. Dew's *Ironmaker to the Confederacy* (1966) further examined Tredegar's role in the Confederacy. He focused on Tredegar's relationship with the Confederacy, and used manuscripts and primary resources unavailable to Bruce thirty years earlier. Gorgas supported Tredegar's ordnance

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production by securing skilled laborers from the army and providing financial aid for the purchase of iron furnaces. Dew concluded Tredegar's important ordnance production was hindered by shortages of labor and raw materials.\textsuperscript{11} The Tredegar Iron Works was the Confederacy's largest foundry, but the other Richmond iron companies also provided ammunition and iron products for the war effort.

The Richmond iron companies and Gorgas's ordnance facilities employed black laborers whose efforts were largely ignored until recently. James H. Brewer's \textit{The Confederate Negro: Virginia's Craftsmen and Military Laborers, 1861-1865} (1969) and Ervin L. Jordan's \textit{Black Confederates and Afro-Yankees in Civil War Virginia} (1995) examined the Confederacy's mobilization of black labor. Both authors concluded black laborers performed vital tasks for the Confederacy with little white supervision. The North was skeptical about the Confederacy's use of black labor, but the Confederate authorities proved remarkably enlightened with the demands of total war. Brewer and Jordan detailed the various jobs performed by black labor. Blacks erected earthworks and mounted heavy cannons in the Richmond and Petersburg defensive lines. Moreover, Gorgas used black teamsters for hauling ordnance supplies to the Army of Northern Virginia and unloading stores at the ordnance depot. After major battles, blacks collected and

cleaned discarded small arms. Black workers also performed skilled labor tasks and earned the admiration of their white employers. The Ordnance Bureau employed black coopers for manufacturing powder kegs and black wheelwrights for repairing wagons. The Niter & Mining Bureau and the Tredegar Iron Works also used black miners and furnacemen. Furthermore, Tredegar employed black foundrymen, puddlers, and bricklayers in its foundry and rolling mills. The James River Kanawha Canal’s black boatmen and workers operated this vital supply line between Richmond’s iron industry and the Shenandoah Valley iron furnaces. With white males serving in the army, Gorgas’s Richmond ordnance facilities also employed white females for ammunition manufacturing. No major work has explored the role of white female labor in the Richmond Laboratory or the Confederate war industries.

This paper examines the ordnance shortages that the Confederacy faced in 1861, and Gorgas’s mobilization and integration of the Richmond iron industry for ordnance production. In 1861 the Confederate Army contained many types of cannons and small arms. Gorgas wanted ordnance production standardized for the simplification of ammunition distribution. In addition, Gorgas fought the Virginia authorities for the control of ordnance production, and this

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underscored the larger question of national and state governmental authority within the Confederacy. Gorgas and the Richmond ordnance industry were also affected by larger national supply problems with labor, raw material, and food shortages. Gorgas lobbied the War Department for skilled laborers, supported government control of raw materials, and distributed food to the Ordnance Bureau's employees. Gorgas dealt with problems facing any nation mobilizing for war, and the Ordnance Bureau's success helps to explain why the Confederate States, outnumbered four to one, survived for four years.
CHAPTER 1

RICHMOND'S ANTEBELLUM IRON INDUSTRY

On June 2, 1861, Major Josiah Gorgas arrived in Richmond, the new capital of the Confederate States, from Montgomery, Alabama. Since the early 1800s, Richmond had been Virginia's chief commercial and manufacturing city.¹ Richmond was centrally located on the James River, which provided waterpower and transportation. In addition, the James River Kanawha Canal linked Richmond with the Shenandoah Valley's charcoal iron furnaces. Richmond's industrial base was strategically important to the Confederacy. Earlier, the secession debates underscored Virginia's industrial importance to the Confederate States, and Gorgas inherited Virginia's defensive preparations resulting from the state convention.

During the formation of the Confederate States in February 1861, Virginia voters elected 152 delegates for a state convention. The delegates debated Virginia's future political allegiance for two months. Although the majority

¹In 1861 Richmond possessed 5 railroad lines, 12 mills producing $3 million worth of flour, 52 tobacco manufacturers with a $5 million annual gross, and the South's largest iron industry which employed 1,550 workers and had $2 million of annual sales. See Emory M. Thomas, The Confederate State of Richmond: A Biography of the Capitol (Austin: University of Texas Press, 1971), 21-24.
of the delegates were Unionists, ex-governor Henry Wise and George Wythe Randolph argued against further political ties with the United States. Unlike Wise's political arguments for states' rights, Randolph offered economic reasons for Virginia's secession from the Union.

Randolph chaired the Committee on Federal Relations and addressed the commercial aspects of the Union. He questioned whether Virginia's commercial interests were best served by the United States or the Confederate States. Furthermore, Randolph noted that the economic aspects of secession had been ignored in the political debate. Randolph argued the market for Virginia's wheat, tobacco, iron, and coal was in Europe and the Lower South. Moreover, the North only represented economic competition and supported protective tariffs that favored Northeastern

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2George Wythe Randolph was a grandson of Thomas Jefferson and a U.S. Navy veteran. Before the war, Randolph practiced law in Richmond and served on the city council. He also organized the Richmond Howitzers, a volunteer artillery unit. Randolph ably commanded the Confederate artillery at the Battle of Big Bethel in June 1861 and was later promoted to brigadier general. In 1862 Randolph was appointed secretary of war. He was influential in the passing of the conscription act, which made white males between eighteen and forty-five years old subject to military service. Randolph resigned as secretary of war over President Jefferson Davis' constant interference with the War Department. See Shackleford, George Wythe Randolph and the Confederate Elite, 165-71.

industry.  

The Confederacy needed raw materials for ordnance production, and Randolph argued that Virginia's coal and iron industries were losing ground against Northern competition. Between 1822 and 1842, nearly two million tons of Virginia bituminous coal was shipped from Richmond.  

With figures from the U.S. Census and DeBow's Review, Randolph stated that from July 1, 1856, to the end of 1859 Virginia coal shipped to Richmond decreased annually by 2,307 tons, while Northern coal brought to Richmond increased annually by 4,033 tons. Pennsylvania anthracite

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5Bituminous coal, soft coal, has a 70 percent to 85 percent carbon content and a higher heating value than brown coal, which has a 60 percent carbon content. In the nineteenth century, bituminous coal was especially used for the production of illuminating gas which lighted homes. Anthracite coal has a 90 percent carbon content and has the highest heating value of the three types of coal. Anthracite coal is cleaner burning and was heavily used in industry.

coal was the main competitor of Virginia bituminous coal.\textsuperscript{7}

Virginia's coal industry, however, declined for other reasons beyond the introduction of Pennsylvania anthracite coal. After the 1840s, the quality of Richmond coal decreased and the mining costs increased. Richmond coal near the surface was already mined and expensive pumps were needed for extracting the coal below the water level. Despite these hinderance, Virginia in 1860 was the fourth largest coal producer in the United States with 473,360 tons.\textsuperscript{8}

Virginia's charcoal iron furnaces faced similar problems. In 1860 only fourteen iron furnaces operated in the Shenandoah Valley. With the introduction of Pennsylvania anthracite coal, American iron furnace operators used the cheaper hard coal for smelting iron. Virginia lacked hard coal and only the cost effective furnaces were able to stay in blast. Randolph pointed out that since July 1, 1857, the Western Virginia iron brought to Richmond decreased annually by 379 tons, while Northern iron shipped to Richmond increased by 3,867 tons.\textsuperscript{9}


Compared with the Lower South, Virginia contained large deposits of coal and iron ore. Alabama had comparable deposits of iron ore, but these were not currently exploited. Randolph believed that the Lower South was a ready market for Virginia's coal and iron. Furthermore, Randolph noted that some of Virginia's iron works [Richmond's Tredegar Iron Works] were already marketing products in the South and separation from the Confederacy meant their economic ruin. If Virginia remained in the Union, Tredegar's owners threatened to relocate in the Lower South. Tredegar's production rose to $100,000 per month filling ordnance orders for the Lower South. Between January 1861 and April 1861, Tredegar manufactured 20,078 artillery projectiles and 204 cannons for the Lower South.\textsuperscript{10}

Despite Randolph's arguments, the state convention members were not convinced, and the Virginia state convention on April 4, 1861, voted eighty-eight to forty-five against secession. The catalyst for Virginia's secession arose from South Carolina's attack on Fort Sumter in Charleston Harbor on April 12, 1861. The Tredegar Iron Works cast most of the heavy artillery that ringed Charleston Harbor and bombarded Fort Sumter. The first shot of the Civil War came from a Tredegar ten-inch mortar. South Carolina's massive artillery barrage was the result of

\textsuperscript{10}Ibid.; Sales Rolling Mill, November 1860-November 1867, Tredegar Company Records, Virginia State Library, Richmond, Virginia; (hereafter cited as TCR); Foundry Records of Gun Casts, 1861-1865, TCR.
three months intensive production by Tredegar.11

In response to South Carolina's actions, Abraham Lincoln requested 75,000 volunteers for ending the Southern rebellion. This action, however, prompted Virginia's support of the Confederate States. On April 17, 1861, the Virginia state convention voted eighty-five to fifty-five for secession from the Union.12 Virginia's secession united the Confederate Ordnance Bureau with the South's largest iron industry.

During the 1830s and 1840s, Richmond merchants established five iron works that were the nucleus of the city's iron industry.13 In 1835 the Belle Isle Manufacturing Company was established and pioneered Richmond's iron industry. Belle Isle produced bar iron, boiler plate, and various types of nails. Financial difficulties prompted the company's reorganization in 1839 and several partnerships controlled the company until Hugh Fry purchased it in 1854. In 1856 Fry changed the company's name to Old Dominion Iron & Nail Works. With a firmer financial foundation, Old Dominion Iron & Nail Works soon produced first-class nails that were sought over British and

11McPherson, Battle Cry of Freedom, 254-55; Dabney, Richmond, 160; Charleston Mercury, August 16, 1861; Dew, Ironmaker to the Confederacy, 82.

12McPherson, 278-80; Thomas, The Confederate Nation, 93-95.

13See Appendices A-D for these company's census figures.
Northern nails. In 1860 the company produced 75,000 kegs of nails worth $215,750.14

The second oldest iron business was the Richmond Foundry established in 1836 by D. I. Burr & Company. The Richmond Foundry produced locomotive engines for the Richmond, Fredericksburg & Potomac Railroad. In 1843 the company was renamed Burr, Sampson & Pae (Thomas Sampson and Alexander Pae). Burr left the business in 1849, and Sampson & Pae controlled the Richmond Foundry through the Civil War. During the 1850s, Thomas Sampson and Alexander Pae expanded their business and profited on a steady market for their numerous types of steam engines and iron castings.

Richmond's Personal Property Tax and Real Estate Tax Books for 1860 listed Sampson & Pae as owning four slaves and the Richmond Foundry's property as worth $20,000.15

In 1837 Francis B. Deane established Richmond's third iron business, the Tredegar Iron Works. Deane suffered financial reverses from the Panic of 1837, and Joseph R. Anderson, a former army officer, leased Tredegar in 1843. Under Anderson's supervision, Tredegar grew to become the

14Bruce, Virginia's Iron Manufacture in the Slave Era, 290-92; R. G. Dun & Co. Collection, Virginia vol. 43: 374, Baker Library, Harvard University Graduate School of Business Administration; (hereafter cited as Dun Collection with volume and page number); United States Census, 1860: Manufacturing Schedule, Virginia, Henrico County, National Archives, Washington, D.C.

15Bruce, 294-95; Dun Collection, vol. 43: 100; Richmond, Personal Property Tax Book, 1860, Virginia State Library, Richmond, Virginia; Richmond, Real Estate Tax Book, 1860, ibid.
South's largest iron works. Between 1844 and 1860, Tredegar cast 881 cannons for the U.S. Navy and War Departments. In 1844 Tredegar received the contract for the armored U.S. revenue cutter Polk. With funds from Federal contracts and Virginia railroad work, Anderson purchased Tredegar in 1848. Tredegar's reputation in ordnance production influenced South Carolina officials to contract with Anderson. Between 1850 and 1851, Tredegar cast sixty-four coastal and heavy artillery cannons for South Carolina. With increased Northern and British competition in the 1850s, Tredegar entered new markets in the South and struggled to maintain their Northern markets. In 1859 Anderson formed the J. R. Anderson & Company, which consolidated Tredegar's Foundry, Rolling Mill, and Locomotive Shop with the Armory Rolling Mill. Richmond's Real Estate Tax Book for 1860 listed the Tredegar property as worth $114,900.¹⁶

In 1839 Charles Talbott established the Shockoe Manufacturing Company, which along with the Richmond Foundry became the city's premier machine shops. In 1842 James M. Talbott joined his brother's business and the partnership of Talbott & Brothers lasted until 1870. The Shockoe Foundry made iron castings, steam engines, and later locomotive engines. Their market, similar to other Richmond iron works, was mostly in the South. Talbott & Brothers enjoyed a fine reputation in financial and mechanical matters. Richmond's Real Estate Tax Book for 1860 listed the Shockoe

¹⁶Dew, 3-4, 12-13; Richmond, Real Estate Tax Book, 1860.
Foundry's property as worth $40,000.17

The Broadmeadow Mining & Manufacturing Company, established in 1846, was intended for steel production from high grade Virginia iron. The company experienced financial problems and in 1848 Christopher Tompkins (a former West Point classmate of J. R. Anderson) purchased the company, renaming it the Virginia Steel Company. In 1851 the company was renamed the Richmond Iron & Steel Works under the partnership of Tompkins & Gwyn. Tompkins & Gwyn, in 1855, sold the Richmond Iron & Steel Works to James Hunter & Company who controlled the company during the Civil War. From 1855 to 1860, the Richmond Iron & Steel Works produced annually four hundred tons of bar iron from scrap railroad rails.18

In the 1850s, Richmond's iron industry grew with the construction of several machine shops, a stove works, and a foundry. One such machine shop was the firm of Ettenger & Edmond, which began as William Ettenger & Company in 1851. This company manufactured locomotives for the Richmond railroads. In 1852 D. I. Burr, who started the Richmond Foundry, and William Ettenger formed a partnership that lasted until 1857. In 1857, William Ettenger and Horace Edmond formed a partnership with a capital of $20,000. The Richmond Personal Property Tax Book for 1861 listed Ettenger

17Bruce, 295-96; Richmond, Real Estate Tax Book, 1860; Dun Collection, vol. 43: 85.

18Bruce, 297-99.
& Edmond as owning one slave.\textsuperscript{19}

German immigrant Philip Rahm built a foundry and machine shop in 1852. Rahm had worked for Talbott & Brothers for several years until he built up his savings. Rahm's Eagle Machine Works became a prosperous business and by 1860 he owned eight slaves and real estate worth $20,000.\textsuperscript{20}

Henry R. Burger & Company, in 1856, established a saw manufacturing shop in Richmond. By 1858, Burger formed a partnership with Edward Boyle which expanded in 1859 to include Thomas Gamble. In June 1860, the partnership of Burger, Boyle & Gamble dissolved and Edward Boyle and Thomas Gamble took over the business. In 1860 Boyle & Gamble manufactured 600 saws worth $4,000.\textsuperscript{21}

All of these companies later contracted with Gorgas and constituted the private sector of the city's ordnance industry. Richmond's 7,589 industrial laborers, however, were mostly Northern and foreign workers. Tredegar's Rolling Mill superintendent was a Canadian and of the company's seven hundred white laborers only a small percentage were born in Virginia. Tredegar even organized its skilled labor tasks by nationality with English rollers,

\textsuperscript{19}Dun Collection, vol. 43: 125, 278; Richmond, Personal Property Tax Book, 1861.

\textsuperscript{20}Dun Collection, vol. 43: 146, 358; Richmond, Real Estate Tax Book, 1860; Richmond, Personal Property Tax Book, 1860.

\textsuperscript{21}Dun Collection, vol. 43: 260; U.S. Census, 1860.
Irish puddlers, and Welsh heaters. Irish and German laborers filled the majority of the unskilled positions. In addition, Anderson employed slaves for skilled positions. This created tension with the white skilled laborers, but Anderson controlled this by firing the white laborers who went on strike in 1847 over the introduction of slave labor. The mining companies in the Richmond coal basin also employed British miners and slaves. Antebellum Richmond had a large proletarian class who lived in rough neighborhoods, and boasted one of the largest foreign populations in the South. Richmond's reliance on Northern and foreign labor created problems for Gorgas who lacked a skilled native-born work force.\textsuperscript{22}

Before officially seceding from the Union, Virginia secured vital Federal ordnance supplies and prepared for state ordnance production. Ex-Governor Wise organized attacks against the Harper's Ferry Armory and the Gosport Navy Yard. The Harper's Ferry Armory was one of two U.S. ordnance facilities that manufactured rifled muskets,\textsuperscript{23} and

\textsuperscript{22}Thomas, \textit{The Confederate State of Richmond}, 25-26; Dew, 25-27; Dabney, 134.

\textsuperscript{23}Since the seventeenth century, the smoothbore musket had been the standard infantry weapon. The smoothbore musket had a maximum range of 150 yards. During the nineteenth century, the musket's priming system was altered from flint to the more reliable percussion cap which cut down on misfires. In addition, the French Army developed a musket projectile capable of quick loading in a rifled barrel. The flintlock rifle had always been slow to load and therefore not adopted by European armies. The French experiment combined the accuracy of a rifle and the fast loading of a smoothbore musket. In the 1850s, the United
the Gosport Navy Yard was the U.S. Navy's largest shipyard in the South. Virginia troops seized the Harper's Ferry Armory on April 18, 1861, and transported valuable machinery and weapons to Richmond. The Gosport Navy Yard was captured on April 19, 1861, and Virginia obtained heavy artillery cannons and ordnance supplies. Their efforts aided Gorgas's mobilization of Richmond's resources, but later created problems over whether the national or state government controlled the ordnance supplies.

Since John Brown's raid in 1859, Virginia officials were concerned with the state's security. Consequently, the Virginia General Assembly voted $500,000 for equipping the Virginia State Armory with machinery capable of manufacturing 5,000 rifled muskets per year. In 1801 the Virginia State Armory was constructed in Richmond for manufacturing flintlock muskets. After the War of 1812, the Virginia State Armory ceased arms production and only stored militia arms. The Massachusetts iron business of James T. Ames & Company was considered for the rifle machinery contract, but an inopportune article in the New York Times, which belittled Southern industry and Virginia's dependence on Northern mechanics to equip the Armory, ended the consideration of any Northern firm. In August 1860, the States and Europe adopted rifled muskets which had an effective range between five hundred and eight hundred yards. The rifled musket was responsible for the heavy battlefield losses in the American Civil War.

McPherson, 279-80.
Tredegar Iron Works received the contract and was given a December 1, 1861, deadline for completing the machinery.  

James H. Burton (the former master armorer of Great Britain's Enfield Rifle Factory), and Soloman Adams (a former armorer at the Springfield Armory) provided important technical support for equipping the Virginia State Armory. Both men later worked for Gorgas. Before Virginia's secession, Burton and Adams visited Northern arms companies and, with the assistance of Secretary of War John B. Floyd (a Virginia native), they received detailed drawings of rifled-musket machinery. These drawings later aided Confederate ordnance officers reconstructing the captured machinery from Harper's Ferry. The captured Harper's Ferry machinery, however, ended the need for Tredegar's rifled-musket machinery and the contract was canceled. Tredegar completed half of the machinery for the Virginia State Armory.  

Along with the plans for modernizing the Virginia State

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25 Dew, 52-56; Bruce, 112-13, 328-30; Richmond Enquirer, October 11, 1861; Charleston Mercury, August 13, 1861; "Agreement made August 23, 1861, between the commissioners appointed by the Governor under an act of Assembly passed January 21, 1861, of the one part and Joseph R. Anderson & Co. of the other part," August 23, 1860, Calendar of Virginia State Papers and Other Manuscripts, January 1, 1836-April 15, 1869, ed. H. W. Flournoy, vol. 11, (Richmond, Virginia: Virginia State Library, 1893), 186.

26 Dew, 64-65; Bruce, 331; James H. Burton to John R. Chambliss, June 19, 1861, Journals and Papers of the Virginia State Convention of 1861, (3 vols., Richmond, VA: Virginia State Library, 1966), vol. 3: 7; (hereafter cited as Virginia, Journals and Papers with volume and page number).
Armory, state officials authorized the formation of the Virginia Ordnance Department. On April 1, 1861, Charles Dimmock (a West Point graduate) was appointed the Chief of the Virginia Ordnance Department with the rank of colonel. Since 1844, Dimmock commanded the Public Guard which protected the Virginia State Armory. As the Chief of Virginia Ordnance, Dimmock worked feverishly to equip the volunteer regiments raised in response to Virginia's secession. He also supervised Burton's work on the Armory and organized an ordnance laboratory. Between April 1, 1861, and June 14, 1861, Dimmock oversaw the manufacture and distribution of forty rounds of ammunition per soldier for 50,000 troops. The Virginia Ordnance Department also issued 43,658 shoulder arms and 115 cannons from the state arsenals. On June 14, 1861, the Confederate Ordnance Bureau was given control of the Virginia Laboratory, which contained cartridge machines capable of manufacturing 75,000 rounds of small arms ammunition a day. Dimmock also transferred to the Confederate Ordnance Bureau 1,000,000 percussion caps, 9,894 artillery projectiles, and 114,000 small arms cartridges.  

The Virginia militia's seizure of the Gosport Navy Yard

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also strengthened the state's defense preparations. Beyond the repair and shipbuilding facilities, the Virginia militia captured 1,198 heavy artillery guns, 300,000 pounds of gunpowder, 110,217 artillery projectiles, 154,605 percussion caps, and 158,467 small arms cartridges. The heavy artillery later fortified the Elizabeth, James, York, and Rappahanock Rivers. Virginia's numerous navigable rivers left the state vulnerable to naval assault. The newly created Virginia Navy erected batteries along the major waterways of Tidewater. By June 30, 1861, when the Confederate Navy took command of Gosport, Virginia forces had removed all but 489 cannons. In addition, Virginia shipped Gosport cannons to other Southern states needing coastal artillery.28

When Gorgas arrived in Richmond, the Virginia Ordnance Department had controlled ordnance production and distribution for two months. Furthermore, state officials had already begun renovating the Virginia State Armory. These proved valuable resources for the Confederacy, but Gorgas met determined resistance from state officials over the control of ordnance production. During the war, Gorgas also encountered supply problems that hindered ordnance production, and historians need to fully examine if Richmond fulfilled the great role G. W. Randolph argued the city was

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28Dew, 87; Captain S. Baron to John Letcher, June 10, 1861, Virginia, Journals and Papers, vol. 3: 69; Report of Ordnance and Ordnance Stores on hand at the Gosport Navy Yard, April 21, 1861, ibid., vol. 3: 32-34.
destined to play in the new Confederate States.
CHAPTER 2
ESTABLISHMENT OF THE ORDNANCE BUREAU

After his arrival in Richmond, Josiah Gorgas planned for the construction of an arsenal, a depot, and a laboratory. Gorgas also sought control of the Virginia State Armory, where he planned to establish the Ordnance Bureau's headquarters. Furthermore, Gorgas contracted with Richmond's iron companies for ordnance materials and other products. In securing arms and ammunition, Gorgas dealt with the broader issues of the War Department's authority over ordnance supplies, states' rights within the Confederacy, mobilizing and integrating Richmond's iron industry, and the standardization of Confederate ordnance production.

Despite Richmond's industrial potential, Gorgas faced a daunting task equipping the Confederate Army. The Confederate States was woefully unprepared for organizing an effective military resistance or supporting a prolonged armed conflict. There was a shortage of field artillery and only a few volunteer artillery units were prepared for

1Vandiver, Ploughshares Into Swords, 66-67.
The Gosport Navy Yard and the captured U.S. forts provided coastal and heavy artillery, but the Tredegar Iron Works was the only Southern foundry capable of casting heavy artillery. The captured U.S. arsenals contained 135,000 muskets and rifles. Many of the muskets were antiquated flintlocks, which needed modifications for percussion caps. Combined with state arms, the Confederacy had 150,000 shoulder arms for the mustering volunteer units. The Confederacy also lacked carbines and handguns for the cavalry. The South possessed few arms companies that produced pistols or revolvers. In addition, the Confederacy had less than 1,000,000 small arms cartridges, approximately 250,000 percussion caps, and only 60,000 pounds of gunpowder. In response, Gorgas sought domestic and foreign ordnance sources for the next year's military campaigns.

Two days after his arrival, Gorgas established an arsenal, a depot, and a laboratory in Richmond. During the

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2The Washington Artillery of New Orleans was organized in 1838 and fought in the Mexican War. This unit contained members of the Creole elite. In 1861 the Washington Artillery had five companies ready and trained for combat. In addition, the Richmond Howitzers was organized by George Wythe Randolph in 1859 and recruited from the city's elite. Randolph thoroughly drilled the unit and once war erupted the volunteer company expanded to three companies. See Faust, *Historical Times Illustrated Encyclopedia of the Civil War*, 806; Shackleford, 48.

war, these facilities manufactured and repaired vital ordnance supplies. The Richmond Arsenal consisted of several former tobacco warehouses at the bottom of Seventh Street (near the James River). The Richmond Arsenal issued cannons and small arms, repaired and manufactured artillery carriages, and manufactured infantry and cavalry equipment. The Richmond Laboratory was located at Brown's Island on the James River, and a small footbridge linked the two ordnance installations. The Richmond Laboratory manufactured and issued small arms cartridges, artillery projectiles, friction primers, percussion caps, and artillery fuzes. The Ordnance Depot was located behind the Arsenal and stored equipment ready for shipment. Gorgas still needed the Virginia State Armory and its rifled-musket machinery.

In his efforts at supplying the Confederate Army, Gorgas contended with uncooperative state officials who resisted Confederate authority. Colonel Charles Dimmock, the Chief of the Virginia Ordnance Department resented Gorgas's arrival in Richmond. Indeed, Gorgas sought the centralization of ordnance production and wanted the efficient organization of the limited material resources. In 1861 Gorgas was a major and his lower rank reduced the Confederate Ordnance Bureau's credibility in Dimmock's viewpoint. Dimmock was also eighteen-years older than

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Gorgas, a former U.S. Army officer, and a resident of Richmond since 1844. Moreover, Dimmock zealously guarded his military authority and the Harper's Ferry ordnance stores to the detriment of the field commands.

The spirit of cooperation was lost upon Dimmock even before Gorgas's arrival. In May 1861, Dimmock complained to Major General Robert E. Lee, Virginia's military commander, about issuing ammunition to volunteer units from other Confederate states stationed in Virginia. In addition, Dimmock resented supplying the naval batteries on the James River, which led to the establishment of the Richmond Naval Laboratory. In his defense, Dimmock possessed neither the labor nor the resources for supplying all the Confederate forces in Virginia. Dimmock, however, lacked diplomacy and ignored orders from anyone except the governor of Virginia.

Gorgas and Dimmock first clashed over the disposition of the captured Harper's Ferry ordnance supplies. Gorgas faced severe shortages and looked for any source of ordnance supplies. In the summer of 1861, the Confederate government and the Virginia State Convention negotiated the transfer of the Harper's Ferry machinery and ordnance stores. Before the Confederacy gained official control of these supplies, Gorgas had urgent need of tools for arms repair. On July 8, 1861,
1861, Gorgas requested Lieutenant Colonel James Burton transfer gunsmith tools from the Virginia State Armory for arms repair in Winchester. Furthermore, Gorgas requested Master Armorer Soloman Adams transfer lead and machinery to the Richmond Laboratory. Burton informed Dimmock who answered that only the governor had authority over these supplies. Rebuffed, Gorgas warned Dimmock that his delays prevented the proper distribution of ordnance supplies and conflicts between their departments harmed the field armies. In response, Dimmock wrote Secretary of War Leroy P. Walker and complained about Gorgas's requisition of state supplies.\footnote{J. Gorgas to James Burton, July 8, 1861, War Department, The War of Rebellion: A Compilation of the Official Records of the Union and Confederate Armies (128 vols., Washington, D.C.: Government Printing Office, 1880-1901), series IV, vol. 1: 471; (hereafter cited as OR with volume and page number); United States, War Department, Josiah Gorgas to Soloman Adams, July 11, 1861, Letters Received by the Confederate Secretary of War, 1861-1865, M437, roll 4, War Department Collection of Confederate Records, RG 109; (hereafter cited as LRCSW with roll number); James Burton to Charles Dimmock, July 8, 1861, OR, series IV, vol. 1: 472; Gorgas to Dimmock, July 11, 1861, ibid., series IV, vol. 1: 470; C. Dimmock to L. P. Walker, July 12, 1861, ibid., series IV, vol. 1: 469-70; Vandiver, Ploughshares Into Swords, 67.}

In support of Gorgas, Walker wrote Governor John Letcher and asked for greater cooperation by the Virginia Ordnance Department. In addition, Walker believed the two ordnance departments squabbling over limited resources worsened supply problems. Fortunately for the Confederacy, Letcher cooperated with the War Department and ordered Dimmock to transfer the Harper's Ferry stores to the
Garbage Works
2 sets 14 Garman's 10
mix w/ Richmond - combine
machines w/ H.R. & Shorr
Production - Burton 1
A.O.W.?
Ordnance Bureau. In July 1861, Letcher and Confederate President Jefferson Davis also arranged the transfer of the Virginia State Armory for the war’s duration. Virginia reserved the right of property on the machinery and both sides agreed to inventory the captured U.S. ordnance stores. The inventory and legal proceedings slowed the transfer until September 1861. Gorgas, however, successfully gained possession of the Richmond Armory and work began on the erection of the rifled-musket machinery.

Despite the transfer of the captured stores, Dimmock still resisted the Confederate Ordnance Bureau and hampered any efforts for effective cooperation. In October 1861, Confederate ordnance officers seized four cannons at the Richmond Foundry, and Gorgas ordered them sent to Tredegar for rifling. In addition, Gorgas sent two cannons left outside near the Richmond Armory to the Richmond Foundry for reboring and mounting on field carriages. In both instances, Dimmock claimed these were state cannons and protested fiercely. Gorgas sent these cannons to Lieutenant General John Magruder who desperately needed artillery for his Peninsula defenses.

Dimmock also complained about the Ordnance Bureau’s

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9John Letcher to Judah Benjamin, December 10, 1861, LRCSW, roll 18; J. Gorgas to J. P. Benjamin, October 13, 1861, ibid., roll 12.
altering Virginia flintlock muskets to percussion cap. Gorgas argued the Confederacy paid for these alterations and government agents collected flintlocks from field commands. The soldiers were traded an altered musket for a flintlock, which frequently misfired and was useless in wet weather. The altered muskets were suitable weapons until replaced by Enfield or Springfield rifled muskets. Nonetheless, Dimmock still clashed with Gorgas over these antiquated firearms reissued to Confederate units and wanted the Virginia muskets reserved for the state militia. In response, Gorgas ordered the Virginia muskets stored in the Richmond Arsenal transferred to the Virginia Ordnance Department. Most of these were unfit for alteration to percussion cap, and Gorgas already accomplished the task of removing the flintlock muskets from field units.  

The fight between the rival ordnance chiefs continued and created friction between Virginia and the Confederate States. In December 1861, Dimmock requested five thousand percussion caps from the Richmond Arsenal. Lieutenant Briscoe G. Baldwin commanded the Richmond Arsenal and sought Gorgas's approval for the transfer. Gorgas endorsed Dimmock's letter with these instructions: "Please issue the least useful. These demands seem to me to come very often." Baldwin sent Dimmock the percussion caps, but mistakenly

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10 J. Gorgas to J. P. Benjamin, November 6, 1861, ibid., roll 14; Briscoe G. Baldwin to Charles Dimmock, November 28, 1861, ibid., roll 18; Charles Dimmock to John Letcher, November 29, 1861, ibid., roll 18.
returned Dimmock's letter with Gorgas's endorsements. Upon receiving the letter, Dimmock forwarded it to Letcher who believed Gorgas was plundering Virginia's ordnance supplies. Letcher complained to Secretary of War Judah Benjamin on December 3, 1861, that "[t]he conduct of this officer has been characterized by a disrespect of the rights and authorities of the State of Virginia. . ." In addition, Letcher charged that Gorgas distributed the Harper's Ferry ordnance supplies without consulting state officials. The agreement was for Confederate and Virginia officers to inventory the ordnance supplies and access their value, but Gorgas subverted this process and directly issued ordnance supplies to Colonel Turner Ashby in the Shenandoah Valley. Furthermore, Letcher believed Virginia's authorities cooperated with Confederate requests for state ordnance supplies. Letcher also objected to Gorgas's comments about Dimmock's request for percussion caps and pointed out that Virginia had given the Confederacy its cap machines. In the future, Letcher wanted consultation before Gorgas issued state property."

Gorgas never received any official reprimand, and Benjamin no doubt understood the urgency of supplying the Confederate Army. Moreover, Gorgas enjoyed the friendship of President Davis and other prominent Confederate

"Charles Dimmock to John Letcher, February 16, 1862, ibid., roll 47; Briscoe G. Baldwin to John Letcher, February 8, 1862, ibid., roll 47; John Letcher to Judah P. Benjamin, December 3, 1861, ibid., roll 17; Letcher to Benjamin, December 10, 1861, ibid., roll 18."
officials. Letcher also exasperated Davis and the War Department with the drawn out negotiations for the transfer of the Harper's Ferry rifle machinery and the Virginia State Armory. Letcher was a legalist who wanted all the details of the Armory's and the rifle machinery's transfer settled before the Confederacy gained control. This wasted valuable time and the Confederate Army was still in a weak position after the First Battle of Manassas.

The conflict between the Confederate and Virginia ordnance chiefs highlighted the struggle for states' rights in the new nation faced with the demands of modern warfare. Dimmock was more concerned with preserving state ordnance supplies and protecting antiquated weapons than cooperating with his Confederate counterpart who was responsible for supplying the entire Confederate Army. In addition, Letcher wanted the Harper's Ferry ordnance supplies inventoried and their value accessed before Gorgas began issuing them to the troops. Gorgas, however, successfully maneuvered for the control of the captured U.S. ordnance supplies and the Virginia State Armory. Unlike the more distant regions of the nation, the Confederate government's presence in Richmond increased its authority and influence over

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13 Ibid.; Boney, John Letcher of Virginia, 133-34.
Virginia’s officials.¹⁴

Despite resistance from state officials, the Richmond iron businesses eagerly sought the favor of the War Department and offered their material support. Indeed, Richmond’s iron industry rapidly retooled for ordnance production and provided a variety of products for the Confederacy. Gorgas also asserted his authority over these companies’ production.

Richmond’s oldest iron business, Old Dominion Iron & Nail Works, supplied the Ordnance Bureau, the Quartermaster Department, and the Engineer Bureau with nails, tacks, rail spikes, plate iron, boiler iron, shovel iron, and sheet iron. The Richmond Arsenal and Laboratory relied heavily on

¹⁴The Confederate government created a centralized state, but met resistance from Governor Joseph Brown of Georgia and Governor Zebulon Vance of North Carolina. Brown maintained an independent state militia, which was equipped with arms and ammunition needed by the Confederate Army. During the Union Army’s advance on Atlanta in 1864, President Davis wanted the Georgia militia’s arms for the Army of Tennessee. Brown resisted releasing the state arms until he disbanded the militia for harvest season. Similarly, Vance monopolized North Carolina’s textile industry and reserved state manufactured uniforms for the militia. By April 1865, the Army of Northern Virginia was dressed in rags, while thousands of uniforms were stored in North Carolina. Unlike North Carolina or Georgia, Virginia was occupied by the Confederate Army and contained the nation’s capitol. Consequently, Davis had a greater influence over Governor Letcher and state officials. See Frank Lawrence Owsley, State Rights in the Confederacy (Gloucester, MA: Peter Smith, 1961), 35-36, 276-77; William Harris Bragg, "Joe Brown vs. the Confederacy: The Governor fights the Government," Civil War Times Illustrated 26 (November 1987): 40-43.
Old Dominion Iron & Nail for iron plates, nails, and tacks.\(^{15}\)

In contrast, the Ordnance Bureau contracted with Sampson & Pae's Richmond Foundry for artillery projectiles, elevating screws, axles, handspikes, and sights. Sampson & Pae also provided the Richmond Armory with gunsmith tools which were necessary for the manufacture and repair of shoulder arms. Furthermore, the Richmond Arsenal supplied Sampson & Pae with wrought iron and Scotch pig iron. Gorgas believed this firm provided important support and once ordered the Richmond Armory to send them a large piece of belting, which had broken on one of their machines.\(^{16}\)

The Tredegar Iron Works was the Confederacy's largest foundry and a major incentive for defending Richmond. Gorgas's diplomacy was tested supervising Tredegar's ordnance production whose owner (Joseph R. Anderson)


graduated from West Point, served in the Engineer Corps, and had twenty years of ordnance production experience. Anderson also had powerful political connections within the Virginia and Confederate governments. In 1861 Anderson received a brigadier general's commission and later fought in the Seven Days Campaign. Tredegar, however, required his leadership and Anderson resigned his commission. Despite Anderson's military and political leverage, Gorgas maintained his authority over the civilian contractor.

The Confederate government sold iron to Tredegar at cost, and Anderson complained that other iron works received advances for pig iron purchases. Gorgas replied that Anderson was in no position to dictate the financial operations of the War Department. Tredegar had also failed to produce the fifteen-inch cannons in their contract. Tredegar's prominent status, however, caused consternation

17Dew, 7-8, 95, 150-1; John F. Tanner to Leroy P. Walker, February 20, 1861, LRCSW, roll 1.

18In the late 1850s, Anderson rejected the Rodman plan for casting heavy artillery. Captain Thomas Jackson Rodman, U.S. Ordnance Department developed a method of casting heavy artillery around a hollow tube. Cool water was poured into the hollow tube, while hot coals were packed around the foundry mold. This process allowed the cannon to cool from the interior to the exterior, which created less stress on the gun. Tredegar and other foundries cast cannons into a solid mass, allowed them to cool, and then bored them out. This made the cannon cool from the exterior to the interior. The Rodman plan proved faster and produced safer large caliber cannons. Anderson, however, believed this method unsafe and resisted the U.S. War Department's insistence Tredegar adopt the Rodman plan. This later denied the Confederacy parity in heavy artillery. Tredegar never cast a cannon larger than twelve-inches and the Union Army mounted a fifteen-inch Rodman in their Washington defenses. See Dew, 44-49.
among other iron works. F. B. Deane, Jr. & Son of Lynchburg produced artillery projectiles for the War and Navy Departments and wanted their contract readjusted once the company learned Tredegar received higher prices. Gorgas agreed with F. B. Deane, Jr. & Son's request for similar prices, but refused to readjust past payments. He believed this a prudent measure against claims from other government contractors. Gorgas argued the Ordnance Bureau's contracts were determined by other factors than material prices, the size of the order and the time period of the contract.¹⁹

Tredegar's Foundry cast field, siege, and coastal artillery for the Confederacy's numerous field commands, inland fortifications, and coastal defenses. Tredegar also produced artillery projectiles, implements, and carriages. Moreover, Tredegar's Rolling Mill produced various sizes of iron bars and rail spikes. Southern railroad companies needed these vital products for replacing and repairing damaged rail lines.²⁰ In order to complete government contracts, Anderson expanded Tredegar's physical plant with a new gun foundry and other shops. The War Department loaned Anderson money for Tredegar's expansion, which needed

¹⁹"J. R. Anderson & Co., to the Secretaries of War and Navy, October 13, 1863, LRCSW, roll 80; Josiah Gorgas to James A. Seddon, October 22, 1863, ibid., roll 80; J. Gorgas to G. W. Randolph, October 1, 1862, ibid., roll 49; F. B. Deane, Jr. & Son to R. G. Kean, Chief of the Bureau of War, November 4, 1862, ibid., roll 49; Kean to Randolph, November 8, 1862, ibid., roll 49.

²⁰"J. R. Anderson & Company," Confederate Business Papers, roll 18; Foundry Records, TCR; Rolling Mill Sales, TCR.
Gorgas's approval.

The Shockoe Foundry, operated by Talbott & Brothers, also supplied the Confederacy with war materials. From 1861 to 1862, the Shockoe Foundry produced 1 table saw, 5 steam engines, 2 cap machines, 12 cap boards, 12 brass bullet molds, and 1 friction tube mold. The Richmond Laboratory received cap machines, cap boards, bullet molds, and friction tube molds, which were needed for ammunition production. Talbott & Brothers also manufactured fifty gun carriages and five steam engines. Moreover, Gorgas wrote Secretary of War Leroy Pope Walker for this company's proposal for constructing a steam cannon. The U.S. Army captured a Confederate Winans steam cannon in May 1861, but this type of cannon never went beyond the experimental stage and no evidence exists that Talbott & Brothers ever produced one.  

In the spring of 1862, Talbott & Brothers leased the Shockoe Foundry to the Navy Department. The Shockoe Foundry provided the main component for the Richmond Naval Ordnance Works, which consisted of an ordnance store, a naval laboratory, and a gun carriage shop. In the summer of 1861, Talbott & Brothers leased property for the construction of the naval laboratory. The Richmond Naval Ordnance Works' foundry banded and rifled heavy artillery produced by Tredegar. This eased the burden on Tredegar's work force.

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21"Talbott & Brothers," Confederate Business Papers, roll 1,004; J. Gorgas to L. P. Walker, July 2, 1861, LRCSW, roll 4.
The ordnance store also equipped naval artillery for service. In addition, the gun carriage shop equipped naval vessels and the Drewry's Bluff and Chaffin's Bluff batteries along the James River. Furthermore, the naval laboratory manufactured artillery projectiles, fuzes, friction primers, percussion cap primers, small arms cartridges, and loaded powder bags. Most importantly, the Richmond Naval Laboratory cooperated with Gorgas and traded ordnance supplies with the Richmond Laboratory.22

Similar to Old Dominion Iron & Nail, James Hunter & Company's Richmond Iron & Steel Works supplied the War and Navy Departments with rolled iron, nail rods, bar iron, and shoe iron. When the War Department needed a saw mill, Confederate officials approached the firm and Hunter gave them a $2,204 estimate for a twenty-horsepower engine with a fifty-four inch saw mill. Most importantly, the Richmond Armory received steel and iron gun parts from Richmond Iron & Steel.23


23"James Hunter & Son, Richmond Iron & Steel Works," Confederate Business Papers, roll 484; R. M. T. Hunter to J. P. Benjamin, October 17, 1862, LRCSW, roll 12.
The Confederacy also received aid from the Richmond iron businesses established after 1850. Ettenger & Edmond produced gun carriages, heavy artillery equipment, shot furnaces, and portable forges. In addition, the Eagle Machine Works provided soda cracker cutters, steam engines, battery wagons, caissons, travelling forges, barbette carriages, artillery projectiles, scrap iron, shovels, and blacksmith tools. Philip Rahm died before the war began and his son, A. J. Rahm, assumed business operations.24

Boyle, Gamble & Company was one example of Gorgas’s ability to regulate civilian contractors and settle disputes. The company invented a saber bayonet attachment and they started production of these bayonets on June 1, 1861. The patent for their invention arrived three months later. During these three months, two other companies pirated Boyle, Gamble, & Company’s invention and produced bayonets for the Ordnance Bureau. A legal battle ensued with Edward Boyle and Thomas Gamble seeking compensation for the unauthorized use of their invention. The District Court judge granted an injunction against the further unauthorized production of the bayonets, and the War Department’s legal council opposed this over the urgency of ordnance production. Subsequently, Gorgas met with Boyle and Gamble. Gorgas berated their lack of patriotism, and he informed them that the Ordnance Bureau planned to ignore the

injunction. Furthermore, Gorgas wanted this settled out of court, and he considered Boyle and Gamble were at fault for not first approaching the War Department over the matter.25

Despite the loss of their legal battle, Boyle, Gamble, & Company manufactured circular saws, swords, sabers, axes, bayonets, and curry combs for the Navy and War Departments.26 The inventors obviously had a legal claim with their patent, but the demand for ordnance supplies forced Gorgas’s draconian measures. As the war continued, Gorgas exerted a powerful influence over the civilian contractors.

In contrast to the Richmond foundries and machine shops, the Union Manufacturing Company produced sewing machines and needles. This company, originally named the Lester Manufacturing Company, was formed by Mr. Lester of Richmond and Mr. George Sloat of Philadelphia in September 1860. It was renamed the Union Manufacturing Company two months later. Once the war broke out, the company quickly expanded their enterprise into ordnance production. From August to November 1861, the Union Manufacturing Company altered 2,974 flintlock muskets to percussion cap. The Union Manufacturing Company also supplied sewing machines, needles, drill presses, tools, lathes, planers, gun parts,

25Andrew Johnston to Judah Benjamin, September 30, 1861, LRCSW, roll 3.

torpedo locks and anchors, and bayonets.27

Unlike the other Richmond ordnance contractors, Samuel C. Robinson was not involved in the iron business or another metal trade. Robinson operated a lumber mill. The Richmond Real Estate and Personal Property Tax Books for 1860 listed Robinson with land worth $5,342 and four slaves. The 1860 U.S. Census listed Robinson's lumber mill with $35,000 invested capital, 7 employees, and an annual production worth $45,000. During the war, Robinson capitalized on the Confederate cavalry's lack of effective firearms and built a factory for manufacturing the Sharps carbine. The Richmond Sharps was a fifty-two caliber breech-loading carbine, which proved inferior to the U.S. model and leaked gas from the breech. Robinson also manufactured percussion caps, rifled-musket parts, and building materials. Furthermore, Robinson's workers altered 3,272 flintlock muskets to percussion cap.28 Samuel C. Robinson & Company and the Union Manufacturing Company provided vital support in altering the flintlock muskets and their work was a source of friction between Dimmock and Gorgas.

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Beyond his work in Richmond, Gorgas combated national supply problems and standardized ordnance production. The Confederacy needed gunpowder and possessed four small powder works, which produced only enough for local demands. In July 1861, Gorgas selected George Washington Rains\textsuperscript{29} for managing Confederate gunpowder production. In addition, the Confederate Army had several models of shoulder arms and this complicated the manufacture of small arms cartridges. Gorgas wanted the Confederate laboratories centralized and ammunition production standardized. In May 1862, John W. Mallet\textsuperscript{30} was named the Superintendent of the Confederate States Laboratories. Confederate small arms production needed experienced guidance and Gorgas appointed Dimmock's former subordinate, James Burton, as the Superintendent of Armories on September 2, 1861. Furthermore, Confederate gunpowder production needed niter, charcoal, and sulphur. In May 1862, Gorgas placed Major Isaac St. John, a former engineer officer, in charge of the Niter Corps.\textsuperscript{31}

\begin{quote}
\textsuperscript{29}Rains graduated from West Point in 1842, fought with the U.S. Fourth Artillery in the Mexican War, and became the president of the Washington Iron Works at Newburgh, New York in 1856. He proved one of Gorgas' most capable subordinates. See Savas, "The Life Blood of the Confederate War Machine," 89.
\end{quote}

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\textsuperscript{30}Mallet was a British chemist educated in Ireland and Germany who formerly worked for the Alabama geological survey. At the outbreak of the war, Mallet served as an aide-de-camp for Brigadier General Robert Rodes. See Vandiver, \textit{Ploughshares Into Swords}, 113.
\end{quote}

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\textsuperscript{31}Gorgas, 75-76, 87; George Washington Rains, \textit{History of the Confederate Powder Works} (Augusta, GA: Chronicle and Constitutionalists Printers, 1882), 3-4; Marion D. Smith, "Confederate Saltpeter Mining in Northern Alabama," \textit{Alabama}
Despite his efforts at stimulating domestic production, Gorgas still relied on foreign military supplies. Foreign ordnance supplies were extremely critical to the Confederacy's survival in 1861 and 1862. Gorgas sent Major Caleb Huse to Great Britain. Huse purchased European ordnance and quartermaster supplies, which were mainly shipped to Bermuda or Nassau. Then blockade runners left these neutral ports for Charleston, South Carolina or Wilmington, North Carolina. A rail line linked Wilmington and Richmond. During the critical winter of 1861-1862, Gorgas received fifteen thousand small arms from Huse which made up for the lack of domestic production.32

By the end of 1861, Gorgas established ordnance facilities in Richmond, gained control of the Richmond Armory and the Harper's Ferry machinery, and asserted his authority over the Virginia Ordnance Department. Richmond became the center of Gorgas's larger domestic ordnance infrastructure. In response to the ordnance shortages of 1861, Gorgas established temporary arsenals and depots throughout the Confederacy. By December 1861, Gorgas had eight arsenals and four depots which manufactured and

Historical Quarterly 42 (1980): 72; Savas, 87-88; Mallet, "Works of the Confederate Ordnance Bureau," 5, 7-8, 10; Vandiver, Ploughshares Into Swords, 79, 106; Goff, Confederate Supply, 31.

32Vandiver, Ploughshares Into Swords, 86.
shipped ordnance supplies.\textsuperscript{33} The Southern railroad system was not centralized and forced the widespread establishment of ordnance facilities for supplying the numerous Confederate field commands.\textsuperscript{34} Gorgas achieved the mobilization of Confederate resources, centralization of the Ordnance Bureau's authority, and standardization of ordnance production within the chaotic first year of the war.

\textsuperscript{33}Gorgas established arsenals and depots in Augusta, Georgia; Charleston, South Carolina; Fayetteville, North Carolina; Richmond, Virginia; Savannah, Georgia; Nashville, Tennessee; Mount Vernon, Alabama; Baton Rouge, Louisiana; Montgomery, Alabama; Little Rock, Arkansas; and San Antonio, Texas. See Gorgas, 74.

\textsuperscript{34}Vandiver, \textit{Ploughshares Into Swords}, 61; Gorgas, 74.
CHAPTER 3
FULL MOBILIZATION OF THE ORDNANCE BUREAU

In 1863 the Ordnance Bureau reached full mobilization and survived the military reverses at Gettysburg, Vicksburg, and Port Hudson that cost the Confederacy 70,000 small arms, 223 cannons, and large stores of ammunition. In human terms these military disasters cost the Confederacy 50,000 soldiers.¹ This strained Gorgas's supply system, but his domestic and foreign ordnance sources kept the Confederate Army in the field. Richmond continued manufacturing artillery, small arms, ammunition, and ordnance equipment that prolonged the war another two years. Gorgas also battled conscription of skilled labor, raw material and food shortages, and transportation problems that hindered ordnance production. These problems were interconnected and worsened by the lack of Confederate governmental leadership.

The Richmond ordnance industry depended on Northern and foreign skilled labor and lacked a skilled native white labor force. As battlefield casualties mounted, Gorgas fought constantly against the conscription of skilled craftsmen. In a letter to Jefferson Davis in March 1862, 

¹Vandiver, Ploughshares Into Swords, 196; idem, ed., The Civil War Diary of General Josiah Gorgas (University, AL: University of Alabama Press, 1947), 55; (hereafter cited as Gorgas Diary).
Secretary of War Judah Benjamin explained that labor shortages hindered arms production and rightly observed Southern farmers were not made into gunsmiths in a week. Consequently, the supply bureaus and private industry fought over a decreasing number of skilled workers.

Both Josiah Gorgas and Joseph R. Anderson lost valuable production time with their workers conscripted into the Confederate Army or the Richmond home guard. The Peninsula Campaign in 1862 and later Union cavalry raids necessitated the formation of home guard battalions: the Sixth (Tredegar) Battalion Virginia Infantry, Local Defense Troops consisted of three companies; the First Battalion Virginia Infantry, Local Defense Troops consisted of six companies from the Richmond Armory and the C.S. Carbine Factory; the Fifth Battalion Virginia Infantry, Local Defense Troops consisted of six companies from the Richmond Arsenal.

Despite early patriotic enthusiasm, government and industrial workers soon grew tired of home guard duty. By 1864, Tredegar's production dropped with the battalion frequently on active duty. Desertion rates were high among the foreign iron workers. Although exempt from Confederate service, Governor William Smith in 1864 drafted Tredegar employees into the militia. With Gorgas's persuasion, the War Department released the Tredegar Battalion from active service.

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2Judah Benjamin to Jefferson Davis, March 12, 1862, OR, series IV, vol. 1: 988.

3Bruce, 345; Dew, 94-95; Wallace, 179-80, 184.
duty. In March 1865, however, the battalion was again recalled and the mechanics continually deserted. Gorgas also lost valuable production time and irreplaceable skilled workers. During Dahlgren’s Raid in March 1864, the Armory Battalion was mobilized and suffered eight casualties. John Jones, a master barrel-straightener, was killed and consequently production dropped 360 rifles a month. Gorgas complained these valuable craftsmen needed exemption from field service and the frequent false alarms disrupted their work.\(^4\)

In September 24, 1864, the War Department ordered that the Armory and Arsenal Battalions were subject only to their direction or the Department General. The workers were also to be released at the earliest possible time from the battlefield. This never settled the matter, and William N. Smith wrote Gorgas in January 1865 that two experienced workers deserted the Richmond Laboratory over local defense service.\(^5\)

Beyond conscription, Gorgas faced wage competition for the South’s few skilled laborers. In December 1861, Gorgas wrote Secretary of War Benjamin complaining that the

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\(^4\)Bruce, 397-99; Dew, 245-48; Vandiver, Ploughshares Into Swords, 161, 235; Josiah Gorgas to James A. Seddon, March 9, 1864, LRCSW, roll 127.

\(^5\)United States, War Department, Special Order No. 228, September 24, 1864, Letters Received by the Confederate Adjutant and Inspector General, M474, roll 134, War Department Collection of Confederate Records, RG 109; (hereafter cited as LRCAIG with roll number); William N. Smith to Josiah Gorgas, January 15, 1865, LRCSW, roll 151.
Virginia Ordnance Department offered higher wages to a Richmond Armory employee, and he rightly argued this labor competition was counterproductive. Despite the frequent transfer of ordnance supplies, the Richmond Naval Ordnance Works was also a competitor for skilled workers, and Lieutenant Colonel William LeRoy Broun increased the Richmond Arsenal's pay rate to match the higher wages paid by the Navy Department. In 1863 the Selma Foundry in Alabama, operated by the Navy Department, began casting heavy artillery and lured government and private industrial workers away from Richmond with higher wages.6

In order to obtain skilled mechanics, Gorgas frequently requested the War Department detail soldiers with special qualifications. These detailed men were placed in government or private establishments. Although the majority of detailed men were glad to leave the army, Gorgas still had problems with desertion and dissatisfaction among these men.7 In August 1862, Major William S. Downer reported that

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6J. Gorgas to J. P. Benjamin, December 15, 1861, ibid., roll, 18; W. LeRoy Broun to J. Gorgas, March 31, 1863, ibid., roll 120; Josiah Gorgas to James A. Seddon, January 15, 1864, ibid., roll 127.

7Gorgas also contended with dishonest men who lied about their work status when contracting with his subordinates. One worker, Mr. Stephens, from the Clarksville Harness Shop deserted and formed a partnership with a Mr. Alcott. Subsequently, Stephens & Alcott received a contract for manufacturing halters. Major Smith Stansbury learned that Stephens was a conscript and had been detailed to the Clarksville Harness Shop. The prices of the halters were also found to be exceedingly high. Stansbury canceled the contract and forced Stephens to either return to the army or Clarksville. Mr. Alcott protested Stansbury’s actions. Gorgas stated the firm violated ethical business
several detailed men left the Richmond Armory and the
workers believed they were outside of military jurisdiction.
Gorgas ordered these men classified as deserters and
returned to the army. Sergeant Paul Harris, a former
machinist, was detailed to the Richmond Armory. Unsatisfied
with his position, Harris wanted to return to the Second
North Carolina Infantry and Master Armorer Adams rated his
work marginal. Gorgas arranged for Harris’s return to the
army. As casualties mounted, Gorgas found it almost
impossible to receive detailed soldiers from the War
Department.

Besides detailed workers, Gorgas recruited British
workers for the Ordnance Bureau. The Confederacy arranged
their transatlantic voyage. The British workers were paid
over £4 in gold per week, which angered Southern workers
whose wages were affected by inflation. In addition, the
British workers refused Gorgas’s offer of half specie and
half currency wages. Consequently, the Confederacy paid for
their return voyage. Gorgas lost £2,000 in gold and still
had a shortage of skilled mechanics.

practices and Stephens (as a detailed man) was unable to
contract with the War Department. See Smith Stansbury to
Stephens & Alcott, August 28, 1862, LRCSW, roll 30;
Stansbury to Gorgas, September 27, 1862, ibid., roll 30; W.
S. Downer to J. Gorgas, September 26, 1862, ibid., roll 30.

W. S. Downer to J. Gorgas, August 22, 1862, ibid.,
roll 43; James Burton to Josiah Gorgas, April 25, 1862,
LRCAIG, roll 38.

Vandiver, Ploughshares Into Swords, 167-68; Edward
Smith to W. S. Downer, May 18, 1863, Compiled Service
Records, roll 78.
To offset the shortage of white labor, the Confederacy mobilized black labor. Gorgas used black teamsters for hauling ordnance supplies to the Army of Northern Virginia and unloading stores at the Richmond Arsenal. After major battles near Richmond, ordnance officers had blacks collect and clean discarded weapons. Furthermore, the Confederate government and private industry used black skilled labor. The Ordnance Bureau employed black coopers for making powder kegs and wheelwrights for repairing wagons. Captain John Kane of the Clarksville Harness Shop had free black carpenters, blacksmiths, and mechanics. In addition, the Niter & Mining Bureau employed black miners and furnacemen. Tredegar had black foundrymen, puddlers, and bricklayers; the company also used black workers at the company coal mines and blast furnaces.\(^\text{10}\)

Gorgas also used white female laborers in the Confederate Laboratories. Due to the shortages of male workers, the Richmond Laboratory used female workers for manufacturing percussion caps, friction primers, small arms cartridges, and powder bags. These were generally young women from poor families whose male family members were serving in the military. From March 1863 to April 1865, the Richmond Laboratory employed on average 250 women. They were under the direction of a male supervisor. The skilled

female workers earned nearly $3.00 per day while unskilled
female workers earned about $1.50 per day.\footnote{11}

On October 20, 1864, Gorgas's labor problems reached a
climax when the War Department ordered one-fifth of the
Ordnance Bureau's work force into the field. Despite his
arguments, the Confederate Army was seriously short of
soldiers and needed reinforcements against the numerically
superior Union Army. The Richmond Arsenal provided 226 men
and the Richmond Armory provided 31 men for the defense of
Petersburg and Richmond. The Ordnance Bureau sent a total
of 713 men to the army and retained 2,642 men.\footnote{12}

Despite Gorgas's efforts, there was no possible
solution for the loss of Northern skilled labor. Black
laborers and white apprentices lacked the experience of the
Northern mechanics. The Confederacy possessed few skilled
workers and wartime reduced the available manpower reserves.
Despite Gorgas's arguments to the President and the War
Department, the Ordnance Bureau competed with the
Confederate Navy, state ordnance departments, and private
industry for skilled labor. Due to Tredegar's importance,
Anderson requested skilled workers directly from the War
Department. Both Gorgas and Anderson contended with the
Confederate Army's reluctance to release men of military age

\footnote{11}"Timebook, Richmond Arsenal, January 1863-April 1865,"

\footnote{12}General Orders No. 82, Adjutant and Inspector General
S. Cooper, October 20, 1864, \textit{OR}, series IV, vol. 3: 741; J.
Gorgas to S. Cooper, November 16, 1864, LRCAIG, roll 134.
Despite their mechanical skills.  

Richmond's ordnance production was also effected by raw material shortages, which transportation problems worsened. Tredegar's foundry and rolling mill never received one-third of their potential coal and iron consumption. The Civil War cut off Northern supplies of pig iron and anthracite coal. Anderson contracted for Tennessee and Georgia pig iron, but high transportation costs prohibited their usage. In 1861 Tredegar used fifteen thousand tons of iron, and Anderson sought governmental assistance for revitalizing Virginia's iron furnaces. With governmental loans, Anderson purchased eight iron furnaces, two coal mines, and leased four iron furnaces. Furthermore, Anderson convinced other furnace owners, driven out by Northern competition in the 1850s, that their iron furnaces were needed by the Confederacy. In addition, Gorgas's subordinate, Isaac St. John, supervised the operation of at least thirty iron furnaces in the Confederacy.  

Despite the revitalization of Southern iron furnaces, labor, food, and transportation shortages limited iron production. The iron furnaces needed experienced operators.

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and many furnacemen were already in the army. Gorgas and Anderson convinced the War Department to detail experienced furnacemen and hire black laborers. Moreover, the iron furnaces were located in remote areas with poor roads and this limited the shipment of food for the furnacemen and transportation of the iron ore. Tredegar’s physical plants had the capacity for the consumption of twenty thousand tons of iron per year and never received eight thousand tons per year. Tredegar received excess government iron at cost, but the Niter & Mining Bureau supported other Richmond and Southern foundries.¹⁵ Tredegar’s artillery production was limited by raw material shortages, and this was one cause of the army’s shortages of heavy and light artillery.

Beyond labor and raw material shortages, Gorgas contended with inflation driving food prices beyond his employees’ wages.¹⁶ The Confederacy suffered severe food shortages with the Commissary Department’s impressment of staple crops and livestock. Consequently, farmers hoarded their crops and soldiers suffered in regions that still contained ample food supplies. By the spring of 1864, Richmond’s food sources were exhausted from three years of


¹⁶ John B. Jones related that in 1860 ten pounds of bacon cost $1.25 and three years later the same amount cost $10.00. In 1863 Gorgas recorded in his diary that beef sold $1.25 per pound and that most laborers only earned $2.50 per day. See John B. Jones, vol. 1, A Rebel War Clerk’s Diary: At the Confederate States Capital (Philadelphia: J. B. Lippincott and Company, 1866), 128, 240, 284; Vandiver, Gorgas Diary, 29, 68.
In February 1864, Major W. S. Downer wrote President Davis requesting assistance in feeding the Richmond Armory’s employees and their families. The cost of flour was beyond their wages. Downer wanted flour and meal sold to the Armory’s employees at government prices. By the winter of 1864-1865, Gorgas set up stores at ordnance installations for employees to purchase food and clothing at reduced prices.\(^{17}\)

The Confederacy’s decaying railroads restricted Gorgas’s collection and distribution of ordnance supplies. Southern railroads lacked the locomotives and rolling stock for transporting vital army supplies and essential raw materials. The Confederate railroad system became overextended by the war’s first winter. Tredegar concentrated on ordnance contracts, which reduced its rail iron production. Anderson only supported the railroads that hauled company supplies; this did not always correspond with the Confederate supply line. In response, Gorgas decentralized the ordnance network in 1863 and directed that the field armies receive supplies from the closest arsenal or depot. Although this relieved some problems, Gorgas still faced the crumbling of the railroads supplying these ordnance facilities. In November 1864, Staunton, Virginia saddlemakers Castelman & Allerwough wrote Captain James

\(^{17}\)Goff, 250; Thomas, Confederate State of Richmond, 119-20; Major W. S. Downer to Jefferson Davis, February 25, 1864, LRCSW, roll 125; Broun, "The Red Artillery," 373; Vandiver, Ploughshares Into Swords, 209.
Dinwiddie of the Richmond Ordnance Depot that saddles needed by General Lee had not been delivered due to a lack of railroad transportation. While stockpiles of equipment lay in depots, the Confederate Army suffered shortages due to the transportation system. The Confederate government never adequately regulated the railroad system.

Despite supply shortages, Gorgas's ordnance network performed admirably, and Richmond remained the center of his domestic ordnance infrastructure. The Richmond Armory, the Confederacy's largest rifled-musket producer, manufactured 1,000 to 1,500 rifled muskets per month. Moreover, the Richmond Armory repaired firearms and cut down damaged rifled muskets for cavalry carbines. In October 1863, the Master Armorer Soloman Adams listed an annual production of 15,204 rifled muskets and carbines. Confederate firearms expert William Albaugh believed the Richmond Armory, from September 1861 to January 1864, produced 39,582 rifled muskets and carbines.

The Richmond Laboratory on Brown's Island manufactured small arms cartridges, artillery projectiles, friction primers, percussion caps, and other explosives. The Richmond Laboratory was the Confederacy's highest producing

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18Goff, 39, 107-8, 242; Dew, 272; Castelman & Allerwough to James Dinwiddie, November 22, 1864, Ordnance Bureau Records, vol. 93: 127; Vandiver, Ploughshares Into Swords, 179.

ordnance laboratory with a daily production capacity of 100,000 small arms cartridges and 900 artillery projectiles. The Richmond Laboratory supplied the majority of the Richmond Arsenal's small arms cartridges and supplied other Confederate arsenals. The Laboratory building contained five rooms and numerous dependencies. Percussion cap and friction primer production was located in one room, cartridge production was divided into three rooms, and powder bag production was located in another room. The Richmond Laboratory suffered only one explosion, which killed thirty-four and wounded twenty-nine.22 Except for

20 The Baton Rouge Arsenal produced 40,000 small arms cartridges per day, the Augusta Arsenal produced 30,000 small arms cartridges per day, the Charleston Arsenal produced 20,000 small arms cartridges per day, and the Mount Vernon Arsenal produced 15,000 small arms cartridges per day. See Josiah Gorgas to Judah Benjamin, September 24, 1861, OR, series IV, vol. 1: 622.


22 On Friday, March 13, 1863, one of the Laboratory's cartridge rooms exploded. The explosion destroyed fifty feet of the room, blew out the walls, and collapsed the roof. The explosion resulted from the improper handling of a friction primer by a young Irish girl, Mary Ryan. Ryan struck a primer board against a table to dislodge a varnished friction primer and this created a spark that ignited cartridges in the room. The resulting explosion killed thirty-two females and two males, and wounded twenty-four females and five males. Amelia Gorgas nursed the wounded, many who were horribly burned. The Richmond Naval Laboratory also suffered from careless workers. In November 1864, a detailed worker placed a hot coal near an artillery shell's fuze plug. The worker wanted to view the shell's interior, but the coal ignited the powder. The shell exploded showering the room with fragments, but the worker escaped injury except for minor burns. See Richmond Whig, March 14, 1863; David L. Burton, "Richmond's Great Home Front Disaster: Friday the 13th," Civil War Times Illustrated 21 (October 1982): 40; Richmond Whig, March 16,
this accident, the Laboratory operated safely throughout the war.

The Shockoe Foundry (Talbott & Brothers), rented by the Confederate Navy, also produced ammunition. During the war, the Richmond Naval Laboratory issued 26,193 artillery projectiles, 82,017 friction primers, 29,358 fuzes, 28,900 percussion caps, 32,660 small arms cartridges, and 475 powder kegs. The Navy Department also cooperated with the War Department and the Richmond Naval Laboratory sent ordnance supplies to the Richmond Laboratory. During the war, Gorgas received 2,228 artillery projectiles, 19,094 fuzes, 150 percussion caps, 47,765 friction primers, and 48 powder bags from the Richmond Naval Laboratory.\textsuperscript{23}

From July 1861 to January 1865, the Richmond Arsenal issued 1,647 cannons, 1,375 gun carriages, 875 caissons, 921,441 artillery projectiles, 323,231 infantry arms and 34,067 cavalry arms. The Richmond Arsenal was one of the Confederacy's largest ordnance facilities and also received captured ordnance supplies for repair or distribution. The battles that raged across Virginia supplied all types of ordnance supplies. Confederate ordnance officers gleaned firearms, equipment, and cannons left on the battlefield. After the Seven Days Campaign in 1862, the Richmond Arsenal received 20 cannons and 31,000 small arms. Moreover, the Confederates captured 9,091 small arms and 255,000 small

\textsuperscript{1863; Richmond Examiner, November 21, 1864.}

\textsuperscript{23}Naval Laboratory Day Book.
arms cartridges at the Battle of Fredericksburg in December 1862. After the Battle of Chancellorsville in May 1863, the Confederates captured 13 cannons, 19,500 small arms and 300,000 small arms cartridges.24 These weapons were repaired, cleaned, and issued to Confederate units. Captured or repaired small arms made up a substantial percentage of the Richmond Arsenal’s issues.

The Ordnance Bureau also received much needed ordnance supplies and war materials from Richmond’s private sector. From April 1861 to October 1864, Old Dominion Iron & Nail produced 13,114 kegs of nails and 119 kegs of tacks and spikes. The Quartermaster Department, the Ordnance Bureau, the Engineer Bureau, the Niter & Mining Bureau, and the Navy Department purchased Old Dominion’s nails. Nails were essential for basic construction projects and manufacturing packing boxes. In addition, the company produced 12,490 pounds of shoe nails and tacks. The Army of Northern Virginia had 100,000 horses that needed shoe nails. Old Dominion Iron & Nail also produced 90,869 pounds of plate iron, shovel iron, and sheet iron. A. J. Rahm’s Eagle Machine Works received shovel iron and plate iron from Old Dominion Iron & Nail. In 1864, the Richmond Arsenal bought 24,903 pounds of rolled copper from Old Dominion Iron & Nail.

for manufacturing percussion caps.\textsuperscript{25}

Sampson & Pae's Richmond Foundry also produced a variety of ordnance and tools. From 1861 to 1863, this company manufactured at least 51,927 artillery projectiles, 334 elevating screws, gun carriage axles, handspikes, and artillery sights. In addition, Sampson & Pae provided the Richmond Armory with gunsmith tools (vent punches, tan hooks, and pole yokes). Unfortunately, the National Archives contained incomplete accounts of this company and it undoubtedly produced more artillery projectiles and equipment until April 1865. This company's importance was underscored by the request of Captain George Minor, Chief of the Naval Ordnance and Hydrography Department, that Gorgas assist the release of this firm's employees from militia duty. The Navy had ordered artillery projectiles and machinery for two powder mills from Sampson & Pae.\textsuperscript{26}

The Tredegar Iron Works provided the Confederacy with cannons, gun carriages, artillery projectiles, and a variety of iron products. The Army of Northern Virginia depended heavily on Tredegar for field artillery. During the 1862 campaigns, the Confederate artillery was seriously outnumbered by the Union artillery. Moreover, the Army of


Northern Virginia contained at least eleven types of cannons and this complicated the supply of ammunition. In December 1862, General Robert E. Lee wanted the six-pound smoothbores and twelve-pound howitzers recast into twelve-pound Napoleons. The Union twelve-pound Napoleon had a greater range and firepower than the Confederate six-pound smoothbore. In the summer of 1862, the Army of Northern Virginia's artillery numbered 271 guns, but there were only 36 Napoleons.

Consequently, Gorgas arranged for the transfer of the six-pound smoothbores and twelve-pound howitzers. The inferior cannons were removed gradually and Tredegar, by the

27After the Seven Days Campaign in 1862, the Army of Northern Virginia's artillery consisted of twenty-pound Parrott rifles, ten-pound Parrott rifles, three-inch rifles, twenty-four pound howitzers, twelve-pound howitzers, twelve-pound Napoleon smoothbores, six-pound smoothbores, twelve-pound Blakely rifles, Hotchkiss rifles, twelve-pound Whitworth rifles, and twelve-pound James rifles. These eleven types of cannons varied in accuracy and quality. See Artillery in the Army of Northern Virginia in the summer of 1862, at Sharpsburg, and etc., OR, series I, vol. 19, part I: 836-37.

28With its light weight and versatility, the bronze twelve-pound Napoleon smoothbore was the most popular field piece of the Civil War. The Napoleon fired solid shot, shell, and canister, and trained gunners fired two aimed shots or four canister a minute. The Napoleon had a maximum range of two thousand yards with shot or shell and at closer ranges canister spread a deadly pattern of musket balls. This destructive firepower combined with rifled muskets decimated attacking enemy columns. See Douglas Welsh, The Civil War (New York: Galahad Books, 1982), 60.

spring of 1863, cast fifty twelve-pound Napoleons. This strengthened Lee's field artillery and simplified ammunition distribution. During the Battle of Chancellorsville in May 1863, Lee's artillery performed superbly and poured enfilade fire down the Union lines.  

On May 15, 1863, Tredegar suffered a serious setback that affected artillery production. The Crenshaw Woolen Factory, situated near the iron works, caught on fire and ignited several Tredegar shops. The fire destroyed the locomotive shops, the pattern shop, a boiler shop, the boring shop, two older foundries, and scores of valuable tools and machinery. The new gun mill and the fifteen-inch Columbiad boring pattern were the most serious losses. Anderson was fortunate the blacksmith shop, a boiler shop, the rolling mills, the new gun foundry, and the ammunition foundries survived the destructive blaze. The fire disrupted Tredegar's production of ten-pound and twenty-pound Parrott rifles for the Army of Northern Virginia, and Anderson concentrated his efforts on repairing the damage. Tredegar's twelve-pound Napoleons performed well in the dense undergrowth at Chancellorsville, but Lee needed more long-range artillery. The third day at Gettysburg proved the inadequacies of the Confederate artillery, which lacked the long-range firepower necessary to force the Union artillery off Cemetery Ridge. Consequently, the Union

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30J. Gorgas to the Secretary of War, December 10, 1862, ibid, series I, vol. 21: 1047; Foundry Records, TCR; Dew, 190-91.
artillery halted Pickett’s Charge with canister fire at point-blank range.\textsuperscript{31}

Besides field artillery, Tredegar produced coastal artillery for the Charleston and Wilmington defenses and heavy artillery for the Richmond defenses. Tredegar manufactured more cannons and artillery projectiles than any other Southern iron works. The Tredegar Company Records listed a total of 1,186 cannons cast by the foundry and 363,163 artillery projectiles produced by the rolling mill. Charles D. Dew in \textit{Ironmaker to the Confederacy} counted 1,099 cannons delivered to the War and Navy Departments.\textsuperscript{32}

Despite the Tredegar Iron Works’ concentration on ordnance production, the company produced rolled iron and bar iron. From January 1862 to December 1863, Tredegar rolled at least 14,925 iron bars for railroad repair and military construction. The Quartermaster Department, the Ordnance Bureau, the Niter & Mining Bureau, and the Navy Department purchased Tredegar bar iron. The Richmond Armory and Arsenal received Tredegar rolled iron and bar iron, which was needed for the manufacture and repair of small arms. In addition, Tredegar sold Sampson & Pae 235 iron bars for their government contract work.\textsuperscript{33}

Similarly, James Hunter’s Richmond Iron & Steel Works

\textsuperscript{31}\textit{Richmond Examiner}, May 16, 1863; Dew, 193-96.

\textsuperscript{32}Gorgas, 81; Foundry Records, TCR; Rolling Mill Sales, TCR; Dew, 290.

produced rolled iron for the Confederacy. Once raw material shortages began, the Confederacy sold this company 233,269 pounds of scrap iron. From December 1861 to October 25, 1864, Richmond Iron & Steel produced 689,934 pounds of rolled iron, nail rods, and bar iron for the Quartermaster Department, the Ordnance Bureau, the Niter & Mining Bureau, and the Navy Department. In addition, Richmond Iron & Steel manufactured 218,432 steel and iron gun parts (hammers, triggers, screws, etc.) for the Richmond Armory and the C.S. Carbine Factory. The Armory and Carbine Factory also received from this company rolled iron and steel for rifle and carbine barrels. With Gorgas’s assistance, Richmond Iron & Steel received nine detailed mechanics, and Gorgas later approved the detailed men’s continued employment with the company.34

The records exist only to 1863 for Ettenger & Edmond whose machine shop built the first locomotive in Richmond. From 1861 to 1863, Ettenger & Edmond manufactured at least 249 heavy artillery carriages, 12 caissons, 9 portable forges, 6 shot furnaces, and numerous sponge staffs. The artillery carriages were important for the James River naval batteries and Richmond’s heavy artillery emplacements. The shot furnaces heated hot shot, which was fired at a velocity to lodge into an enemy vessels timbers and ignite the

surrounding wood. Although dwarfed in comparison to Tredegar, this machine shop produced valuable artillery equipment for the Richmond Arsenal.

A. J. Rahm's Eagle Machine Works also manufactured a variety of ordnance equipment. From 1861 to 1864, the Eagle Machine Works produced 121,008 artillery projectiles, 73 gun carriages or caissons, and 31 portable forges. From existing records, the Eagle Machine Works was the second largest producer of artillery projectiles of the Richmond iron companies. Beyond artillery equipment, the Eagle Machine Works produced tools for the Engineer Bureau and the Niter & Mining Bureau. This company received iron from Old Dominion Iron & Nail and manufactured 56,820 shovels, 346 picks, and 100 mattocks. These tools proved invaluable for the construction of the Richmond and Petersburg defensive lines, which totaled over seventy miles.

Similarly, Boyle, Gamble, & Company provided the Confederacy with tools and ordnance. From 1861 to 1864, Boyle, Gamble, & Company produced 18 circular saws, 400 axes, 24 shoe hammers, 24 pairs of shoe pincers, 48 shoe knives, 24 awl handles, and 8,708 curry combs. The saws were used by the Engineer Bureau for cutting lumber for fortifications and building materials. The blacksmith tools were essential for the proper maintenance of the cavalry and


draft horses. The Richmond Arsenal also contracted with the company for ten thousand curry combs and five hundred axes in February 1863. Moreover, Boyle, Gamble & Company produced at least 377 rifled-artillery projectiles. Furthermore, Boyle, Gamble & Company manufactured fine edged weapons for the Ordnance Bureau. In the Confederate Business Papers, this company was paid for 732 sabers and swords and 511 saber bayonets. Realizing the company's importance, Gorgas fought for the renewal of the five detailed men who worked for the company, and he later kept Edward Boyle and Thomas Gamble from being drafted in October 1864.37

The Union Manufacturing Company also produced machinery and tools for the Ordnance Bureau. From 1861 to 1864, the Union Manufacturing Company produced 6 drill presses, 6 lathes, 2 plainers, 1 portable forge, 143 machined parts, 239 pikes, and 22,239 gun parts. The Richmond Armory used the machinery, machined parts (screws, bolts, etc.), and gun parts (hammers, triggers, etc.) for rifled-musket production. The Union Manufacturing Company also produced at least 372 rifled-artillery projectiles.38

Samuel C. Robinson also provided 12,748 steel and iron gun parts (hammers, triggers, barrel cones, etc.) for the


38"Union Manufacturing Company," Confederate Business Papers, roll 1,048.
Richmond ordnance facilities. Besides gun parts, Samuel C. Robinson & Company produced a copy of the fifty-two caliber Sharps carbine. From December 1862 to March 1863, the Confederate Business Papers listed Robinson manufacturing 896 Sharps carbines, but these are incomplete records. Before the Confederate government purchased his factory and machinery in 1863, Robinson manufactured at least 1,500 Sharps carbines. Gorgas moved Robinson's machinery to the Richmond Armory and established the C.S. Carbine Factory. The C.S. Carbine Factory then produced an estimated 3500 Sharps carbines. Later in the war, the C.S. Carbine Factory discontinued production of the Sharps carbine and manufactured muzzle-loading Enfield carbines.39

With Gorgas's assistance, Richmond also became the center for Confederate ordnance experimentation. The Tredegar Iron Works and the Union Manufacturing Company produced the first American torpedoes (underwater mines).40

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40Although used in earlier conflicts, the Civil War introduced the large-scale use of torpedoes (undersea mines) in naval warfare. The torpedo was an inexpensive weapon, and the Confederates employed various types of torpedoes. Naval scientists Matthew F. Maury developed a wooden drift torpedo, which exploded when struck by a ship's hull. Confederate engineers later invented a metal contact torpedo and a pile torpedo. The pile torpedo consisted of an underwater wooden framework with torpedoes projected near the surface for striking a ship's hull. In addition, Maury experimented with electrically-detoned torpedoes. The submarine batteries (electric torpedoes) were constructed of boiler iron, filled with gunpowder, and an insulated cable was connected to the land. When an enemy vessel passed over the submarine battery, the shore operator triggered the
In addition, Tredegar cast the powerful Brooke rifled naval cannon designed by Confederate Navy Lieutenant John M. Brooke. Tredegar also produced the war's first railroad-mounted cannon and machine gun.

The railroad-mounted cannon resulted from interservice cooperation between the Navy and War Departments. Before the Seven Days Campaign, General Lee requested on June 5, 1862, that Gorgas construct a railroad gun for the Richmond & York River Railroad. Lee believed a railroad gun was torpedo with a switch. Both the Tredegar Iron Works and the Union Manufacturing Company manufactured electric torpedo tanks, chains, and locks. Submarine batteries built at Richmond protected Southern ports and rivers. During the war, thirty-four Union ships were sunk or damaged by torpedoes. See Philip Van Doren Stern, The Confederate Navy: A Pictorial History (New York: Da Capo Press, 1992), 70, 182-83; Milton F. Perry, Infernal Machines: The Story of Confederate Submarine and Mine Warfare (Baton Rouge: Louisiana State University, 1965), 5-10, 13-18, 199-201; Viktor von Schelika, A Treatise on Coast Defense (London: E & F. N. Spon, 1868), 300; Dew, 122; Foundry Records, TCR; "Union Manufacturing Company," Confederate Business Papers, roll 1,048.

John Mercer Brooke was a twenty-year veteran of the U.S. Navy. Between 1862 and 1865, Tredegar cast at least sixty Brooke naval rifles. Brooke developed 6.4 inch, 7-inch, 8-inch, and 11-inch models. These cannons had a high muzzle velocity. During one test, a seven-inch Brooke naval rifle fired an iron bolt at a target 260 yard away and penetrated eight inches of iron and eighteen inches of wood. On April 7, 1863, Charleston shore batteries equipped with Brooke naval rifles heavily damaged the U.S monitor Keokuk, which sank the next morning. Brooke became the Chief of the Navy Ordnance and Hydrography Department in 1863 and remained at this post until April 1865. See George M. Brooke, Jr., John M. Brooke: Naval Scientists and Educator (Charlottesville: University Press of Virginia, 1980), 242, 262-64, 269-71; Dew, 278; Foundry Records, TCR; Charleston Mercury, April 11, 1863.

needed to disrupt the rail transportation of Union heavy artillery. Gorgas received the cooperation of the Naval Ordnance Chief Captain George Minor who controlled the armor plate. Minor selected Lieutenant Brooke for the project. Brooke mounted a thirty-two pound rifled cannon on a railroad car with sloping two-inch armor plate protecting the wooden superstructure. Tredegar rolled the armor plate and cast the cannon. The Richmond Naval Laboratory issued the railroad gun with two hundred rounds. By June 24, 1862, Brooke completed the railroad gun and Minor transferred it to the army. During the Battle of Savage Station on June 29, the railroad gun shelled advancing Union soldiers. The Union Army also used railroad guns. During the Petersburg Campaign in 1864, the Union Army shelled Confederate positions with a thirteen-inch mortar and a thirty-two pound cannon mounted on railroad cars.43

The machine gun was first introduced in the Civil War, and Gorgas fostered Confederate experimentation with machine guns. Several Northern inventors patented rapid-fire and volley guns, but the U.S. Ordnance Department never adopted

a machine gun until 1866. The Confederate Ordnance Bureau, however, welcomed any technological development. In September 1861, the first Williams machine gun was produced at the Tredegar Iron Works. Captain D. R. Williams invented a single-barreled machine gun that operated by a hand crank, which closed the breech and fired the weapon. The Williams machine gun fired a paper cartridge that a loader manually placed in the receiver with a percussion cap. This early machine gun fired twenty rounds a minute, but the breech jammed when it overheated. The Williams machine gun also used the gas produced by the fired cartridge to open the breech. On May 23, 1862, the Williams machine gun was first used at the Battle of Seven Pines. Tredegar produced twenty and Sampson & Pae produced four Williams machine guns. From December 1862 through January 1863, the Richmond Arsenal issued six Williams machine guns to field commands. They saw limited use throughout the Civil War. Josiah Gorgas also invented a machine gun with an eighteen-shot turret, which revolved and fired by a hand crank. Gorgas only

44The Billinghurst-Requa battery consisted of twenty-five barrels mounted horizontally on a carriage that fired simultaneously seven to ten times a minute. In addition, William Ager developed a hand-cranked machine gun, which fired 120 rounds a minute and was supplied with an extra barrel to prevent one barrel from overheating. In 1862, Dr. Richard Gatling solved this problem by developing a machine gun with six rotating barrels that fired at the six o'clock position and cooled the rest of their revolution. The Gatling gun fired 250 rounds a minute. See Hogg, 51-55; Sue Allen, "Dr. Regua's Gun," Civil War Times Illustrated 27 (February 1989): 30-33; Gary James, "The Search for the Ultimate Weapon," Civil War Times Illustrated 31 (January-February 1993): 49-54.
manufactured one model machine gun, and labor shortages prohibited the production of this intricate weapon.45

Richmond's ordnance industry was central to Confederate ordnance acquisition. In 1861 Gorgas had 150,000 U.S. and state shoulder arms for equipping the mustering state volunteers. Unfortunately, these arms varied in caliber and Gorgas took steps for the production of rifled muskets. By 1862, the Richmond Armory and the Fayetteville Armory had a combined monthly production of 1500 Enfield rifles. Josiah Gorgas reported to the War Department that the Confederacy manufactured 14,349 small arms in 1862. By 1863, the Confederacy produced 27,752 small arms and reached the highest production of the war. In 1864 labor shortages and supply problems worsened and domestic production dropped to 20,485 small arms. From December 1861 to December 1864, the Confederacy produced 62,586 small arms. The Richmond Armory produced an estimated 39,582 Enfield rifles and Robinson and the C.S. Carbine Factory produced an estimated 5,000 Sharps Carbines. Richmond's ordnance industry produced nearly 45,000 rifles and carbines, which accounted for nearly 75 percent of Confederate arms manufactures.46


Although Gorgas worked for self-sufficiency, the Confederacy still relied on foreign ordnance supplies. In three years, the Confederacy manufactured 62,586 small arms. Ordnance Bureau and private blockade runners, however, brought 600,000 small arms to the Confederacy. The Confederacy produced large stores of ammunition and was less dependent on foreign ammunition. At the peak of domestic production in 1863, the Confederate laboratories manufactured 36,531,966 small arms cartridges, 298,305 artillery projectiles, 288,526 friction primers, and 46,500,099 percussion caps. In 1863 the Confederacy imported 81,750 small arms cartridges, 352,440 artillery projectiles, 16,099 friction primers, and 472,500 percussion caps.47

The Richmond ordnance industry provided vital artillery, small arms, ammunition, and iron products. Although domestic production of small arms never equaled foreign importations, Gorgas’s ordnance installations produced enough powder and ammunition for the Confederate Army’s requirements. Brigadier General E. Porter Alexander believed the Confederate Army never lost a battle for the lack of ammunition. In fact, the Army of Northern Virginia


still contained ample quantities of ammunition when it surrendered at Appomattox.
CHAPTER 4
GORGAS'S LEADERSHIP OF THE ORDNANCE BUREAU

Although considered an able administrator and bureau chief by his contemporaries, Gorgas and the Ordnance Bureau received criticism from field and general officers. Throughout the war, the Confederate Army contended with inferior ordnance supplies against their better armed Union adversaries. Confederate artillery officers frequently complained about ammunition quality. In addition, Confederate cavalry officers also criticized the reliability of Samuel C. Robinson's Richmond Sharps. Gorgas defended the Ordnance Bureau's quality control, but conceded problems existed that were the result of inexperienced workers and raw material shortages. He also believed many accidents resulted from improper use of cannons or firearms. Gorgas, however, was ultimately responsible for ensuring the safety of ordnance supplies and frequent accidents resulted in morale problems.

The Confederate artillery was outnumbered by the Union artillery and hindered by unreliable ammunition. Brigadier General E. Porter Alexander commanded the Army of Northern Virginia's First Corps artillery and was considered the
Confederacy’s best artillery officer. In his Military Memoirs of a Confederate, Alexander praised Gorgas’s efforts at maintaining the army’s ammunition supply. Moreover, Alexander acknowledged the Confederate labor and raw material shortages. Although sympathetic to Gorgas’s problems, Alexander believed the Confederate artillery projectiles were inferior and the fuzes were unreliable. By the Petersburg Campaign in 1864, Porter considered the three-inch rifle shells dangerous and forbade their use over Confederate infantry.

Similar to Alexander, Captain Hypolite Oladowski, the Army of Tennessee’s Chief of Ordnance, complained that the three-inch shell’s flight was erratic and dangerous. In

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1In 1861 Alexander, a West Point graduate, was appointed the chief of ordnance for General Joseph Johnston’s army and served until after the Battle of Antietam in September 1862. Alexander was then given command of a First Corps artillery battalion and by May 1864 commanded the Corps artillery. His battalion helped stop the Union infantry’s advance on Marye’s Heights at the Battle of Fredericksburg in December 1862. In addition, General Lee relied on Alexander’s expert reconnaissance. At the Battle of Chancellorsville in May 1863, Alexander located the strategic position at Hazel Grove. Once the Confederates occupied Hazel Grove, Alexander’s artillery poured enfilade fire down the Union lines. During the climatic third day at Gettysburg, Alexander also coordinated the artillery barrage on Cemetery Ridge. Although offered command of the Army of Tennessee’s artillery, Alexander faithfully served General Lee until Appomattox. See Edward Porter Alexander, Military Memoirs of a Confederate (Bloomington: Indiana University Press, 1962), xix, 52, 302, 345-48, 415, 418-21; Report of Lieut. Col. E. P. Alexander, commanding Battalion Reserve Artillery, December 20, 1862, OR, series I, vol. 21: 577.

response, Captain Briscoe G. Baldwin, who commanded the Richmond Arsenal, explained that sabots were not used for these shells and the powder bags needed to be tied around the projectile’s base for better accuracy. In 1864, Superintendent of Laboratories John Mallet warned the Richmond Arsenal commander that improperly constructed brass cups attached at the three-inch rifle shell’s base became deformed and frequently jammed in the cannon’s muzzle. Artillery officers also formalized their suggestions and stated the improvements needed for their branch of service.

In June 1863, General Lee instituted an ordnance board, consisting of six veteran artillery officers and chaired by Alexander, for discussing changes needed in cannons and projectiles. The board adopted seven proposals: first, percussion shells and shrapnel were the only projectiles needed by the rifled cannons; second, alter the Field Manual’s ordnance distribution for the twelve-pound Napoleon and the twenty-four pound howitzer so that the ammunition chest contained more shrapnel; third, graduate the paper

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¹The twelve-pound Napoleon’s ammunition chest contained twelve rounds of shot, twelve rounds of shrapnel, four rounds of shell, and four rounds of canister. The twenty-four pound howitzer’s ammunition chest contained twelve rounds of shot, eight rounds of shrapnel, and three rounds of canister. Solid shot was best for long range and often bounced after impact disrupting advancing enemy units. Shrapnel or spherical-case shot was a hollow cannon ball filled with powder and musket balls, which exploded overhead enemy troop formations. Shell was also a hollow cannon ball filled with powder, but exploded on impact not in the air.
fuzes to half seconds for improved accuracy; fourth, increase the Napoleon and howitzer fuzes from two to five seconds to two to eight seconds for better accuracy; fifth, discard the Confederate artillery saddle patterns for the Grimsley artillery saddle; sixth, inspect friction primers closer before issue to the army; and seventh, graduate cannon rear sights up to ten degrees with the corresponding range in yards and seconds on the opposite degree scale.\textsuperscript{5}

Gorgas adopted most of these proposals and welcomed the ideas of the field officers. Captain William N. Smith, who commanded the Richmond Laboratory, commented on several of the Ordnance Board's proposals. Smith believed that the time involved for graduating paper fuzes was too much and percussion shells were unsuited for rifled cannons. The projectile had to hit an object squarely for an explosion and the friction fuze developed by Colonel W. LeRoy Broun exploded on contact with any object. The Ordnance Board subsequently tested Broun's friction fuze and also recommended its use. Furthermore, Smith defended the friction primers manufactured at the Laboratory and said that any misfire was a result of copper shortages that

\begin{quote}
Canister was a tin tube filled with musket balls that produced lethal patterns out to 150 yards. See War Department, The Ordnance Manual for the Use of the Officers of the Confederate States Army (Richmond: Ordnance Office, 1862; reprint, Dayton, Ohio: Morningside Bookshop, 1976), 261-62, 319-20.
\end{quote}

\textsuperscript{5}Proceedings of an Ordnance Board Convened in the Army of Northern Virginia by Virtue of the Following Order, Special Order No. 154, June 5, 1863, LRCAIG, roll 78.
forced the use of lead and other inferior materials in their construction. Smith's comments underscored the conflicting views held by ordnance and artillery officers. The serving line officers contended with the defective ordnance supplies, and the staff officers dealt with inadequate materials for ordnance production.

Although Gorgas received helpful criticism from field officers, Major General Daniel H. Hill was the only officer who ever charged him with treason and the Ordnance Bureau with deliberate sabotage. General Hill was one of the Confederacy's toughest division and corps commanders, but his career was tarnished by frequent arguments with superiors. Hill's acerbic demeanor, however, was not exhibited toward his men whose welfare concerned him. In April 1862, Hill commanded a division at Yorktown and faced formidable Union land and naval forces. The Confederate shore batteries were unable to effectively defend the town against Union gunboats and the Confederate heavy artillery was no match for the massed Union siege guns.

Lieutenant S. F. Pierson commanded a battery at Yorktown and wrote to Hill that a ten-inch rifled Columbiad

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6William N. Smith to W. LeRoy Broun, October 19, 1863, ibid., roll 78.

cannon had exploded. Pierson also listed five instances of gross neglect by the Ordnance Bureau. He stated that the rifled cannons were not properly turned and the rifling was imperfect; a carriage axle broke because of poor workmanship; four improperly made shells burst near the muzzle; fifty shells contained water and iron filings; and small arms cartridges contained rifle powder mixed with cannon powder. Consequently, Hill wrote Secretary of War George W. Randolph expressing his distrust of the Ordnance Bureau and forwarded a copy of Pierson's letter.

Hill complained about the Confederate artillery's inferiority and the incompetence of the Ordnance Bureau. During artillery duels, Hill explained a 24 pound rifled cannon and a 6.4 inch cannon burst. The 6.4 inch cannon's carriage disintegrated from the explosion and killed two men and wounded another four. During the Yorktown Campaign, five Tredegar cannons burst. Moreover, Hill stated that Confederate artillery shells frequently failed to explode. In addition, Hill noted that the cannons were cast of inferior metal and he ordered all new cannons subjected to safety tests. Most condemning to Gorgas, Hill characterized the Ordnance Bureau as "a Yankee concern throughout" and believed there was sabotage in ordnance production.

In response to Pierson's and Hill's accusations,

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8Lieutenant S. F. Pierson to D. H. Hill, April 24, 1862, LRCSW, roll 48.

Randolph quickly defended Gorgas and the Ordnance Bureau. Randolph assured Hill that there was no sabotage in Southern foundries or the Ordnance Bureau. Furthermore, Randolph explained that shortages of high quality iron caused the casting of weak cannons. Randolph also ordered two tested Columbiads sent to Hill. Despite Randolph’s assurances, Hill distrusted Tredegar’s cannons and ordered them left at the Yorktown wharf. Hill also continued to deride the condition of the Confederate artillery and lamented that the Union Army received ten cannons for every new Confederate cannon sent to Yorktown. Although mistaken in his charges against Gorgas, Hill had a legitimate grievance with the cannons’ bursting and needlessly adding men to the casualty list.

Gorgas remained calm in his response to Hill’s charges, writing Randolph, "Any opinion delivered without the knowledge of the people thus stigmatized may well be left to the consideration due it . . . ." Gorgas also stated that the charge of sabotage was unfounded and the Richmond Laboratory employees took an oath of allegiance last summer. Any worker who refused was fired on the spot. Gorgas concentrated on Pierson’s comments about the Ordnance Bureau and explained to Randolph the reasons behind these

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11 J. Gorgas to G. W. Randolph, May 1, 1862, LRCSW, roll 48.
occurrences.

Gorgas explained that the rifled cannons were turned on the outside for faster production, the shortage of adequate tools produced imperfect rifling, the axles broke on only a few carriages of the total production, and the shells burst at the muzzle because of defective percussion fuzes. Gorgas also noted that rifled cannons were a recent technological development, and the Ordnance Bureau was forced, in the midst of a war, to develop suitable projectiles and work out any problems that occurred. Pierson noted Confederate shells often contained water and iron filings. Gorgas reported that powder shortages forced the shipment of unloaded shells and these were clearly marked as such. Furthermore, the iron filings came from the Tredegar workers drilling the fuze hole, and shells were no longer shipped directly from the iron works. Before shipment, the Richmond Laboratory inspected and dried every shell. Powder shortages also forced the mixing of rifle and cannon powder in cartridges. The Ordnance Bureau tested the mixture before shipping the cartridges to field commands.¹² Finally, Gorgas defended the reputation of the Ordnance Bureau.

Gorgas further expressed to Randolph that the charges of treason were based on ignorance, but forthrightly admitted the shortcomings of the Confederate ordnance works. The lack of experienced ordnance officers hindered the

¹²Gorgas to Randolph, May 1, 1862, ibid., roll 48.
Bureau's efforts. Gorgas related that he and a second lieutenant were the only former officers of the U.S. Ordnance Department. Until the newly commissioned officers learned their jobs, Gorgas realized that mistakes were going to happen, but skilled labor and raw material shortages were the cause of the majority of accidents. Most importantly, Gorgas criticized the Tredegar Iron Works and believed their antebellum reputation for safe ordnance was not supported by recent events.13

For twenty years Tredegar used a combination of Blackheath coal with Grace and Cloverdale iron for casting high-quality cannons. Tredegar had a good reputation, but the war disrupted iron production and forced the use of inferior iron. This caused the cannons' bursting at Yorktown. During the Battle of Fredericksburg, Tredegar's use of inferior iron nearly cost the Confederacy three high-ranking officers. A thirty-pound Parrott rifle exploded within ten feet of General Lee, Lieutenant General James Longstreet, and Brigadier General William N. Pendleton.14 They escaped injury, but were no doubt concerned about the reliability and safety of Confederate ordnance.

These actions prompted Tredegar's purchase of the Cloverdale and Grace iron furnaces, and thereafter the accidents were reduced. The Ordnance Bureau also had

13Gorgas to Randolph, May 1, 1862, ibid., roll 48.

difficulties with British cannons. In his diary, Gorgas recorded his disgust that an imported six hundred-pound Blakely rifled cannon burst during ordnance tests. In addition, inexperienced gun crews also caused accidents. In May 1863, Lieutenant General D. H. Hill commanded a corps in the Army of Tennessee and a Whitworth breech-loading rifled cannon exploded. The resulting investigation revealed that the gunners had not screwed the breech in completely and this resulted in the cannon's bursting. Although Gorgas freely admitted the Ordnance Bureau's shortcomings, he also believed improper training of gunners and their lack of knowledge contributed to the Confederate artillery's problems.15

Beyond heavy ordnance problems, Gorgas received complaints from cavalry officers over the reliability of the Richmond Sharps. In a letter to General Lee, Colonel John R. Chambliss noted the superior Union breech-loading carbines and criticized the performance of the Richmond Sharps, which often failed to fire and leaked gases from the breech. Gorgas replied to Chambliss that muzzle-loading carbines were preferred by most commands and that the shortage of skilled labor prevented the production of a first-class carbine. The Richmond Arsenal inspected the Richmond Sharps and returned several for faulty construction. The Richmond Sharps often failed to explode

caps (the vent was not bored between the chamber and the cone) and the hammers also fell from the half-cock position.\textsuperscript{16}

The problems associated with the Richmond Sharps were also caused by improper loading of the carbine. In 1863, Richmond Arsenal commander Lieutenant Colonel W. LeRoy Broun received complaints from cavalry officers that thirty or forty Richmond Sharps burst during an engagement. The Richmond Sharps was a complicated weapon compared with the Enfield musketoons. The Richmond Sharps was loaded by moving the trigger guard forward, which opened the breech. The paper cartridge was inserted into the chamber and the trigger guard was moved back, which closed the breech and tore off the end of the cartridge exposing the powder. Once a percussion cap was placed on the nipple and the hammer placed a full-cock, the carbine was ready to fire. This was a simple operation, but loading the carbine without a cartridge often resulted in loose powder falling behind the barrel near the fore-end. The loose powder caused the explosion.\textsuperscript{17} The combination of poor craftsmanship and improper use resulted in the Confederacy abandoning the production of the Richmond Sharps.


\textsuperscript{17}W. LeRoy Broun to J. Gorgas, May 21, 1863, Compiled Service Records, roll 36; Albaugh, 66-73.
Despite the criticism of some field officers, the Ordnance Bureau was the best organized supply bureau, and Gorgas prolonged the survival of the Confederate Army. On November 15, 1864, the Richmond Enquirer printed an article that praised Gorgas's efforts against supply problems and establishment of the domestic ordnance infrastructure, which the city's industry played a major role. The article also characterized Gorgas's "skill, energy, zeal, and faithfulness" and noted Gorgas's rank of colonel when other bureau chiefs were brigadier generals. Davis awarded Gorgas's efforts with a promotion to brigadier general, which was confirmed on November 19, 1864.¹⁸

Josiah Gorgas was a logistical genius whose talents were recognized by Confederate political and military leaders. He fostered industrial growth, regulated the production of civilian contractors, placated the War Department's demands for economic usage of limited funds, secured weapons from reluctant state officials, and selected capable subordinates who aided the Ordnance Bureau's efficiency.

Colonel Rains's Augusta Powder Mill produced a total of 2,750,000 pounds of gunpowder in just three years. Moreover, Lieutenant Colonel Mallet directed the Confederate laboratories and regulated ammunition production. Fulminate of mercury produced the spark in percussion caps. When

¹⁸Richmond Enquirer, November 15, 1864; Compiled Service Records, roll 109.
mercury supplies ran out, Mallet developed a mercury substitute, and this prolonged the war another year.19

The Niter & Mining Bureau branched off from the Ordnance Bureau in 1863, but Isaac St. John coordinated his efforts with Gorgas. The Niter & Mining Bureau provided 50% of the niter for gunpowder production. Furthermore, the Niter & Mining Bureau directed or aided thirty iron furnaces by the end of the war. In response to copper shortages, Gorgas and St. John impressed copper turpentine and apple brandy stills from North Carolina’s backcountry. Percussion caps were constructed from copper and vital for the Confederacy’s survival. The copper stills provided the sole source of copper for the last year of the war.20

Gorgas charged Lieutenant Colonel Bayne with the blockade running’s domestic organization. Bayne relieved Gorgas of extra responsibilities and ably carried out his duties. As the Union blockade tightened, the War Department appointed Bayne, the Chief of the Bureau of Foreign Supplies on March 17, 1864. While Gorgas secured the financial backing, Major Caleb Huse purchased the arms and ordnance stores in Britain, and Bayne organized the transportation of ordnance supplies from Bermuda and Nassau to Confederate ports. During the war, the Ordnance Bureau imported

19Vandiver, Ploughshares Into Swords, 114, 314; George Washington Rains, History of the Confederate Powder Works (Augusta, GA: Chronicle and Constitutionalist Printers, 1882), 26; Gorgas, 88; Mallet, 4-5.

20Gorgas, 76; Mallet, 10-11; Vandiver, 106-7; Broun, 365-76.
600,000 small arms.\(^\text{21}\)

Theodore P. Savas’s article "Life Blood of the Confederate War Machine: George Washington Rains and the Augusta Powder Works," challenged the traditional interpretation of Gorgas and argued that the chief of ordnance's subordinates were responsible for the Ordnance Bureau’s success.\(^\text{22}\) Undoubtedly, Gorgas relied on his subordinates to relieve the tremendous workload of the Ordnance Bureau, but Gorgas personally fought for the retention of skilled labor, adequate finances for foreign arms importations and domestic arms production, and contracted with private firms for ordnance supplies. Bayne, St. John, Mallet, and Rains were vital to the Ordnance Bureau, but they received their labor and finances from Gorgas and looked to their chief for leadership. A twenty-year veteran of the U.S. Ordnance Department, Gorgas was no mere functionary, and no supply bureau chief enjoyed the same success as Gorgas. Indeed, the War Department sacked both Quartermaster General Abraham Myers and Commissary General Lucious Northrop.

Although Gorgas performed admirably against the Confederate supply problems, the civilian leadership never articulated clear strategic goals or implemented the necessary solutions against the supply problems. President Davis reacted to supply problems rather than anticipating

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\(^{21}\)Vandiver, 102-3; Gorgas, 80-81; Goff, 247.

\(^{22}\)Savas, 109.
problems, which the former U.S. Secretary of War knew faced the Confederacy. Davis also encroached upon the authority of the Secretary of War and reserved supply decisions for the presidency normally made by the Secretary of War. Consequently, the Confederacy had five secretaries of war and three served a total of fifteen months. Davis reduced them to liaisons between the chief executive and the bureau chiefs. Only George Wythe Randolph stood up to Davis, but served as secretary of war for only nine months.

Davis and the Confederate government never implemented the proper steps for relieving the country's supply and labor problems. The Confederacy needed the railroads integrated, farm land converted to staple crops, manpower carefully distributed between the military, industry, and agriculture, and government blockade runners purchased for ordnance, medical, and quartermaster supplies. In the defense of states' rights, the Confederate government enacted conscription, impressment, and martial law. These were radical measures for nineteenth-century Southern politicians, but Davis was unwilling to nationalize the Confederate railroads. The demands of total war forced the Confederacy's creation of a centralized state. Governor Joseph Brown of Georgia and Governor Zebulon Vance of North Carolina, however, asserted their independence and resisted

\(^{23}\)Goff, 242-43.

\(^{24}\)Ibid., 243-44; Thomas, The Confederacy as a Revolutionary Experience, 60-66, 69.
Confederate centralized authority. Davis struggled with Brown and Vance, while important problems went unsolved.

Josiah Gorgas performed his duties well and was served by capable subordinates. The Confederate officers, however, had legitimate reasons for complaining when Ordnance Bureau supplies were more of a danger to their men than the enemy. Most problems resulted from the lack of skilled labor and adequate raw materials. Gorgas, however, never pushed for Tredegar's adoption of the Rodman method (hollow casting), which the Northern foundries used for large-caliber artillery. When Tredegar finally adopted the Rodman method, the Confederacy was already doomed to defeat. In addition, Alexander and other artillery officers noted the high number of Confederate shells that failed to explode. This was a waste of resources and undermined the confidence of the gunners in the Ordnance Bureau's quality control. The Richmond Arsenal and Laboratory commanders needed closer direction from Gorgas who struggled with supply problems. Although providing effective leadership, Gorgas failed to maintain the quality of Confederate ordnance supplies.
CHAPTER 5

CONCLUSION

Richmond was the center of Josiah Gorgas's ordnance industry and produced the majority of Confederate manufactured artillery, shoulder arms, and ammunition. Moreover, Richmond machine shops and foundries manufactured valuable tools and equipment for the war effort. Richmond also became the center for Confederate ordnance innovations. These inventions (mines, machine guns, and rail-mounted artillery) became the armaments of the twentieth-century's world wars. Despite Richmond's preeminence in arms production, Georgia contained the three top arms companies that produced revolvers,¹ and the Augusta Powder Works produced the majority of the Confederacy's gunpowder.

The Confederacy was outnumbered four to one, but Gorgas kept the Confederate Army supplied with arms and ammunition. In 1863 the Confederate laboratories manufactured thirty six

¹From July 1862 to November 1864, Griswold & Gunninson manufactured 3,600 revolvers. The firm of Leech & Rigdon produced 1,500 revolvers from the spring of 1862 to December 1863. The third largest Confederate revolver company started in Richmond, but moved to Atlanta before they began production. Edward N. Spiller formed a partnership with David Burr who established the Richmond Foundry. A total of 1,400 Spiller & Burr revolvers were produced from the summer of 1862 to the end of the war. See Albaugh, Confederate Arms, 11-17; William A. Albaugh et al., Confederate Handguns (New York: Bonanza Books, 1963), 28-31, 46-48, 61-76.
million small arms cartridges. The Army of Northern
Virginia carried two million cartridges into Pennsylvania,
which meant that year the Confederacy manufactured enough
ammunition to fight eighteen Gettysburgs.² Northern
industry, however, manufactured vast quantities of ordnance
supplies.

The Tredegar Iron Works cast 1,099 cannons in four
years, but Northern foundries cast 8,000 cannons.
Furthermore, the Confederacy manufactured 62,586 small arms
and imported 600,000 small arms. The Richmond Armory
produced one thousand rifled muskets per month. By 1864,
thirty eight Northern arms companies manufactured five
thousand small arms per day. In four years, the North alone
manufactured 643,439 Springfield rifled muskets.³ Despite
Northern industrial power, Gorgas mobilized Confederate
industry and prolonged the Confederacy's survival. Gorgas's
efforts provided an example for the United States and other
nations in future conflicts.

Despite Gorgas's efforts, the Confederacy collapsed in
April 1865. The Confederate government evacuated Richmond
on April 2, 1865. Before the evacuation, the Confederates
burned the city's tobacco warehouses, and the resulting fire

²Josiah Gorgas to James A. Seddon, November 15, 1863,

³Dew, 290; Josiah Gorgas to James A. Seddon, OR, series
IV, vol. 2: 299; Gorgas to Seddon, ibid., series IV, vol. 2:
958; Gorgas to Seddon, ibid., series IV, vol. 3: 986;
Soloman Adams to Josiah Gorgas, September 22, 1864, ibid.,
series IV, vol. 3: 676-77; Philip B. Sharpe, The Rifle in
destroyed most of the city from the capital to the riverbank. The Richmond Laboratory on Brown Island was the only Confederate ordnance facility that survived the blaze; the white framed buildings were later torn down. Only the brick walls of the Richmond Armory remained with the rifled-musket machinery and stores of weapons consumed by the flames. The Richmond Arsenal and Ordnance Depot were completely destroyed by the flames. Fire also consumed a few of the Richmond iron businesses, but some survived and continued their operations after the war.

The Old Dominion Iron & Nail Works escaped damage and expanded significantly after war. Throughout the 1870s, the company continued to prosper and acquired valuable real estate in Chesterfield County. In the 1900s, the company’s name changed to Old Dominion Iron & Steel Corporation. Moreover, the company installed the South’s first electric steel furnace in 1916. After World War II, Old Dominion Iron & Steel manufactured heat exchangers. In the 1960s, the company relocated from Belle Isle to a larger facility in Chesterfield County, where it continues to operate.

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5See Appendices C and D for postbellum census figures.

Fire destroyed Sampson & Pae's Richmond Foundry, the city's second oldest iron company. Existing records reveal that Sampson & Pae never rebuilt the foundry or reentered the iron business. In addition, the fire destroyed the Richmond Iron & Steel Works owned by James H. Hunter & Company and this company also never rebuilt their physical plant.  

Similar to Old Dominion Iron & Nail, the Tredegar Iron Works survived the fire and remained in operation into the next century. After the war, Joseph R. Anderson quickly took the oath of allegiance and petitioned the government for control of the iron works. Anderson feared the U.S. Treasury Department was going to seize Tredegar, and he stated that the Confederacy forced the iron works production of ordnance supplies. This contrasted to Anderson's earlier support for secession and commercial overtures to the Confederate States in February 1861. Anderson was a businessman foremost and rearranged the facts for saving his iron works. The Treasury Department never seized the iron works, and Anderson formed a new partnership in March 1867, the Tredegar Company.  

The Tredegar Company suffered from the Panic of 1873 and went out of business in 1876. In 1879, Anderson established the Tredegar Iron Works Company, and this

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7Dun Collection, vol. 43: 100; U.S. Census, 1870.

company lasted into the twentieth century. During the First World War, Tredegar produced artillery projectiles, but never cast another cannon. The old physical plant was struck by fire in 1957, and the company operated a small rolling mill in Chesterfield County until 1986, when the facility was transferred to Ohio.9

The machinists firms of Talbott & Brothers and Ettenger & Edmond resumed operations after the war. Talbott & Brothers regained the Shockoe Foundry, which the Confederate Navy leased during the war. By 1866, the company was back in business. The 1870 U.S. Census showed the company was renamed Talbott & Sons. The company’s business increased in the 1870s and they owned real estate worth $250,000. Similarly, Ettenger & Edmond resumed operations and prospered after the war. In May 1865, the company was listed as out of business, but resumed operations by June 1866. Ettenger & Edmond manufactured engines, boilers, hydraulic presses, and repaired machinery. During the next decade, the business weathered the Panic of 1873 and continued moderate growth. Both firms were listed in the 1880 U.S. Census.10

Philip Rahm’s Eagle Machine Works survived the fire, but not the leadership of his son A. J. Rahm. In 1867, the partnership of Kahl & Rahm was formed, but the company

9Dew, 319; Dun Collection, vol. 44: 357, 381, 475.

10Dun Collection, vol. 43: 278, 390; Ibid., vol. 44: 279, 408, 419.
suffered financial problems and was out of business by September 1869. Similarly, the Union Manufacturing Company survived the fire, but was unable to remain in business after the war. The company resumed operations, but was unable to pay off their debts and went out of business by August 1869.\textsuperscript{11}

Boyle, Gamble & Company survived longer in the post-war period, but also experienced financial problems. Their shop was destroyed by the fire, but Edward Boyle and Thomas Gamble remained in the saw manufacturing business. The partnership was dissolved in 1869, and Boyle assumed the company's considerable debts. Financial problems continued, and Boyle was out of business by 1874.\textsuperscript{12} Postbellum Richmond remained an integral part of Southern industry, but steel replaced iron and Richmond was superseded by Birmingham, Alabama. Gorgas's establishment of ordnance facilities in the Lower South encouraged Southern industrialization. Richmond was severely damaged by the Civil War and lost its dominance of Southern heavy industry. Alabama's postbellum industrial expansion made Birmingham the South's iron and steel industrial center by the twentieth century. The former Confederate Chief of Ordnance also experienced financial problems after the war.

The Confederate defeat left Gorgas and thousands of

\textsuperscript{11}Dun Collection, vol. 43: 358, 382; Ibid., vol. 44: 272, 487.

\textsuperscript{12}Ibid., vol. 43: 324; U.S. Census, 1870; Dun Collection, vol. 44: 324.
veterans without employment in the economically shattered South. Gorgas became interested in Alabama’s nascent iron industry, and he and eleven stockholders purchased the Brierfield Iron Works in January 1866. Unfortunately, rail transportation costs and raw material shortages limited the company’s profit and the Brierfield Iron Company’s finances were depleted by 1869.\textsuperscript{13} With the company’s failure, Gorgas joined other ex-Confederates entrance into academia.\textsuperscript{14}

At the University of the South at Sewanee, Gorgas was headmaster of the Junior Department and vice-chancellor. The board of visitors interfered with his work, and Gorgas resigned in July 1878. During his tenure at Sewanee, Gorgas gained a good reputation and the University of Alabama elected him president. Gorgas accepted the position and moved his family to Tuscaloosa, but suffered a stroke on

\textsuperscript{13}Vandiver, \textit{Ploughshares Into Swords}, 275-86; Gorgas Journal, 194-95, 197, 231-32.

February 23, 1879, and lacked clarity of mind for sometime. Since the end of the war, Gorgas experienced neuralgia and numbness in the left arm. Unfortunately, Gorgas never fully recovered, and the University of Alabama accepted his resignation in July 1879. The University appointed Gorgas the school librarian, but his health steadily declined until his death on May 15, 1883.\textsuperscript{15}

As Chief of Ordnance, Gorgas contended with issues and problems affecting any nation going to war. He directed the mobilization, integration, and standardization of ordnance production. The First and Second World Wars demanded large quantities of ordnance for the participants war machines and required careful planning. Confederate ordnance production was hindered by shortages of labor, raw materials, food, and transportation. In addition, the Confederate government never adequately rationed manpower and material resources, which hastened its defeat. The United States and Europe learned from the Confederacy's mistakes.

The Civil War introduced the military use of railroads. At the First Battle of Manassas, the Confederates transported reinforcements from the Shenandoah Valley by railroad and this checked the Union advance. The Confederate railroad system, however, never effectively distributed war materials to the field commands. In the 1800s, Europe's railroads expanded greatly, and the Prussian

government recognized the strategic value of railroads. The Prussian victories against the Austrians and the French were influenced by the rapid deployment of superior forces by rail. By the First World War, the Allies and Central Powers had sophisticated railway networks for transporting troops and once war erupted the opposing sides rapidly deployed their troops to the front.¹⁶

The United States entered the First World War in 1917, and endeavored to supply its armed forces three thousand miles across the ocean. President Woodrow Wilson was a child during the Civil War and witnessed the Confederate industrialization. Therefore, Wilson instituted careful plans for rationing the nation’s resources and created several important positions for directing the war effort. Bernard Baruck, Chairman of the War Industries Board directed the nation’s industrial conversion to war production. Baruck effectively became an economic dictator with regulatory powers over production and labor issues. In addition, Federal Food Administrator Herbert Hoover rationed the nation’s food supplies and encouraged the planting of victory gardens for home consumption. As a result of careful planning, the United States supplied its troops on the Western Front, and the home front never suffered any mass shortages of food.

the Confederate States. American industry manufactured surplus ordnance and war materials for the Allied armed forces. Reich Minister of Armaments and War Production Albert Speer possessed Gorgas’s logistical genius and maintained the Wehrmacht until the conquest of Germany. Indeed, German war production peaked in 1944 despite the Allied strategic bombing campaign. Speer, like Gorgas, faced critical shortages of manpower and raw materials. Germany’s war industries lacked adequate skilled laborers with the formation of the Volksstrum and the enormous battlefield losses increased the demand for new recruits. In addition, gasoline and raw material shortages hindered the German war machine. Both Speer and Gorgas faced better equipped enemies, but managed their resources and provided their nation’s armed forces with arms and ammunition.

Beyond Gorgas’s logistical achievements, the Confederate Ordnance Bureau developed several weapons that were used in later conflicts. The Confederacy introduced the first machine gun, which American inventor Hiram Maxim perfected in 1884. The Maxim machine gun fired six hundred rounds per minute and, similar to the Confederate Williams machine gun, operated from the force of the fired cartridges. In the First World War, the machine gun hindered mobile warfare and inflicted millions of casualties. Furthermore, the Confederacy introduced the large deployment of undersea mines. During the Franco-Prussian War, the Prussian Navy mined German harbors and
effectively neutralized the powerful French Navy. After the
Confederate defeat, Matthew F. Maury and Viktor von Schelika
(a Prussian-born Confederate officer), lectured Prussian
naval officers on mine warfare. Undersea mines were also
used in the First and Second World Wars. Moreover, the
Confederacy invented rail-mounted artillery and in both
world wars the Germans mounted heavy artillery on railcars.

Despite the efforts of Vandiver, Bruce, and Wiggins,
Josiah Gorgas remains an unknown figure of the Civil War.
Scholars have written numerous biographies on Confederate
military and political leaders. Ironically, the
Confederacy's survival was prolonged by a Northern-born
former U.S. ordnance officer who labored against impossible
supply problems. Gorgas provided effective leadership of
the Ordnance Bureau, and supplied the Confederate Army with
arms and ammunition long after clothing and food supplies
became unreliable. Confederate officers, however, had
legitimate criticisms of unreliable ordnance supplies. The
Ordnance Bureau often lacked the proper materials for
manufacturing first-class artillery projectiles or weapons.
Despite this problem, Gorgas was responsible for maintaining
the reliability of ordnance supplies and ensuring
Confederate soldiers were not injured by defective ordnance.

Vandiver and Bruce also never examined Gorgas's
direction of Richmond's ordnance production or his relations
with private industry. Richmond contained the South's

17Ibid., 312; Brooke, 318-20.
largest iron industry, and Gorgas directed the city’s conversion to ordnance production. Gorgas managed Richmond’s private companies with labor exemptions and surplus raw material sales. The Confederate ordnance facilities and the city’s private contractors manufactured essential ordnance and war materials. Richmond became the center of Gorgas’s domestic ordnance network. His efforts for the Confederacy are worthy of examination and help historians understand why that nation, outnumbered four to one, survived for four years against a better equipped enemy.
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Richmond Whig

Secondary Sources

Books


Articles


# APPENDIX A

## RICHMOND'S IRON INDUSTRY IN 1850

<table>
<thead>
<tr>
<th>COMPANY</th>
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APPENDIX B

RICHMOND'S IRON INDUSTRY IN 1860

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## APPENDIX C

### RICHMOND’S IRON INDUSTRY IN 1870

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APPENDIX D

RICHMOND'S IRON INDUSTRY IN 1880

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