Southern iron manufacturing had to change in a hurry when the Civil War began. What had been a modest industry geared to producing mainly domestic and agricultural ironware was pressed into service to match the fearsome weaponry of the industrial North. The Confederate government effectively nationalized the region’s iron industry by funding its rapid expansion and capturing the lion’s share of output in government contracts. Richmond’s Tredegar Iron Works, the most sophisticated iron-making complex in the South, was greatly enlarged to increase the capacity of its rolling mill and cannon foundry. New mills were built deep in Confederate territory to produce iron plating for battleships and rails to move military supplies. New and enlarged foundries hastened to cast heavy cannon for navy warships and coastal defenses. A new national laboratory at Macon, Georgia, strove to manufacture high-quality small-arms ammunition. The government commissioned geological surveys to find coal, iron ore, and niter, the latter being the key ingredient in gunpowder and the one kind of ordnance matériel the South had not produced before the war.1

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According to historian James McPherson, this effort resulted in the one success story of Confederate industrialization. "Although often less well armed than their enemies," he writes, "Confederate soldiers did not suffer from ordnance shortages after 1862." He credits the Confederate chief of ordnance, Josiah Gorgas, "a genius at organization and improvisation," who scraped together necessary supplies from unlikely sources and created a domestic arms industry almost from scratch. As Gorgas declared in 1864, "Where three years ago we were not making a gun, a pistol nor a sabre, no shot nor shell (except at the Tredegar Works)—[not] a pound of powder—we now make all these in quantities to meet the demands of our large armies."\(^2\)

Gorgas was being less than truthful in this boast. His own correspondence on behalf of the Ordnance Bureau reported that small arms were always in short supply; by September 1864 most were being imported from Europe.\(^3\) My aim in this article is not to debate the volume of Confederate arms production, but rather to illuminate the conditions under which arms manufacturers struggled to meet wartime demand, particularly for heavy ordnance. Judging from Confederate military correspondence and the detailed company records of the Tredegar Iron Works and the Shelby Iron Works, near Columbiana, Alabama, Confederate heavy ordnance producers suffered a sometimes crippling shortage of skilled labor that limited output and rendered some facilities inoperable. Those who managed to hold on to their skilled workforce, such as Tredegar and Shelby, were compelled to compromise principles dear to the cause of industrial slavery by courting and employing white immigrant artisans whose identity was anathema to Southern slave society. However bravely and creatively Confederate ordnance officers and manufacturers waged the battle of production, they lost the war for a slave society by demonstrating that a modern iron industry could not be based on slave labor.

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The Geography of Technology and Skill

In the two decades prior to the Civil War, the U.S. iron industry became increasingly divided along technological and regional lines. New concentrations of innovative technology and large-scale production developed between the Delaware and Susquehanna rivers in eastern Pennsylvania (cradle of the anthracite iron industry) and in other parts of the Mid-Atlantic where ironmasters and artisans solved the chemical difficulties of smelting iron with the region’s bituminous coal. This period also saw the rise of large rolling mills in the United States, prompted by growing demand for railroad rails, sheet iron, and nails. Although some of the largest rolling mills and most furnaces were built in proximity to iron ore, coal, and waterpower in rural areas, most mills were located in northern cities or industrial towns. By 1850 the outlines of what would later be called the manufacturing belt were clearly visible in the geography of large-scale iron production in the urban Northeast, Pennsylvania, and Ohio, with important western outposts in St. Louis and Chicago.4

Nested within and extending beyond this new industrial framework were smaller ironworks that used centuries-old technologies to smelt, refine, and manufacture iron. Charcoal blast furnaces remained a leading source of pig iron despite the increasing use of anthracite and bituminous coal after 1840.5 Charcoal iron was cheaper for some finishing plants because of proximity. Rolling mills and foundries in Boston obtained most of their pig iron from charcoal furnaces in eastern Massachusetts and the Hudson Valley. Mills in Richmond relied on charcoal iron from the Shenandoah Valley and western Virginia. Tradition also favored charcoal iron producers. Despite the availability of equally good iron from coke and anthracite furnaces by the 1840s, certain charcoal furnaces’ reputation for producing superior pig iron prolonged the popularity of their product, particularly among foundries that made high-quality castings such as heavy cannon and machine parts.6 The peak of new charcoal furnace construc-


### TABLE 1
BLAST FURNACES, CIRCA 1858

<table>
<thead>
<tr>
<th>JANUARY 2001</th>
<th>No. active</th>
<th>No. furnaces reporting output</th>
<th>Annual output capacity (tons)</th>
<th>Mean capacity (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern states</td>
<td>394</td>
<td>206</td>
<td>465,892</td>
<td>2,262</td>
</tr>
<tr>
<td>Southern states</td>
<td>151</td>
<td>118</td>
<td>145,006</td>
<td>1,229</td>
</tr>
<tr>
<td>Alabama</td>
<td>3</td>
<td>3</td>
<td>1,326</td>
<td>442</td>
</tr>
<tr>
<td>Georgia</td>
<td>7</td>
<td>7</td>
<td>3,044</td>
<td>435</td>
</tr>
<tr>
<td>Kentucky</td>
<td>40</td>
<td>27</td>
<td>39,498</td>
<td>1,463</td>
</tr>
<tr>
<td>Maryland</td>
<td>21</td>
<td>19</td>
<td>34,422</td>
<td>1,812</td>
</tr>
<tr>
<td>Missouri</td>
<td>4</td>
<td>2</td>
<td>3,213</td>
<td>1,607</td>
</tr>
<tr>
<td>North Carolina</td>
<td>5</td>
<td>3</td>
<td>675</td>
<td>225</td>
</tr>
<tr>
<td>South Carolina</td>
<td>33</td>
<td>29</td>
<td>43,504</td>
<td>1,500</td>
</tr>
<tr>
<td>Tennessee</td>
<td>5</td>
<td>5</td>
<td>1,156</td>
<td>385</td>
</tr>
<tr>
<td>Virginia</td>
<td>33</td>
<td>25</td>
<td>18,168</td>
<td>727</td>
</tr>
</tbody>
</table>

Source: J. Peter Lesley, *The Iron Manufacturer’s Guide to the Furnaces, Forges and Rolling Mills of the United States* (New York, 1859). Figures for each state and region exclude ironworks listed by Lesley as having been abandoned by 1858.

Southern states are defined as those permitting slavery, including southern Missouri (see fig. 1).

The iron industry’s expansion came in the 1850s, when demand for iron propelled the industry’s expansion in Pennsylvania, Ohio, and many western and southern states.7

Although the South had fewer ironworks than the North, Southern output in 1860 met most of the region’s internal needs and provided some exports. According to the best industry directory of the period, all Southern states except Florida and Louisiana had blast furnaces, bloomeries, and forges by the late 1850s, and most had at least a few rolling mills.8 They provided agricultural machinery (mainly cotton gins), stoves, and other domestic wares. Nail mills in Wheeling supplied the building needs of the upper South. Other rolling mills ranged from small, single-roll operations producing a few hundred tons of merchant bar annually to the industrial complex at the Tredegar Iron Works in Richmond, which included a large, modern rolling mill as well as one of the nation’s biggest foundries. Gor-

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8. Lesley’s directory of the iron industry is exceptionally detailed. Unlike most nineteenth-century iron industry directories, which are little more than lists of ironworks, their owners, date of construction, and production capacity, the *Iron Manufacturer’s Guide’s* paragraph-long entries describe the geographical location and endowments of
gas’s note that the South was producing no shot nor shell “except at the Tredegar Works” was slightly disingenuous, for Tredegar’s foundry was one of only four works in the country that made heavy cannon and shells for the federal government before the Civil War.⁹

As tables 1 and 2 show, the South had about one-quarter the capacity of Northern ironworks on the eve of the war. Southern ironworks employed most of the same technologies as did works in the North but not in the same proportions. Most Southern furnaces burned charcoal, none burned anthracite, and few matched the capacity of the largest anthracite and coke furnaces in Pennsylvania. Many of the largest and technologically most advanced Southern furnaces and mills were located in border states whose territory—and whose citizens’ loyalty—belonged to the Union by the end of 1861 (fig. 1). The loss of these facilities posed a serious threat to the Confederate war machine, as the Virginia state assembly recognized when

| TABLE 2 | Rolling mills, circa 1858 |
| --- | --- | --- | --- |
| Northern states | 175 | 124 | 612,428 | 4,939 |
| Southern states | 37 | 31 | 143,443 | 4,627 |
| Georgia | 2 | 2 | 12,900 | 6,450 |
| Kentucky | 7 | 5 | 19,809 | 3,962 |
| Maryland | 11 | 8 | 85,738 | 10,717 |
| North Carolina | 2 | 1 | 215 | 215 |
| South Carolina | 2 | 2 | 810 | 405 |
| Tennessee | 3 | 3 | 2,780 | 927 |
| Virginia | 11 | 10 | 21,191 | 2,119 |

Source: J. Peter Lesley, The Iron Manufacturer’s Guide to the Furnaces, Forges and Rolling Mills of the United States (New York, 1859). Figures for each state and region exclude ironworks listed by Lesley as having been abandoned by 1858.

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it approved the seizure of the federal armory at Harpers Ferry and the removal of its machinery to the state-owned armory in Richmond.  

The geography of industrial capacity and iron-making technology had important consequences for regional labor markets. Particular production processes and machines required particular skills and work relations. Although men anywhere could learn how to puddle, roll, and heat iron, it took time to master the skills involved in those operations. Regions without large rolling mills lacked men with those skills. The smaller scale and generally less sophisticated technologies of antebellum Southern ironworks had produced a regional workforce of isolated artisans, mostly slaves, at scattered furnaces, forges, and bloomeries. They included highly skilled hammer men, forge carpenters, refiners, molders, and founders, but very few if any puddlers, rollers, and heaters. When the Etowah Iron Works in northwest Georgia added a rolling mill to its forge and blast furnace complex in 1848–49, the manager hired a diverse crew of skilled workers from England, Wales, Scotland, Germany, Massachusetts, Pennsylvania, and a number of Southern states. In Stewart County, Tennessee, in 1850, however, employees at a number of blast furnaces and a large rolling mill included only two Northerners and one European. All other white workers were natives of Virginia or Tennessee. The overwhelming majority of ironworkers in Stewart County were slaves owned by iron companies or iron company managers or rented from local farmers.  

The Etowah approach—importing skilled workers from other regions and other nations—was in fact a common practice throughout the United States and Europe where firms attempted the rapid implementation of new iron-making technologies. The pattern was typical of the diffusion of scientific practice in general. Historically, the replication of scientific apparatus and experiments in new locations required more than the acquisition of

11. Technology may not drive history, but this study suggests a direct and very important relationship between technology and demand for particular kinds of labor. Further study of this relationship may raise new questions about technological determinism, questions skirted or ignored in the classic collection of essays on the subject, Merritt Roe Smith and Leo Marx, eds., Does Technology Drive History? The Dilemma of Technological Determinism (Cambridge, Mass., 1994).
13. Gordon (n. 4 above), 85; Lesley (n. 4 above), 246; U.S. manuscript population census, 1850, Cass County, Georgia.
physical objects or detailed instructions. Effective transfer also required the transmission of technique, that is, the human knowledge that goes into the making of apparatus and its use. For just this reason, the transfer of ironmaking technology from Great Britain to other nations from the seventeenth century through the middle of the nineteenth century appears to have been a two-step process: first, hiring an experienced ironmaster, works manager, or engineer who could supervise construction at a new facility; second, recruiting skilled workers who were familiar with the new machinery and production processes.

Welsh metalworkers formed one of the more distinctive cohorts of immigrant artisans whose skills helped bring new iron technology into operation in the antebellum United States. By 1830 South Wales was producing one-third of Britain's iron at some of the world's largest, most innovative ironworks. The center of Welsh iron production was the town of Merthyr Tydfil, Glamorganshire, where puddling was perfected and dubbed "the Welsh Method." The best-known Welsh ironmaster in the antebellum United States was David Thomas. From 1817 to 1839, Thomas worked as superintendent of the Yniscedwyn Iron Works in Carmarthen-shire, South Wales, where he was instrumental in perfecting the process of smelting iron with anthracite. When the Lehigh Coal and Navigation Company entered the race to produce America's first anthracite iron in the late 1830s, it hired Thomas to oversee the construction of an anthracite-burning furnace at Catasauqua, Pennsylvania. Thomas duplicated the Yniscedwyn design and ordered blowing engines and other machinery from British manufacturers. He also attracted scores of Welsh ironworkers to Catasauqua, setting in motion a highly localized chain migration of skilled workers from South Wales to iron towns in southeastern Pennsylvania. Puddlers from Wales were particularly prominent among the


17. For a summary of the debate over whether Thomas or his employer, George Crane, deserves credit for inventing the process, see Darwin H. Stapleton, The Transfer of Early Industrial Technologies to America (Philadelphia, 1987), 178, and Bartholomew and Metz (n. 4 above), 20–27.

18. Minutes of stockholders meeting, 23 May 1839, acc. no. 1198, Lehigh Crane Iron Co., vol. 1a, Eleutherian Mills Historical Library, Wilmington, Del. This was the original plan. Because of delays in shipping equipment from Britain, the furnace cylinders were made in Philadelphia, presumably to Thomas's design. Stapleton, 181–82.

19. U.S. manuscript population census, 1850 and 1860, town of Catasauqua, Lehigh
ranks of skilled workers at large new rolling mills in the United States, such as the Mount Savage Iron Works in western Maryland and others in Pittsburgh, Phoenixville, Danville, Pottsville, and St. Clairs, Pennsylvania.20

Edward Thomas (apparently no relation to David Thomas) is one of the few Welsh ironworkers of this period whose experience has survived in personal letters. Thomas was hired by the directors of the Lycoming Coal Company in 1835 to supervise construction of one of the first coke-fired furnaces in the United States, located at Farrandsville in Lycoming (later Clinton) County, Pennsylvania. “It appears to be more a matter of pride than profit which induced them to proceed with the Furnace here,” he wrote his sister Bess in 1836. “It is the commencement of a new Era, the making of Iron from pit coal in America—they are ambitious of the fame of first bringing it to bear for the benefit of the States.” Ambition pushed American firms to seek out men who could replicate British innovations rapidly. Thomas embraced the challenge—“in a few years,” he told his sister, “I shall blow up such a blaze in America that the influence of all the Tories in England and Wales will not readily extinguish, and I trust that some of my young and even old friends at Merthyr [Tydfil] will witness and laugh at their wailings.”21

Welsh workers were similarly involved in transferring puddling and other techniques to France in the 1820s.22 One firm sent industrial engineer François Cabrol to Merthyr Tydfil in 1826 or 1827 to see coke-fired furnaces and puddling at Cyfarthfa, Dowlais, and other ironworks. By 1830, Welsh engineers, puddlers, heaters, rollers, and polishers were living and working in the iron villages that Cabrol’s company had created in the Aubin Valley at Decazeville, Aubin, Garchizy, and Firmy. Some of these immigrant artisans returned to Wales or emigrated later to the United States. Others married French women and settled in as permanent residents.23 The case of the Decazeville ironworks shows that the direct impor-

County, Pennsylvania; Peter N. Williams, David Thomas: Iron Man from Wales (Trucksville, Pa., 1995).

20. Welsh immigrant obituaries published between 1838 and 1853 in three Welsh-American periodicals: Y Cyfaill o’r Hen Wlad (The friend from the old country), Y Cenhadwr Americanaidd (The American missionary), and Y Beread (The Berean, referring to the biblical town of Berea and its inhabitants). My thanks to J. Gwynfor Jones for explaining the reference to Berea. For a discussion of this source material and its problems, see Knowles (n. 7 above), 10–13.

21. Thomas to his sister Bess, 11 January 1836, typescript, Edward Thomas letters, National Canal Museum, Easton, Pa. The Canal Museum has photocopies of typescripts of Thomas’s letters; the Senator John Heinz Pittsburgh Regional History Center holds photocopies of the manuscripts in its miscellaneous manuscripts collection. My thanks to Lance Metz, historian at the National Canal Museum, for providing me with a copy of the typescripts.


23. Donald Reid, The Miners of Decazeville: A Genealogy of Deindustrialization
vation of experienced managers and artisans accomplished two goals in one stroke: it enabled a firm to recoup heavy start-up costs relatively quickly, and it collapsed the time necessary to inculcate an industrial work culture that was often foreign to the frontier locations chosen for new iron-works. Both gave new companies a competitive advantage. The board of directors of the Decazeville works claimed in 1830, "It is perhaps without parallel in France that a single enterprise has been founded so quickly."

Local people may have been offended by the *ouvriers cosmopolites* working in their midst, but the swift implantation of an efficient workforce delighted owners and investors.  

Emigrating to American industrial frontiers offered rare opportunities to European artisans. In addition to receiving higher wages, immigrants during the antebellum period could sometimes move up the occupational ladder more quickly and even have reasonable hopes of joining the ownership class. David Thomas, unable to rise above the level of plant supervisor in Wales, was lured to Pennsylvania by a starting salary of two hundred pounds per annum (plus fifty pounds for each anthracite furnace he brought into blast), first-class passage for his family and servants, and a new house. As superintendent and technical advisor to the Lehigh Crane Iron Company he enjoyed a series of executive positions and investment opportunities that eventually led to the creation of the Thomas Iron Company and his family's independent fortune. Edward Thomas promised Welsh founders that in Pennsylvania "their earnings will be far superior to any wages they get at Merthyr." He hoped to increase his own earnings by capturing U.S. patent rights for the process of making iron with coke or anthracite. Edwards' letters mention other Welsh artisans who gained positions of greater responsibility and scope when they emigrated, including a molder who supervised construction of Karthous Furnace in Clearfield County, Pennsylvania; a founder from Merthyr Tydfil who became a principal founder and hired "some Welsh miner, a friend of his," as his assistant; and a collier from Aberdare, Glamorganshire, who became a principal collier and manager. Much better a Welshman who knew his craft and was generally familiar with the operations of the industry,

(Cambridge, Mass., 1985), 17–20; Yves Randeynes, “Welsh People in France,” n.d., typescript, transcribes births, marriages, and deaths from parish records; electronic correspondence with Joane Jay (Tucson, Ariz.) and Brian Wagstaffe (Neath, Glamorganshire) regarding the migration history of their relative, Rees Joshua Prosser, and his family.

24. Reid, 18.

25. Agreement between Erskine Hazard, for the Lehigh Crane Iron Company, and David Thomas, 2 July 1839, reprinted in Bartholomew and Metz (n. 4 above), 22; Williams (n. 19 above), 27–28, 65; David Thomas Papers, acc. no. 2023, Eleutherian Mills Historical Library; vols. 1a, 1b (minutes of stockholders' meetings) and 2a, 2b (minutes of the board of directors), Lehigh Crane Iron Company Papers, acc. no. 1198, Eleutherian Mills Historical Library.
Thomas reasoned, than "some Frenchman who never saw an iron work before." 26

While Northern ironworks routinely sought out and hired European labor at all levels of skill, few Southern firms did. The lack of immigrants at most rural Southern ironworks contrasted sharply with the cosmopolitan laboring population in Southern cities before the war. 27 At the South’s most advanced ironworks, one can see the tension between managers’ ideological commitment to industrial slavery and their need to secure workers with the requisite skills for modern manufacturing. The Tredegar Iron Works initially hired many skilled iron artisans, including immigrants such as Rhys Davies, the Welshman who supervised construction of Tredegar’s new rolling mill in 1838. Davies was hired to guarantee that the works were built and run to the highest competitive standard of the day. 28 But the company’s managers were determined to lessen their dependency on white workers and to minimize the potential disruptiveness of independent-minded immigrant labor. Between 1842 and 1847, Joseph Reid Anderson, Tredegar’s guiding force from 1840 through the Civil War, attempted to replace white puddlers and rollers with their slave apprentices. His efforts met stubborn resistance that culminated in a strike led by Welsh and American workers. Anderson fired the strikers and replaced them with slave workers. Productivity fell dramatically. By 1850 Anderson was obliged once again to hire skilled outsiders to fill orders for rails, locomotives, and heavy ordnance. He even sought puddlers from Pittsburgh, against his better judgment. 29 Throughout this difficult period, however, Anderson continued to


28. Obituary of Rhys Davies, Richmond Enquirer, 14 September 1838; Kathleen Bruce, Virginia Iron Manufacture in the Slave Era (New York, 1931), 151, 153, 224.

advocate industrial slavery. In 1850 he claimed to have trained thirty-five slaves to be puddlers, heaters, and rollers. In 1852 he magnanimously offered to help train slaves for the new Etowah rolling mill. On the eve of the war he urged the owner of the Shelby Iron Works in Alabama to employ slaves rather than white men. “I have used both white and slave labor many years in a mill,” he wrote. “A city you know is bad for slaves but in the Country, I would use only negroes in a rolling mill besides the manager. The great advantage is that you can rely on slave labor, whilst you will find it hard to get good white workmen to come to you and then they will quit when you want them most.”

Historian Kathleen Bruce took Anderson at his word, crediting him with “revolutionizing” labor in the Virginia iron industry by employing slaves in the top ranks of skilled labor. His more significant impact was inhibiting the migration of skilled ironworkers into the antebellum South. Rather than using his influential position to advocate a mixed workforce, he insisted upon forcing white artisans to train their replacements, with predictable results. Like many other ironmasters, Anderson yearned for a skilled workforce that would stay put; in the Southern context, that meant slave labor. Virginia ironmaster William Weaver declared in 1825 that “no reliance could be placed in the free White laborers who are employed about Ironworks in this country,” for in “moments of the greatest pressure and necessity, the proprietor must either make them advances which they will

Stockholders, 12 January 1838–9 January 1850, 463–64. He may have meant Welsh puddlers, for they were prominent at antebellum Pittsburgh ironworks and were instrumental in founding the puddlers and boilers union, the Sons of Vulcan, during the Civil War. The Vulcan Record 1 (January 1868); John William Bennett, “Iron Workers in Woods Run and Johnstown: The Union Era 1865–1895” (Ph.D. diss., University of Pittsburgh, 1977).

30. J. R. Anderson to Dr. W. E. Daniell, 28 October 1850, cited in Bruce, 239; J. R. Anderson to Major Mark A. Cooper, 15 December 1851, cited in Gregg D. Kimball, “Expanding Slavery with the Skill of Strangers: The Tredegar Iron Works in the Cultural Geography of the 1850s” (paper presented at the 1996 meeting of the Social Science History Association, New Orleans), 28; Joseph R. Anderson to Horace Ware, 12 February 1859, Incoming Correspondence to A. T. Jones, correspondence files 001, Shelby Iron Works Papers (hereafter SIW001), W. S. Hoole Special Collections, University of Alabama.

31. Bruce, 232–35, 246, 248–49. Bruce does not substantiate her claim that “Practically since 1843 slave labor supervised by white puddlers, heaters, and guide rollers, skilled native Americans . . . , had carried on in large part the work of the Tredegar rolling mill” (224). Dew shows conclusively, in Bond of Iron (n. 12 above), that slave artisans dominated rural iron manufacturing in Virginia and probably most other Southern states.

32. The problem of white artisans refusing to train slaves dates back to colonial iron making. “When the Principio [Maryland] proprietors wanted the British artisans to teach their skills to blacks, they encountered difficulties: ‘all the Arguments yet could be used cou’d not prevail with the Gloucestershire finers to admit of a clause to teach Negroes.’” Gordon (n. 4 above), 118.
never repay, or they leave his service to the ruin of his business.” A superintendent at one of Weaver’s charcoal iron furnaces put it more bluntly in 1860: “the white hands ’damn them . . . won’t stick.”33

The geographic immobility of slaves, however, significantly limited their technical knowledge. British metalworkers in the nineteenth century, like engineers and other industrial artisans, traveled extensively both to keep themselves employed and to move up the occupational ladder.34 On the American iron frontier, roving white artisans learned to adapt techniques and machinery to suit local conditions, becoming expert problem-solvers and innovators as they moved. Although skilled slaves became masters of their trades, they had few opportunities to develop the wider range of skills that became the hallmark of “tramping” white artisans. Slaves’ knowledge was further limited by the predominance of older technologies at Southern ironworks. When the Confederacy suddenly needed more men to cast cannon and to roll iron plates for warships, slaves could not fill the breach and experienced white workers were hard to come by. These limitations on domestic labor supply set the stage for a crisis in iron production during the Civil War.

Labor Crisis in Confederate Iron Production

Confederate President Jefferson Davis foresaw the problem of skilled labor shortages in the spring of 1862, when he told the Congress that “the want of mechanics” to manufacture small arms “does not permit us to hope for such extensive results as would satisfy existing necessities.”35 Secretary of the Navy Stephen Mallory’s reports to the Confederate Congress voiced his growing awareness of a labor problem. On 30 November 1863 he warned that ironworks at Richmond, Charlotte, Atlanta, and Selma would not be able to supply all the large guns needed unless “the proper amount of skilled labor can be concentrated.” In April 1864 he reported that “the want of skilled labor is severely felt” in ordnance production. By his last extant report, submitted on 5 November 1864, the lack of skilled labor had become a “serious evil.”36 The general scarcity of labor hampered the con-

33. Dew, Bond of Iron, 22, 271.
35. Davis to the Confederate House of Representatives, 13 March 1862, reprinted in Ainsworth and Kirkley (n. 3 above), 1:993.
36. Reports submitted by the Confederate Secretary of the Navy to the Confederate Congress, 30 November 1863, 30 April 1864, 5 November 1864, Navy Records transferred from RG45 to RG109, NARA.
struction of the new munitions laboratory in Macon. Once the facility was built the lack of skilled labor severely limited production.\textsuperscript{37} Gorgas told Secretary of War James A. Seddon in October 1864, "The limited number of mechanics left to the Confederacy, must be retained; or the best interests of the Government will be hazarded. Already large amounts of machinery are lying idle, in all parts of the country, for want of workmen to operate them; while three years since, the want felt was of machinery."\textsuperscript{38}

Ordnance manufacturers and Ordnance Bureau officials tried to retain skilled workers by keeping their wages high. At the Shelby Iron Works in early 1862, white artisans were paid from $2 to $5 per day, common laborers from 75¢ to $1. By the end of the war, wage rates at Shelby had quadrupled and more, with the furnace founder receiving $17 a day, the mine supervisor $14, and other furnace and rolling mill workers $5 to $12 a day. Puddlers, rollers, roughers, and heaters, who were paid by the tonnage they produced, received weekly pay ranging from $84 to $122 ($14 to $20 a day).\textsuperscript{39} According to Mallory's estimates, labor claimed up to 36 percent of naval ordnance production costs in 1863–64. Tredegar's wages advanced more slowly, which cost the company some workers until Gorgas imposed controls in an effort to equalize wage rates at government ordnance installations.\textsuperscript{40}

High wages, however, were no defense against military conscription. The most eloquent protests against the conscription of ironworkers were written by John M. Brooke, commander of the navy's Office of Ordnance and Hydrography in Richmond and a close advisor to Mallory. Brooke reported time and again that the lack of properly trained workmen at ordnance factories resulted in frequent delays and second-rate products. Confederate warships continued to use old-fashioned, smooth-bored cannon that did not hurl projectiles with sufficient force to penetrate the iron cladding on Union ships. Their own cladding, Brooke reported, gave way to the Union's more powerful rifled cannon. Contrary to James McPherson's

37. Steven Collins (n. 1 above), 532–34, 540.
39. Deposition of Samuel Clabaugh in the case of \textit{Andrew T. Jones and Others v. Horace Ware}, 22 July 1867, Chancery Court Records, Loose Papers File, Drawer S, Shelby County Museum and Archives, Columbian, Alabama; payroll no. 10, week ending 10 March 1865, Correspondence 1865, correspondence files 003, Shelby Iron Works Papers (hereafter SIW003). These rates of increase far exceed those recorded at Springfield Armory, where wages increased by about 60 percent during the war. Felicia Johnson Deyrup, \textit{Arms Makers of the Connecticut Valley: A Regional Study of the Economic Development of the Small Arms Industry, 1798–1870} (Northampton, Mass., 1948), 200–201. My thanks to Marty Everse for sending me copies of the deposition typescripts.
40. Recapitulations of Estimates of Navy Department, 1861–1865, Navy Records transferred from RG45 to RG109, NARA; Dew, \textit{Ironmaker to the Confederacy} (n. 1 above), 239–42.
implication that being “less well armed” did not significantly hamper Confederate forces, Brooke argued that inferior shells put the Confederate navy at a serious disadvantage. The Confederates knew how to make the new shells, but their ordnance factories lacked the artisans required to produce them.\(^{41}\)

Brooke explained in 1864 that the problem was not an absolute lack of skilled ironworkers, but their deployment. “There are in the Southern States more than a sufficient number of mechanics to work these establishments to their full capacity and to supply all the heavy ordnance required to arm the iron clads and other vessels completed ... and to furnish guns for the defence of our ports against which the iron clads of the enemy cannot stand. But these men have been swept into the Army en masse and their services can only be obtained by special and individual detail, months are generally occupied in the process and so rarely are applications granted that the services of not more than one in ten are secured. Constant effort is being made to supply the deficiency of labor, but with slight results. ... a considerable number of boys are employed, who are gradually acquiring skill but their services will be more valuable hereafter than they are at present.” Brooke estimated that “two hundred machinists, blacksmiths, pattern makers, and moulders would be sufficient to accomplish all that is desired.” He knew one hundred of them by name. “And it may be safely assumed,” he concluded, “that the service, which these 200 men can render in the field is incomparably less than that which they could render” using their skills to make Confederate armaments.\(^{42}\) Brooke was particularly frustrated that construction and operation of a new, well-equipped cannon foundry and rolling mill at Selma were repeatedly stymied by the removal of skilled hands.\(^{43}\)

Confederate naval historian Raimondo Luraghi contends that the lack of munitions artisans posed a more serious threat to the Southern cause than did the shortage of sailors.\(^{44}\) While the navy was generally the least

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42. Brooke to Stephen Mallory, 30 April 1864, reports submitted by Confederate Secretary of the Navy to the Confederate Congress, 1861–1865, folder November 1863–April 1864, Navy Records transferred from RG45 to RG109, NARA.

43. See Brooke’s correspondence with the supervisor of the Selma foundry and rolling mill, Capt. Catesby ap R. Jones, 12 February 1864, 17 August 1864, 25 August 1864, and 8 September 1864, RG109, M1091 (Subject File of the Confederate States Navy, 1861–1865), roll 9, file BA, Ammunition (Papers of Catesby ap R. Jones), NARA. See also Jones to Brooke, 8 May 1864 and 14 May 1864, reprinted in Ainsworth and Kirkley, 3:523; and Jones to Brooke, 12 December 1863, RG109, chap. 9, M437, roll 131, J2, NARA.

well-equipped branch of the Confederate military, the labor problems at naval ordnance facilities were typical for the ordnance industry as a whole. Throughout the war, Joseph Reid Anderson peppered military officials with pleas and demands that individual artisans be detailed to the Tredegar Iron Works so that the company could fulfill government contracts for field cannon and other ordnance. Few of his requests were granted.\(^4\) Anderson’s most successful move was creating a home guard unit in June 1861, known as the “Tredegar Battalion,” which sequestered up to three hundred workers from battlefield duty by confining them to Tredegar under the command of Anderson, now a general. Other ordnance manufacturers attempted to copy the Tredegar model, and in 1864 Gorgas proposed legislation that would attach all ordnance workers to plant-based military units.\(^4\) Only Anderson’s forceful personality and his local influence in Richmond made the home guard strategy effective. Elsewhere, military recruiting officers and government officials routinely violated Confederate laws that exempted skilled ordnance workers from field duty. Even Jefferson Davis failed to enforce the exemptions meant to safeguard arms production.\(^4\)

One of the most revealing commentaries on the labor crisis in Confederate iron was written by J. W. Lapsley, a leading partner in the Shelby Iron Works throughout the war. Lapsley warned the secretary of war in February 1864 that the continuing interference of Confederate conscription officers at Shelby and other ironworks threatened to drive away skilled workers. “These men do not feel identified in any great degree with the South, and are not imbued with sentiments and feelings calculated to

45. Anderson to Seddon, 29 July 1863, RG109, chap. 9, M437, roll 80, A150, NARA. For other Anderson letters requesting details of skilled ironworkers and other favors to assist production at the Tredegar works and its suppliers, see roll 30, A406, A414, A460, A461, A462, A463, A471, A503, A510; roll 80, A66, A107, A149, A152, A264, A351.
47. Ella Lonn, Foreigners in the Confederacy (Chapel Hill, N.C., 1940), 394–401; William L. Shaw, “The Confederate Conscription and Exemption Acts,” American Journal of Legal History 6 (1962), 368–405. The first Confederate legislation granting exemptions, passed on 21 April 1862, included among exempt occupations “all artisans, mechanics, and employés in the establishments of the Government for the manufacture of arms, ordnance, ordnance stores, and other munitions of war . . . who may be certified by the officer in charge thereof, as necessary for such establishments; also, all artisans, mechanics, and employés in the establishments of such persons as are or may be engaged under contracts with the Government in furnishing arms, ordnance, ordnance stores, and other munitions of war: Provided, that the chief of the Ordnance Bureau, or some ordnance officer authorized by him for that purpose, shall approve of the number of the operatives required in such establishments . . . ;” “An Act to exempt certain persons from military duty . . . ,” reprinted in Ainsworth and Kirkley (n. 3 above), 3:160–62.
impress them so strongly in favor of our cause, as to induce them to make any great sacrifices of interest or feeling in its behalf. They are generally without families. . . . So far, those of them who have remained, have been induced to do so by the very high wages paid them. . . . If these men were left to draw their own conclusions from the facts, uninfluenced by other causes, it is but reasonable to conclude that more or less of them would be induced to leave this country.”

Rumors were abroad that General Ulysses S. Grant was offering Southern ironworkers a bounty of six hundred dollars to switch allegiance to the Union, where ironworkers were reportedly exempt from military service. (In fact, they were not exempt.) Even without such temptation, many men were hard-pressed to remain at works threatened by advancing Northern forces. Detention at a Confederate training camp gave skilled men a final reason to defect: “These men . . . are apt to regard their position as insecure, and to conclude that if they can be thus summarily taken from their work to a conscript camp, they may some day be suddenly summoned into the field. . . . The effect of such proceedings is unfortunate, and any thing but assuring to these workmen. They are as a class, very clannish, and what they regard as harsh treatment of any of their number, is resented by all. True policy would I think dictate the most liberal and assuring course toward men so indispensable [sic] to our cause.”

By the best estimates, which admittedly are anecdotal and incomplete, Confederate heavy ordnance producers lost from one-quarter to one-half of their workforce to conscription and desertion by the end of 1864. In addition to Lapsley’s explanation that skilled ironworkers were inclined to flee unpleasantness, Confederate records hint that military officers resented the special treatment that industrial artisans received and may have targeted them for conscription. Confederate naval officers complained bitterly that ordnance workers’ pay kept pace with wartime inflation while fixed military wages reduced them and their families to “the point of destitution, or of charitable dependence.” A lieutenant from the Talladega, Alabama, enrolling office harassed the Shelby Iron Works constantly, once forcing a tense showdown with the rolling mill manager over the company’s allegedly harboring a deserter. It is also possible that Confederate officers genuinely

48. Lapsley to Seddon, 15 February 1864, RG109, chap. 9, M437, roll 132, L68, NARA.
49. The Enrollment Act of 3 March 1863 eliminated occupational exemptions in the North. Drafted men could avoid service by paying a three hundred dollar commutation fee or providing a substitute; see James W. Geary, We Need Men: The Union Draft in the Civil War (DeKalb, Ill., 1991), 66. Northern workers commonly but erroneously believed that men employed by federal arms manufactories were exempt from service; Deyrup (n. 39 above), 199–200.
50. Lapsley to Seddon, 15 February 1864, RG109, chap. 9, M437, roll 132, L68, NARA.
51. Dew, Ironmaker to the Confederacy (n. 1 above), 238–39.
52. John K. Mitchell to Stephen Mallory, 16 November 1863, Navy Records transferred from RG45 to RG109, NARA; G. A. Myers to Seddon, 27 January 1864, RG109, chap. 9, M437, roll 134 (December 1863–February 1864), M(WD)77, NARA; charges
did not understand the consequences of removing skilled ordnance workers from their posts. Had Southern gentlemen better understood heavy industry, Anderson and Brooke might not have had to struggle so hard to secure the labor they required.

Immigrants and Slaves at Tredegar and Shelby

Military and company records strongly suggest that two of the Confederacy's most important heavy ordnance producers maintained production by employing a mix of skilled white workers, including many immigrant artisans, and black slaves. Evidence regarding the Tredegar Iron Works' wartime workforce comes from 1863–64 muster rolls of the Sixth Battalion Virginia Infantry (the "Tredegar Battalion") and from an 1864 volume in which Confederate officials recorded exemptions granted to men in Virginia in 1864.53 Each of these sources lists characteristics that were crucial to determining a man's eligibility for exemption, including his occupation and place of birth. In combination, the muster rolls and exemption volume yield a list of 172 men of known origin, age, and occupation in the Tredegar Battalion, or 53 percent of its members.54

While no list of names can be relied on completely, the people who compiled these documents had reason to be as accurate as they could. As

against the Shelby Iron Co. near Columbiana, 5 June 1863, signed by P. L. Griffiths, Lt. and Enrolling Officer, 4th Alabama District, Correspondence—Labor—Incoming 1861–1863, correspondence files 002, Shelby Iron Works Papers (hereafter SIW002). The alleged deserter, F. M. Jordan, remained at Shelby until the end of the war; see list of men at Shelby Iron Works detailed from the army, 14 March 1865, SIW003.

53. Tredegar Battalion muster rolls, RG109, M324, roll 452, NARA; Record of Enlisted Men Detailed, January–November 1864, Ordnance Department, RG109, chap. 4, vol. 107, NARA. Strictly speaking, men who were detailed were not exempt from service but were sequestered from service by being assigned to military duty away from battle, as in the case of ironworkers assigned to the Tredegar Iron Works' home guard unit. The volume does not make clear whether all the men listed, including many farmers, were actually detailed or were listed because of legal exemption from military service.

54. The two sources differ in the categories they include and the completeness of their information. The muster rolls give ages for all men and place of birth and occupation for about 40 percent of them. The record of exemptions gives name, age, place of birth, and occupation for all men. My method for determining place of birth and occupation for Tredegar Battalion members was to compare name and age for all men in the muster rolls to the exemptions register. This was made possible by the clustering of exemptions by occupation and geographical location in the register: metalworking occupations were most heavily clustered in pages labeled "Richmond." To qualify as a match, entries in the muster rolls and the Virginia register had to have exactly the same last name, though not necessarily the same spelling: have the same first and middle initials (allowing for probable transcription errors such as "T." becoming "F") or the same full first name, if provided; be of the same age, within five years; and either (a) have the same occupation, (b) have the same birthplace, or (c) live, according to the exemption register entry, in a section of Richmond heavily populated by ironworkers.
we have seen, military officials only grudgingly granted “details” (exempting a man from field service in order to work at a government-supervised armaments facility). This was particularly true during the last eighteen months of the war. Manufacturers had to justify each industrial worker’s exclusion from field service by pleading the necessity of his particular skill. This is why the Virginia volume distinguishes, for example, between brass smelters, brass molders, and brass finishers in a cannon foundry. Similarly, Joseph Reid Anderson had to make the case for each member of Tredegar’s home guard unit. Exemption laws required accurate information (including nativity, because of the exemptions protecting foreign-born residents in the South), and it was in employers’ interest to provide it. Thus the Tredegar Battalion muster rolls and the Virginia register are probably more reliable than any U.S. population census of the period.

The compiled birthplace information shows that the majority of white ironworkers at Tredegar and in Richmond as a whole had been born in Virginia. Virginians accounted for 63 percent of Tredegar Battalion members of known origin, men from the rest of the South scarcely 5 percent. The same was true for industrial artisans across the city: 62 percent were Virginians, 5 percent from other Southern states. After Virginians came workers born in the British Isles, the Irish being most numerous, then the English, then Scots. Neither source listed any Welshmen. A higher proportion of Tredegar Battalion members came from Great Britain than was true for the workforce at other Richmond facilities. Most of the remaining ironworkers came from the Northeast, notably Pennsylvania, or from Germany.

At Tredegar, European immigrants were concentrated in skilled metalworking occupations. They accounted for 47 percent of rolling mill artisans, 43 percent of machinists, 33 percent of those in positions involving engineering and industrial design, and 29 percent of foundry and forge artisans. A. G. Osterbind, a German immigrant, was superintendent of the rolling mill, and Englishman Peter S. Derbyshire supervised heavy ordnance production in the foundry. The proportions of Europeans were not so great in other Richmond ordnance factories, although Northern-born artisans were slightly more important. In the city overall, 28 percent of rolling mill workers were Europeans, 23 percent of engineers and industrial designers, and 19 percent of foundry and forge workers. Small arms manufacturers employed mainly Virginians.

55. Although the Welsh were often misidentified as English in mid-nineteenth-century sources (see Knowles [n. 7 above], 4–13), the overall precision of the Virginia register and Joseph Reid Anderson’s familiarity with and dislike of the Welsh may well mean that no Welsh were working in the Richmond iron industry in 1863–1864.

56. Similar proportions of Southern, Northern, and European workers were listed as employees at the Macon Armory in 1863–1865: 75 percent from Southern states (44 percent from Georgia), 13 percent from the British Isles, 10 percent from Northern states, and 2 percent from Germany. Roll of Employees, Macon Armory, Georgia, 1863–1865, Ordnance Department, RG109, chap. 4, vol. 46, NARA.
This evidence suggests that Tredegar probably had the most European workforce of any Confederate ironworks and that white men held most, if not all, artisanal positions. While it is possible that slaves held the skilled positions that are not accounted for by the Tredegar Battalion muster rolls, it seems unlikely that white rolling mill workers would have tolerated black puddlers, heaters, and rollers any better during the war than they had in 1847.\textsuperscript{57} The muster rolls include many more of the skilled white workers in Tredegar’s foundry and forge, as well as forty-two white machinists. Anderson did not claim to employ slaves in these trades, nor does the evidence suggest that any were needed.

The composition of the Shelby Iron Works workforce during the war is much more clear, thanks to the survival of detailed company records. Shelby’s government-funded expansion in 1862 included the construction of a new furnace and extensive remodeling of the rolling mill to add eight new puddling furnaces, five heating furnaces, and a rotary squeezer. The company also built houses for its new white artisans and superintendents.\textsuperscript{58} The augmented workforce for the expanded facility included about sixty white men at the blast furnaces and rolling mill, as well as three salaried superintendents, a bookkeeper, and the president of the company, who worked as general manager.\textsuperscript{59} The white furnace workers included engineers, carpenters, a furnace mason, a pattern maker, molders, and laborers, as well as crews of blacksmiths and carpenters. The rolling mill employed about a dozen white men as puddlers, heaters, rollers, and roughers. They and their assistants produced bar iron, iron plate, rails, and small amounts of spikes and nails.\textsuperscript{60}

A few white men were overseers of slave work crews who chopped wood, made charcoal, hauled coal and provisions, built roads, and charged the furnace. The slave workforce also included craftsmen such as carpenters, shoemakers, tanners, and brick masons. The small number of female slaves at Shelby presumably cooked and laundered for the men and tended agricultural plots (the managers tried to limit their proportion to no more than one in ten of the resident black population).\textsuperscript{61} The number of slaves

57. Gregg Kimball estimates that Tredegar’s rolling mill required about forty-six skilled workers during peak production (full day and night shifts); Kimball (n. 30 above), 15 n. 27. The muster rolls account for only seventeen rolling mill workers.


59. On the original management structure of the company, see minutes of meetings of the board of directors, 1862–1866, esp. 4 September 1862, SIW002.

60. Employee and Negro Time Records, March 1862–December 1868, ledger no. 5, Shelby Iron Works Papers; payroll no. 10, week ending 10 March 1865, Correspondence 1865, SIW003; Employee Lists, Extra Work 186–1864 [sic], and Employee records, lists, pay, etc. [black and white workers] (1863–1864), SIW001.

employed at Shelby appears to have fluctuated considerably over the course of the war, depending on the availability and cost of slaves for hire, but probably never dropped below a total of three hundred men, women, and children, of whom perhaps 20 to 30 percent were owned by the company. In 1862 most of the slaves hired by the company came from cotton plantations in Alabama. As Union forces pressed deeper into the South, some planters withdrew their slaves or declined to renew rental agreements with Shelby, compelling commissioning agent J. M. Tillman to travel farther and farther in search of labor.62

The great majority of slaves at Shelby did heavy manual labor in support of iron production while white workers smelted, refined, and finished the iron. A few hired slaves described as “good furnace hands” may have been experienced forge carpenters and blacksmiths. Their owner claimed that “one of these boys is an engineer—Ja[me]s. Hunt was a rock blaster [and you could] put him [to work] at same.”63 As was typical at this time, the Shelby labor records are frustratingly mute on the actual work done by James Hunt or any other slave. Surviving labor rosters merely log the number of days worked by male slaves. The most detailed records note that slaves earned extra money by cutting wood for charcoal, hewing ore, hauling provisions, and serving as night watchmen. Two work entries note that slaves produced a small number of spikes or nails, but there is no other evidence that slaves worked in the rolling mill during the war.64

Thus Shelby strictly segregated labor by race and skill. Only once did the company attempt to breach the divide. In the autumn of 1864, Shelby’s

62. Various correspondence from slave owners to Shelby Iron Company offering and contracting for hire of slaves, SIW001-003; balance sheet for Shelby Iron Company, 31 December 1863, Statements (1862–1864), SIW001. At the end of the war the company owned at least twenty-nine adult male slaves; Time of hands Belonging to Shelby Iron Co. for Work Done on the Ala. and Tenn. RR Road, 26 April–12 May 1865, Correspondence 1865, SIW003; Incoming re: slave labor, 1862, Correspondence, SIW002; list of Tillman’s travels to Mississippi and Mobile, Alabama to hire negroes in January 1863, Accounts, SIW003.

63. Sam[uel] Kirkman to A. T. Jones, 27 September 1862 (emphasis in original), and J. J. Hutchenson to A. T. Jones, 16 December 1862, Incoming re: Slave Labor, 1862, Correspondence, SIW002.

64. Extra Time at Ore Bank and Cuttin Pudling Wood, May 1864; Extra time at the Ore Bank & Cutting wood for April 1864; Extra Wood (n.d.); Unloading Cord at night, 31 October [18]64; and Coal halling on Sunday 30 October [18]64, unlabeled folder of correspondence, 1864–1865, SIW002. Report of Work done by the Ore Bank hands from 1 May to the 15th of December 1863; Employee lists [black and white], extra work 186–1864 [sic], list of “wachmenn (watching all night),” 29 December 1864; Wood choppers, 14 November 1863, SIW001. Employee Lists, Extra Work 186–1864 [sic], notes of 1 August and 31 October 1863, Incoming Correspondence and Other Items, 1862–64, SIW001. The “ore bank” at Shelby was a surface deposit that was probably worked by the method Ohio miners called scraping or benching, a kind of shallow strip mining in which men used a metal scoop to dig ore directly from the hillside, leaving stepped banks; Knowles (n. 7 above), 172.
officers drew up a plan to add two new puddling furnaces and build a rail-
road spur to bring coal directly to the rolling mill. These changes in pro-
duction capacity required a larger skilled workforce, which manager
Andrew T. Jones intended to acquire at least in part by hiring black pudd-
dlers. Jones wrote to Major Thomas Peters, commander of the Confederate
Quartermasters Department in Selma, that he needed “a practical rolling
mill manager, a real active fellow who can manage negroes [for whom] we
would pay a big price.” A month later, Peters wrote to Jones, “Col. Hunt
informs me that you had, sometime since, two negro puddlers whom you
could not use on account of opposition from your white puddlers. If you
have these men still I think I can exchange them . . . [for] two white pudd-
dlers if you so desire.” Jones did not attempt to force white workers to
accept black artisans at the rolling mill. Nor did he replace the company’s
rolling mill manager, a Welshman named Giles Edwards.

The Shelby company papers show a consistent policy of hiring experi-
enced white artisans for the rolling mill and using slaves for other tasks.
White workers provided what Jones called “efficient labor” in striking con-
trast to Anderson’s argument for the efficiency of slave labor. In return for
white workers’ much needed skills, Shelby provided good housing, com-
petitive wages, and occasional favors, such as paying for magazine subscrip-
tions or allowing artisans to borrow the labor of slaves for personal use. The
company quickly abandoned the notion of installing slaves as puddlers
because it could not risk losing white artisans. If skilled slaves enjoyed
exceptional degrees of personal freedom at Southern ironworks, skilled
whites possessed even stronger leverage in their relations with Southern
employers, at least when employers wanted to retain their services.

65. Unlabeled folder of correspondence, 1865, SIW003.
66. Jones to Peters, 16 December 1864, Company Correspondence, Outgoing from
A. T. Jones, President . . . 1862–1864, SIW001; Peters to Jones, 16 January 1865, and
R. B. G. to Jones, 26 January 1865, unlabeled folder of correspondence, 1865, SIW003.
67. Jones to Gorgas, 16 July 1862, Correspondence, Outgoing re: Labor, 1862,
SIW002.
68. J. M. Tillman to C. J. Hazard, 2 July 1863, Correspondence, Internal re: supplies,
1863, SIW002; Report of Work done by the Ore Bank hands from 1 May to the 15th of
December 1863, SIW001.

T. Stephen Whitman, “Industrial Slavery at the Margin: The Maryland Chemical
Slavery in the American South, 1820–1860: A Quantitative History (Chicago, 1976);
Robert Starobin, Industrial Slavery in the Old South (New York, 1970); Richard Wade,
most to document the range of freedoms allowed and exercised by slaves at Southern
ironworks. “Disciplining Slave Ironworkers in the Antebellum South: Coercion,
Conciliation, and Accommodation,” American Historical Review 79 (1974), 393–418;
“Slavery and Technology in the Antebellum Southern Iron Industry: The Case of Buffalo
Forge,” in Science and Medicine in the Old South, ed. Ronald L. Numbers and Todd L.
Savitt (Baton Rouge, La., 1994): 107–126; and Bond of Iron (n. 12 above).
Labor relations at industrial plants the size of Shelby sometimes hinged on the character and actions of a few individuals. One such figure was Shelby investor and officer J. W. Lapsley, the Southerner who tried to convince the Confederate secretary of war to treat white artisans well. Another key person was Giles Edwards (fig. 2), who was hired in the spring of 1862 to remodel Shelby’s rolling mill and expand the skilled workforce. Edwards was born in Merthyr Tydfil in 1824, the son of a collier. He grew up in the shadow of the Cyfarthfa and Dowlais ironworks, at the time two of the world’s largest and most technologically advanced industrial facilities. As a boy he showed precocious talent at mechanical drafting. When he emigrated to America with his sister and their widowed father in 1842, he was already an accomplished pattern maker and soon got work in Carbondale, Pennsylvania. Later that decade he moved to Scranton and then to Cataqua, where he lived near ironmaster David Thomas and worked as a

70. 1841 Manuscript Census, Merthyr Tydfil, Glamorganshire, microfilm ref. no. HO 107/1415, enumeration district 23, Public Record Office, Kew Gardens; Ethel Armes, The Story of Iron and Coal in Alabama (Birmingham, Ala., 1972), 172–74; plan of Merthyr Tydfil, from actual survey, 1836, attributed to John Wood, Glamorgan County Record Office. My thanks to Sandra Wheatley, University of Wales, Aberystwyth, for providing me with the 1836 plan and helping me determine the location of Giles Edwards’ home on this and other nineteenth-century maps.
pattern maker in the Lehigh Crane Iron Works. A few years later he worked on the construction of the Thomas Iron Works in Hockendauqua.71 By 1855 Edwards had moved again, this time to take a supervisory position at the Cambria Iron Works under John Fritz, who then recommended him to supervise construction of a rolling mill at Bethlehem, Pennsylvania. Fritz also probably helped Edwards get his first job in the South.72 Edwards moved to Chattanooga, Tennessee in June 1859 to superintend the rebuilding of Bluff Furnace, making it the first furnace in the southern Appalachian iron region to smelt iron ore with coke.73

In addition to his technical expertise and breadth of experience, Edwards was an asset to the Shelby Iron Company because his network of contacts extended from Wales to Alabama. Shortly after arriving at Shelby, he set out to recruit rolling mill workers from Chattanooga, Atlanta, Selma, and Montgomery. Nine men soon joined him, including Evan Thomas (furnace builder), D. James (roller), H. T. Beggs (molder), Florance Donovan (finisher), and W. G. Moyle (engineer).74 Puddler and roller David J. Davies, also recruited in 1862, may be the Welshman of the same name who

71. U.S. manuscript population census, 1850, Hanover Township, Lehigh County, Pennsylvania; Armes, 174–75. Armes gives the location of the Thomas ironworks as Tamaqua, but in fact there were no major ironworks there. The Thomas works, built in 1855 in Hockendauqua, are probably where Edwards worked and may have gained his first experience in designing a rolling mill. Lesley (n. 4 above), 8–9.

72. Edwards to Fritz, 20 April 1855, 21 April 1855, 25 April 1855, and 28 April 1855, John Fritz Papers, National Canal Museum. Fritz knew of Edwards’ work in Chattanooga and was interested in investing in ironworks in the area. Edwards to Fritz, 18 July 1859; L. R. Speer to Fritz, 18 July 1860, 31 July 1980, 6 September 1860, 15 September 1860, Fritz Papers. Armes describes Edwards as a protegé of David Thomas and claims (based on the recollections of Edwards’ family) that he left Thomas’s employ because of poor health; see Armes, 175. A letter from Edwards to Fritz suggests another explanation. In 1858 Edwards was out of work (the Cambria rolling mill having closed). He appealed to Fritz for a particularly strong recommendation for a job to supervise construction of a rolling mill at Bethlehem, Pennsylvania, because “The Thomas’es [company] has also been applied to for information concerning me, but has resulted rather disastrously [sic] to my success, and I may add, that, they have acted in a very vindictive manner towards me.” Edwards to Fritz, 27 February 1858, Fritz Papers (emphasis in original).


74. Account of Giles Edwards’ Expenses for Trip to Chattanooga, 30 April–8 May 1862, unlabeled folder with correspondence and notes, 1862–1863, SIW002; Accounts of Giles Edwards, May–December 1863, June–July 1862, and February–May 1863, Statements, 1862–1864, SIW001; Employee and Negro Time Records, March 1862–December 1868, list for March 1863, ledger no. 5, 53–070, Shelby Iron Works Papers. The spelling of Moyle’s name as “Moel” (a phonetic Welsh spelling) in a few company records lends credence to family tradition that Edwards was a native Welsh speaker, as the majority of ironworkers in Merthyr Tydfil were in the 1830s and 1840s. For the family story, see Ethel Armes, “The Ironmasters of Alabama: The History of Giles Edwards,” Advance, 17 November 1906, front page.
participated in the Tredegar strike in 1847. If so, he may have been especially pleased to see black puddlers turned away from Shelby. Several English-born artisans from the Etowah Iron Works also joined Shelby later in the war.\footnote{Richmond City Court Hustings Minutes no. 17, Tuesday, 20 April 1847, reel 91 (1846–1848), Library of Virginia, Richmond; U.S. manuscript population census, 1850, City of Richmond, Henrico County, Virginia; D. J. Davies to Giles Edwards, 12 October 1862, Correspondence—Labor—Incoming, 1861–1863, SIW002; U.S. manuscript population census, 1850, Cass County, Georgia. Davies remained at Shelby through the Civil War: Employees Time Record, 1862–1864, ledger no. 5, 53–070, Shelby Iron Works Papers; payroll no. 10, Correspondence 1865, SIW003.}

Giles Edwards’ career embodies the tradition of British “tramping artisans” recast in a new context. He gained technical skills and broad knowledge about the operation and design of rolling mills by working for various employers. In the United States, his new jobs increasingly required him to solve problems peculiar to industrial frontiers, such as finding the correct mix of ingredients and techniques to produce good iron from local ore and coal. He also gained experience managing issues that arose in mixed-race workforces in the South. Edwards’ combination of technical acumen, diligence, personal contacts, and understanding of the work cultures of Northern, British, and Southern ironworkers proved invaluable in Alabama. He was typically “clannish” in the sense J. W. Lapsley meant: he hired friends and acquaintances, showed some preference for fellow countrymen from Wales, and aggressively protected his carefully gathered workforce from Confederate conscription. Shelby never suffered labor shortages serious enough to curtail production during the war—only the extreme scarcity of supplies in late 1864 and early 1865, and the encroachment of Union forces, did that. Edwards was the pivotal character in carrying out Shelby’s labor policy. The white artisans he hired and whose presence he considered essential to the ironworks’ operation deserve most of the credit for the Shelby Iron Works’ steady productivity during the war.

The Destabilizing Effects of Technological Change

Labor scarcity is a hallmark of wartime industry. During the Civil War, Northern arms manufacturers suffered shortages of skilled labor that grew more acute as the war dragged on. Industrial workers in the North took advantage of their exceptional position by demanding higher and higher wages and threatening to strike against their employers.\footnote{Deyrup (n. 39 above), 197–201; Grace Palladino, Another Civil War: Labor, Capital, and the State in the Anthracite Regions of Pennsylvania, 1840–68 (Urbana, Ill., 1990).} Labor shortages in the Confederate iron industry, however, were exacerbated by Southern elites’ distrust of skilled white labor and their desire to control white and
black labor to an extent that choked the transfer of new technologies and seriously hampered the wartime transformation of Southern industry. The views expressed by J. W. Lapsley and John Brooke were unusual, for few of their contemporaries so closely equated Southern interests with heavy industry. Lapsley and Brooke also had strong personal interest in increasing iron production, Lapsley as a businessman and Brooke as a naval ordnance officer. The most telling perspective was that of Joseph Reid Anderson. An ardent advocate of industrial slavery, he relied upon free white artisans at his own enterprise. He publicly opposed “foreign” labor but may have employed more Europeans than any other Southern ironmaster. The struggle—or the hypocrisy—of his ideological commitment and his managerial decisions reveal the profound conundrum of Southern industry. The managers of the Shelby Iron Works found a workable solution in a mixed workforce strictly segregated along lines of race and occupation, a formula that came to typify Southern heavy industry after the Civil War.\(^77\)

The labor crisis in the Confederate iron industry hints at tensions buried deep in the fundamental relationship between skilled workers and their employers. These tensions were acute in the antebellum and Civil War South. Charles Dew found that Southern ironmasters had to strike “a delicate balance” between coercion and reward in order to extract sufficient labor from slave artisans. This balancing act, he writes, “placed a premium on stability, on getting the work done in old, familiar ways. It afforded precious little incentive toward change and technological innovation. It was, in sum, profoundly conservative.”\(^78\) Technological change destabilized the old system. Southern industrialists found they had to bargain with men they could not coerce. The tremendous pressure of war exposed the weaknesses of the Southern iron industry: insufficient labor supply, insufficient skill, and an ownership class unwilling or unable to acknowledge the crucial link between labor and technology in modern industry.

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77. Lewis (n. 14 above).
78. Dew, “Slavery and Technology” (n. 69 above), 118–19, 124.