IRONWORKS ON RED CLAY CREEK IN THE 19th CENTURY

The Wooddale and Marshallton Mills of
New Castle County, Delaware

By
Carroll W. Pursell, Jr.

IRONWORKS ON RED CLAY CREEK IN THE 19th CENTURY

The Wooddale and Marshallton Mills of New Castle County, Delaware

By

Carroll W. Pursell, Jr.

Published by
Historic Red Clay Valley, Inc.
Wilmington, Del.
1962

Republished digitally by HRCV – 2019

This publication is,

In recognition of the 150th anniversary of the forming of the
Wilmington & Western Rail Road company in 1869,
And dedicated to the memory of HRCV founder,

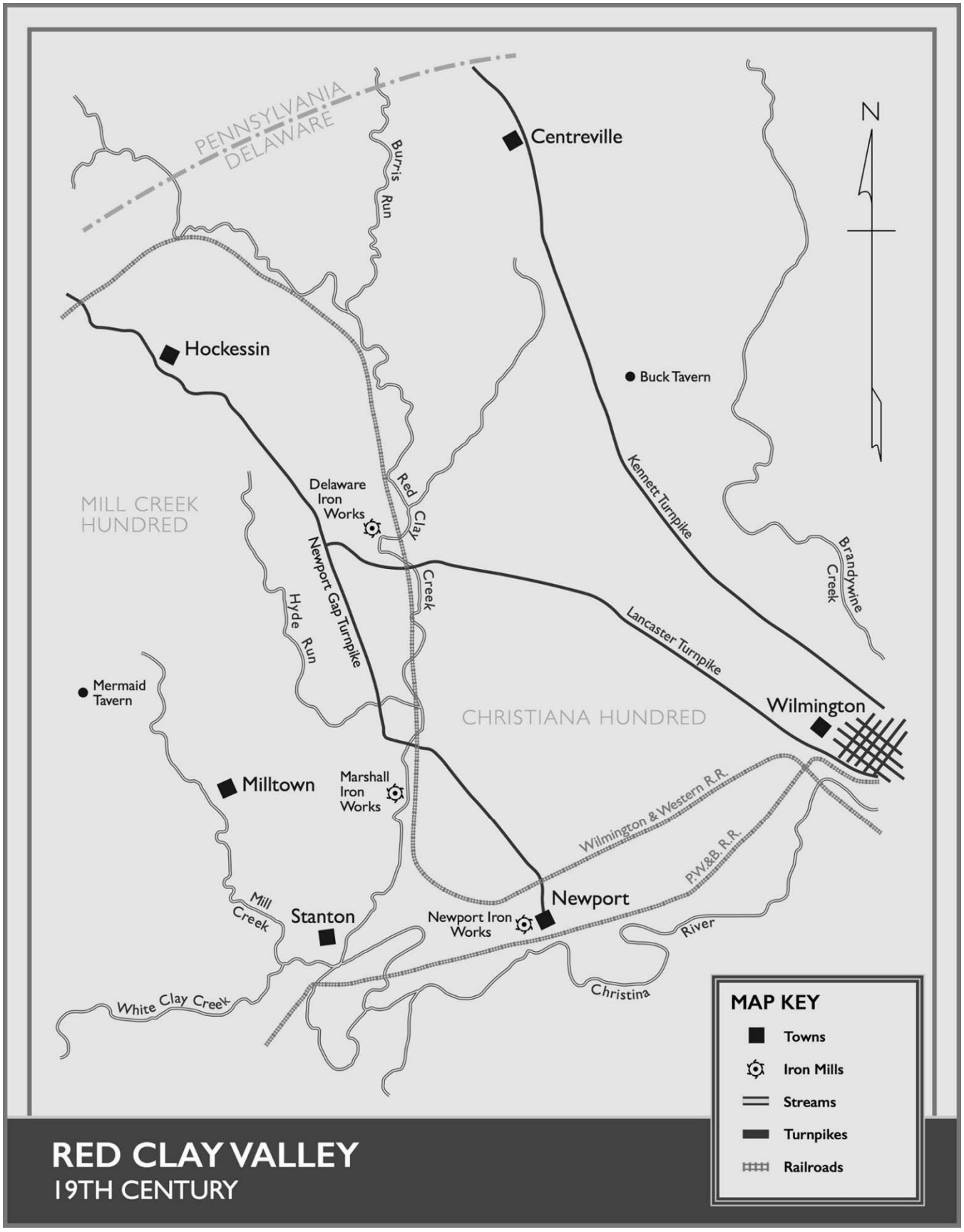
Thomas Clarence Marshall, Jr.

February 20, 1924 ~ February 12, 2019

Educator, Humanitarian, Philanthropist, Preservationist

"The best thing to make in life, is to make a difference!"

Thomas C. Marshall, Jr. and a 1914 Stanley 10 Horsepower Model 607. Shown here in 2013 after restoration, this was the first Stanley purchased by Tom in 1946.



(original map at back of monograph)

Other Monograph Publications of Historic Red Clay Valley, Inc.

140 Years Along Old Public Road by C. A. Weslager, 1960

The Old Hollingsworth Plantation by C. A. Weslager, 1961

The Story of the Wilmington & Western R.R. by A.G. Volkman, 1963

The Faulkland Spice Mill and the Greenbank Mill by Carroll W. Pursell, Jr., 1964

Note Regarding the 2019 2nd Edition

This document was digitally scanned to high resolution images from a copy contained in the Historic Red Clay Valley Archive collection. Optical character recognition was performed and the document transferred to Microsoft WORD for editing.

Editing involved formatting for letter-size pages (the original monograph was printed in a 6" x 9" page size). As a result, the page numbers in this document do not match the page numbers of the originally published monograph. To improve readability, the font size has been increased over what was originally used for the printed monograph. The author's original numbered footnote references are unchanged.

HRCV has elected to build on the author's work with this reissue. Spelling and grammar have changed in the fifty years since this manuscript was originally presented. Where applicable, spelling and grammar changes have been made to bring the text in align with current grammar and spellings. Lettered footnotes refer the reader to new information as well as the original spelling and grammar references at the back of the manuscript.

New facts have been uncovered as well as other relevant information related to the author's original content. Any new facts and information included are printed as part of the letter footnotes at the rear of the monograph. Original photos and drawings have been updated where possible with the originals referenced by letter footnote at the end of the monograph.

This monograph is being released by HRCV in recognition of the 150th anniversary of the Delaware Legislature's Act revising the identity of the Delaware & Chester County Railroad to the Wilmington & Western Rail Road (Laws of the State of Delaware, Volume 13, Chapter 491; March 10, 1869). With this change of corporate identity and a new slate of highly-regarded Delawareans in control of the enterprise, progress on the new railroad progressed rapidly. On October 19, 1872 their efforts were rewarded with the railroad's first day of operation.

Robert E. Wilhelm, Jr., Editor, 2019

Historic Red Clay Valley, Inc., is a non-profit organization engaged in promoting interest in the social and economic history of the Red Clay Creek Valley.

INTRODUCTION

On September 4 and 5, 1871, the Wilmington *Every Evening* published the report of two local citizens who had made a walking inspection tour of the Wilmington and Western Rail Road[A] then under construction. Beginning near the town of Newport, the two had followed the Red Clay Creek upstream as far as Yorklyn. "Here, along this beautiful valley," one of them wrote, "it seems to us, as we strolled through it in early morning; must arise the pleasant villas which are to be in the near future *the country homes of our citizens*." Along the route the reporters had noted Marshall's Rolling Mill – "old and well known sheet-iron mills doing an excellent business" – and Wood's Rolling Mill – "well known and extensive iron works near the Lancaster pike about five miles from this city."

Now, nearly a century later, the reporter's prophecy has proved correct. The Red Clay Valley has lost its industrial flavor and has become a place for "homes of our citizens." But the watchful observer who passes through the valley today can still find many signs of the industrial activity of centuries past. Driving westward from Wilmington to Newark, one may look to the right as he crosses the bridge over the Red Clay Creek just beyond Prices Corner, and see the old millrace which delivered power to Marshall's rolling mill. Or driving northwestward along the Lancaster Pike from Wilmington, turn north just before crossing the Baltimore & Ohio Railroad tracks, and pass by the "deep cut" of the old Wilmington and Western and the millrace and "tenements" of Wood's rolling mill.

The net of history is selective – some facts are caught for posterity and some slip away forever. Wooden mills beyond the range of fire companies burned with distressing regularity, consuming records with the rest. Families carefully buried the bones of their dead, and then destroyed the papers and records the deceased generated thus effectively erasing their existence. But fortunately, neither time nor family have been able to wipe the slate completely clean. An Eleutherian Mills – Hagley Fellowship gave the author the chance to discover those facts about Red Clay industries which remained, and the kindness of Historic Red Clay Valley, Inc., has made it possible to make them more generally available in this form. To them, and to C. A. Weslager, I am particularly grateful.

Chapter 1

If a strong basic iron industry was the industrial prerequisite of national power during the nineteenth century, the young United States in 1800 already showed promise of developing into a robust contender for that honor. Founded in the seventeenth century, the American iron industry grew steadily for a century and a half despite Indian raids and British alarm at potential competition. By the time of the American Revolution, the colonies were producing one seventh of the world's supply of pig iron; more even than was Great Britain herself.[1]

This infant industry clung close to the Atlantic Coast, but was scattered along the seaboard from Maine to the Carolinas. No colony except Georgia was without some activity at one time or another and in most, production was increasing and nearly continuous. As the eighteenth century wore on, the center of this production shifted slowly from the bogs of New England to the pits of Pennsylvania. By 1800 the Delaware River had become the axis of activity which included numerous mines in New Jersey, Delaware, and Pennsylvania.[2] In later years this center was to shift again, to the westward, but for the time Philadelphia was the focus of the American industry.

Although iron ore was noticed in New Castle County during the seventeenth century, particularly in the vicinity of Iron Hill, it was not until about 1722 that a small furnace was set up in the county to exploit this resource. This first furnace, of the type known as a bloomery, was built by John Ball and named after the St. James Church, near which it was built on White Clay Creek.[3] A few years later Sir William Keith, for a short time Governor of Pennsylvania, was also tempted to build a furnace near Iron Hill. His was located near Cooch's Bridge close to the mines, but like Ball's, it, too, failed after only a short time.[4] The third and last attempt to establish an iron industry in the county was made about 1725 by Samuel James, one of the early settlers of the Welsh Tract in Pencader Hundred. This furnace, named the Abbington, was located near Governor Keith's at Iron Hill, but appears to have lasted a bit longer. It, too, was abandoned long before the Revolution.[5]

With the failure of the Abbington Furnace, attempts to produce pig iron in New Castle County were abandoned for many years. No doubt many reasons contributed to the failure of the industry to become established. One of the most important was certainly the fact that colonial iron furnaces consumed huge quantities of wood in the form of charcoal. For making sufficient charcoal, forest lands were needed by the hundreds of acres and iron furnaces were therefore almost necessarily located in the back country, far from the farms and towns of the coast. New Castle County was not the best available location for such operations.

[1] - Arthur Cecil Bining, *Pennsylvania's Iron and Steel Industry* (Gettysburg, 1954), p. 2.

[2] - Arthur Cecil Bining, *Pennsylvania Iron Maufacture in the Eighteenth Cen*tury (Harrisburg, 1938), *passim*; Israel Acrelius, *A History of New Sweden* . . . , trans. William M. Reynolds. Memoirs of the Historical Society of Pennsylvania, XI (Philadelphia, 1874), p. 164.

[3] - Bining, *Pennsylvania Iron Manufacture*, p. 187.

[4] - *Ibid.*, p. 53.

[5] - *Forges and Furnaces in the Province of Pennsylvania*. Pennsylvania Society of the Colonial Dames of America, Publications III (Philadelphia, 1914), p. 42.

An iron industry died out in northern Delaware before the American Revolution, but another was born shortly thereafter. Pig iron produced in furnaces and bloomeries was either poured directly into molds to make cast-iron ware, or converted by forges into the more malleable wrought iron. This in turn was sold to blacksmiths and ironmongers to become raw material for countless items from horseshoes to gunlocks. Large quantities of wrought iron were also sold to slitting mills for further processing.

Slitting mills were those in which bars of wrought iron were rolled into sheets and then slit into rods for nails or strips for hoops. The wrought bars were first heated in furnaces to make them more plastic. They were then passed between smooth rolls to form flat sheets. These sheets were finally passed between pairs of rolls with matching circumferential grooves and were thereby slit into thin bands. Bands of an inch or two of width could be used for barrel hoops or tires for wagon wheels. Bands only a fraction of an inch wide were called nail rods and could later be cut and headed into nails and spikes. These rolls usually received their power, through various shafts and gearing, from water wheels.

The first such slitting mill to be built in New Castle County was located on the Hagley property along the Brandywine Creek.[6] This was built in 1779 by John Gregg and a group of associates, and was still standing, "though very old and obsolete," when E. I. duPont bought the property to expand his gunpowder mills.[7] Before this mill was dismantled about 1814, another slitting mill was built along the banks of the Red Clay Creek, and with it a new iron industry was founded in the state.

James Wood was born in Montgomery County, Pennsylvania, in 1771. This grandson of a Dublin Quaker began to operate an iron forge at Hickorytown in 1805 and for the next 13 years operated this and similar establishments in the Philadelphia area.[8] In 1818 Wood, with three partners, purchased the famous Valley Forge, scene of George Washington's bitter winter encampment of 1777-1778. Here the partners made the first successful attempt to produce crucible steel in this country and here, too, James Wood conceived the idea of making an improved shovel.[9]

Wood patented his "Improvement in Making Shovels and Spades" on February 10, 1825,[B] claiming for it three advantages over the old method: "heretofore [he wrote] they have been made of iron, and none have been made of steel. The supports by which the blade is fastened to the handle by the old method are formed from and are part of the blades themselves, instead of being fastened to the blades by rivets, and the whole formed from a sheet of iron doubled and welded together by hammering, instead of being rolled from a piece of steel, as by this method."[10]

[6] - Now a part of the grounds of the Hagley Museum.

[7] - Inventory, 1814, E. I. duPont de Nemours & Co. (Old Stone Office Collection), Eleutherian Mills Historical Library, Greenville, Delaware. Quoted by permission of the owner, the E. I. du Pont de Nemours & Co., Inc.

[8] - Harleston R. Wood, *Alan Wood: A Century and a Half of Steelmaking* (New York, 1957), pp. 8-9.

[9] - James M. Swank, *History of the Manufacture of Iron in All Ages* (Philadelphia, 1884), pp. 290-291; Wood, *Alan Wood*, p. 9.

[10] - Specification of patent, copy in possession of author. [See footnote B for a copy of the patent]

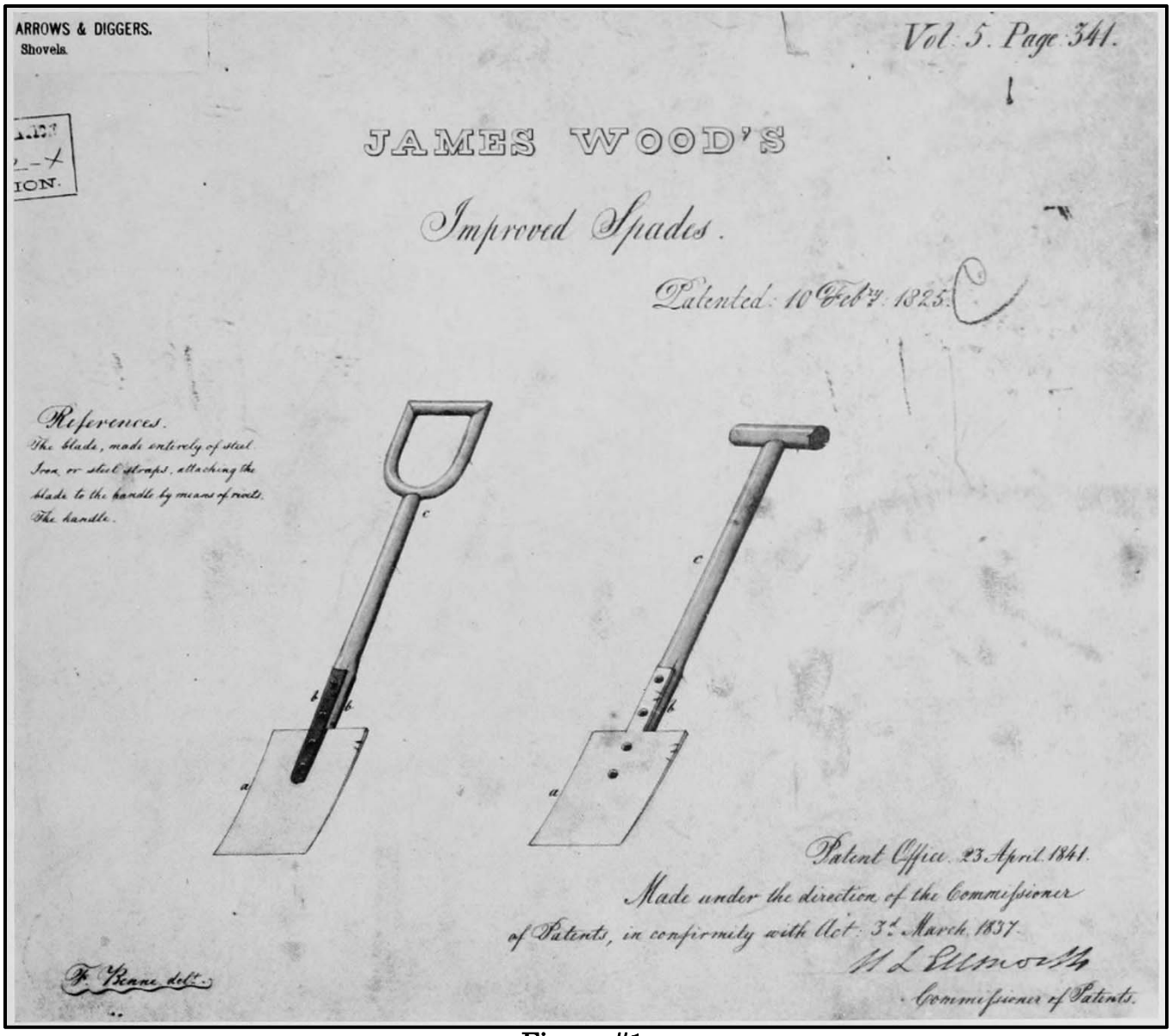


Figure #1

Patent drawing for James Wood's improved spades, February 10, 1825. From Restored Patent Drawings, Record Group 241, Records of the Patent Office, National Archives, Washington, D.C. [C]

It was a good time to enter the business of making shovels. Besides the growing demand for tools from a still largely unmechanized agriculture, the increasing number of internal improvements throughout the country meant a large use of such implements. The Erie Canal, completed in 1825, had used as many as 3,000 workers at a time. Within three years the Pennsylvania canals would be employing 5,000 workmen, and in 1826 the Chesapeake and Delaware Canal was using 2,600 laborers.[11]

Since a rolling mill was needed to produce the new shovels, James Wood prepared immediately to leave the Valley Forge. His oldest son, Alan, then 25, married Ann Hunter

[11] - George Rogers Taylor, *The Transportation Revolution, 1815-1860* (New York, 1951), p. 289; Ralph D. Gray, "The Early History of the Chesapeake and Delaware Canal: Completion of the Canal," *Delaware History*, IX (April, 1960), 70.

Dewees, daughter of the forge's former owner, and the forge itself was disposed of, apparently to a group of 200 Delaware and Pennsylvania residents who, inspired by Robert Owen, intended to establish a communitarian colony.[12] It took some months to settle on an establishment that was both suitable and available but at last, in August, 1826, James Wood and his son Alan leased the slitting mill on Red Clay Creek in Delaware.[13]

This Red Clay slitting mill had been built in 1814, the same year in which that at Hagley was dismantled.[14] It appears to have been operated by the partnership of John Smith, who operated an air furnace in Christiana Hundred, and Edward Gilpin, a Wilmington ironmonger.[15] Born during the War of 1812, the mill "continued until 1817 to do a considerable business, when, in consequence of the great importation of iron, and the depression of price, the proprietors were obliged to abandon the business."[16]

John Smith was the first to go under. When, in 1816, he could not meet a debt of slightly under a hundred dollars, Sheriff Francis Haughey seized his property, including his half interest in the slitting mill. The mill was advertised for public sale late in 1818 and purchased by Edward Gilpin for $2,900.[17] Gilpin, then sole owner of the mill, may have let it remain idle for some time thereafter. In January, 1820, he attempted to rent the establishment, along with the 73 acre farm attached, and described the mill as "nearly new and in good order."[18] In March, perhaps in desperation, he transferred a half interest in the property to the Bank of Wilmington and Brandywine.[19] In contrast to Gilpin's optimistic appraisal, the Bank found that the "complete machinery of a rolling and slitting mill" was not only not in operation, but that the whole mill gave evidence of "decay."[20] The mill was no doubt operated off and on during the next six years, but by whom is not now known.

This had been the rather spotty history of the Delaware Rolling Mill before James Wood and his son leased it in the summer of 1826. James remained in Philadelphia to operate the warehouse and to do the buying and selling. Alan Wood moved with his wife and new child to the banks of the Red Clay to roll iron and make his father's patented shovels.[21] When he took the mill over, it was a small and run-down slitting mill, set up to produce nail rods. Renovation and readjustment converted it into one of the first mills[D] in the nation to produce sheet iron.

[12] - Wood, *Alan Wood*, pp. 9-10; Niles' *Weekly Register*, XXIX (31 Dec. 1825), 275.

[13] - See the author's article, "The Delaware Iron Works: A Nineteenth Century Rolling Mill," *Delaware History*, VIII (March, 1959), 294-309.

[14] - "Return of Delaware Rolling Mill," Industrial Statistics for the State of Delaware taken from the Census of 1820 (microfilm, Eleutherian Mills Lib.). Leslie later wrote that the mill was built in 1812; J. P. Leslie, *The Iron Manufacturer's Guide to the Furnaces, Forges and Rolling Mills of the United States . . .* (New York, 1859), p. 241.

[15] - See Tax Assessment List, Mill Creek Hundred, 1816, p. 37 (Delaware State Archives, Dover, Delaware).

[16] - "Return of Delaware Rolling Mill," Industrial Statistics for . . . 1820 (Eleutherian Mills Lib.).

[17] - *Delaware Gazette* (Wilmington), Nov. 21, 1818; New Castle County Records, Deed Book K-4, 502-503 (New Castle County Court House, Wilmington, Delaware).

[18] - *American Watchman* (Wilmington), Feb. 2, 1820.

[19] - See Deed Book N-4, p. 99 (New Castle County Court House).

[20] - "Return of Delaware Rolling Mill," Industrial Statistics for . . . 1820 (Eleutherian Mills Lib.).

[21] - Wood, *Alan Wood*, p. 10.

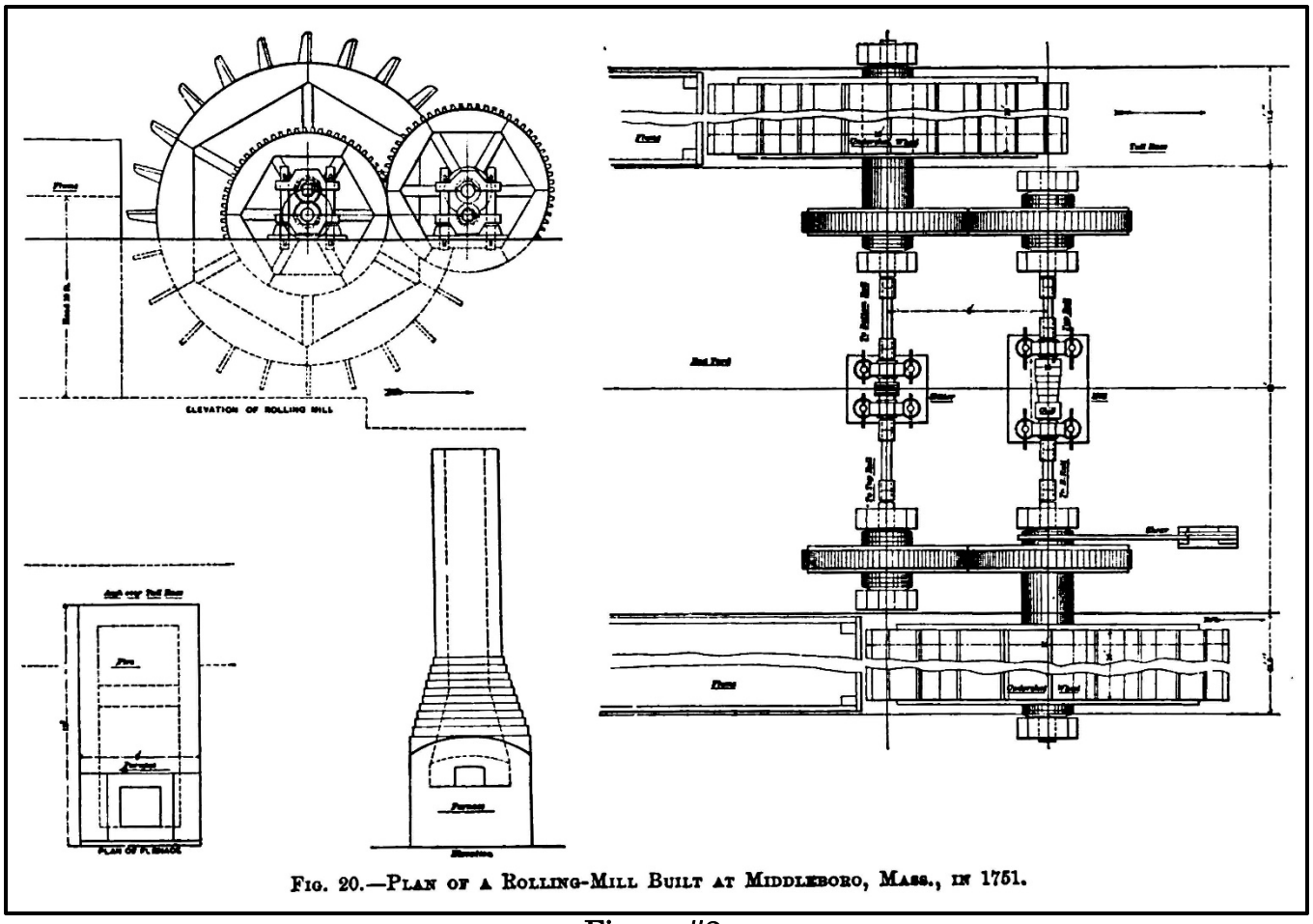


FIG. 20.—PLAN OF A ROLLING-MILL BUILT AT MIDDLEBORO, MASS., IN 1751.

Figure #2

Plan of a typical early American slitting mill. From H. Harrison, "The First Rolling-Mill in America," Transactions of the American Society of Mechanical Engineers, I (1881).[E]

The difference was more one of intention than method. Even in the old style mills the bars had to be rolled into sheets before they were slit into nail rods. Now, under the Woods, it was the sheets themselves that mattered, and the slitting half of the process was abandoned. The whole nail-making business was in a state of flux. Between 1791 and 1804 no less than 41 improvements in nail making were patented, many of them involving the stamping of nails from plates. Slitting mills were already becoming old-fashioned; by 1884 only four remained open in the whole country.[22]

Since the Woods needed sheet iron rather than rods, it became desirable to make the sheets both larger and more uniform in thickness and smoothness. On July 20, 1831, James Wood, drawing upon five years of his son's experience at the Delaware Rolling Mill, patented "a mode of manufacturing Rollers of Cast Iron for laminating or flattening of metals." This new type of roll was built up of three layers of iron, steel, or a combination of the two. As Wood described it, "I make a shaft . . . ; upon and around this shaft I afterwards cast iron, so as to form the intended cylinder. . . . This casting I sometimes effect in one operation, and at other times I complete it in successive operations. The final casting, by which the surface of the roller is formed, is usually made in a chill, or mold, of

[22] - *Letter from the Secretary of State accompanied with a list of . . . Patents . . .* (Washington, 1811), *passim*; James M. Swank, *Progressive Pennsylvania* (Philadelphia, 1908), p. 285.

6654X

J. Wood,

Casting Rolls.

Patented July 20, 1831.

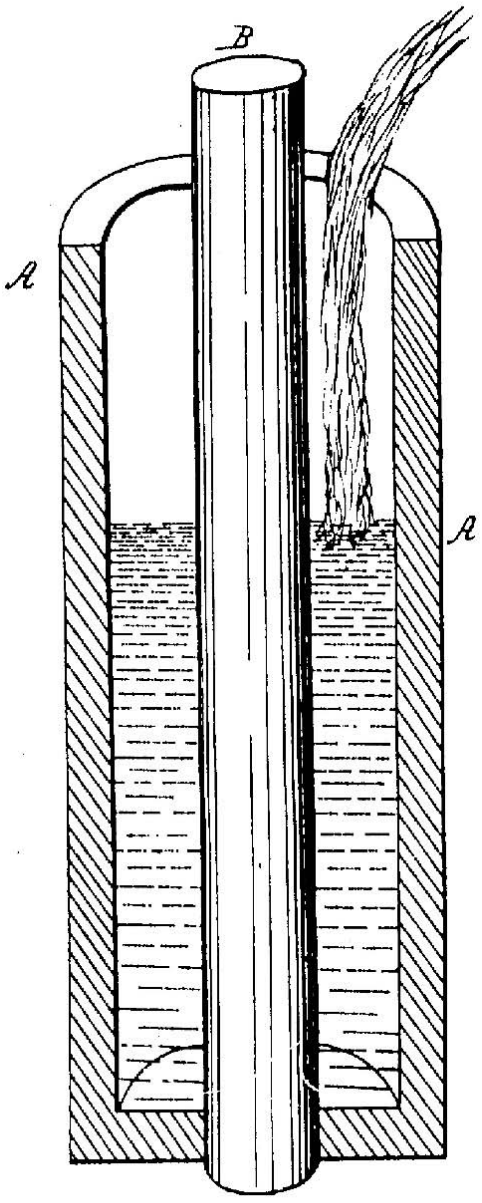


Figure #3

Patent drawing from the US Patent Office for James Wood's improved plan for making rollers, reissued patent X-6654, July 20, 1831.[F]

cast or wrought iron, turned perfectly true, and so constructed as to receive and retain the shaft, first named, exactly in its center. The roller so cast, either chilled or not, may afterwards be dressed by grinding in the usual way. . . ."[23]

Alan Wood operated the ironworks from 1826 to 1832. Near the end of his tenure he estimated that he had $8,000 invested in the enterprise and upon this sum received an annual profit of from 15 to 20 percent. The mill employed, during 1831-32, ten men at one dollar for a twelve-hour day, and operated ten months per year. During this ten-month period, it produced a variety of products, notably 40 tons of sheet iron, 750 dozen shovels and spades, 150 steel hoes, and 110 tons of rolled steel. These products were originally sold on six months' credit, "a very small quantity . . . at the manufactory; almost all sent to Philadelphia, from thence to other parts, say from 20 to 1,000 miles to market." Some were bought by merchants to be resold in South America, but most were finally disposed of "in the different States of the Union; at least one-half are consumed in the southern States."[24]

Alan Wood's lease on the Delaware mill was up in 1832, and, in an effort to bring the producing and mercantile halves of the business into closer proximity, a new rolling mill was built on the banks of the recently completed Schuylkill Canal at Conshohocken, near Philadelphia. The new mill prospered and was enlarged. For eight years, it remained the center of activities of the firm of James Wood & Son.[25]

After the withdrawal of Alan Wood, the rolling mill on the Red Clay continued to have sporadic usefulness. In 1831 Edward Gilpin and the Bank of Wilmington and Brandywine sold the property and facilities to Joseph O'Brien, a Philadelphia merchant.[26] The latter apparently bought the mill only as a speculation, for within a few months of his purchase he advertised: "Valuable water power, and rolling mill for sale, together with an excellent farm of 73 acres, situate on Red Clay Creek, 5 miles from Wilmington, (Del.) 3 from Newport, and near the Lancaster turnpike. The improvements are a Rolling Mill of modern construction, a large stone mansion beautifully situated, two tenant houses, and stable. The water power is sufficient for an extensive business, being the whole water of said creek, a copious and never-failing stream, with a head of 14 feet. The short distance of this valuable property from Wilmington and Newport affords to the occupier all the advantages of the Philadelphia market at a trifling expense."[27]

It was not until a year later, in November, 1832, just six months after the Woods had vacated the premises, that O'Brien was able to sell the property to Dr. William Gibbons (1781-1845), a Wilmington physician and owner of some industrial property in Cecil County, Maryland.[28] Gibbons was able to find people to keep the mill operating at least part of the time. A waste book from the mill has survived bearing the date of 1833, but the

[23] - Specification from the *Journal of the Franklin Institute*, IX, n.s. (Jan., 1832), pp. 69-70.

[24] - *Documents Relative to the Manufactures in the United States* [McLane Report] . . . (Washington, 1833, II, pp. 812-814.

[25] - Wood, *Alan Wood*, p. 11.

[26] - Deed Books N-4, p. 99 and W-3, p. 345 (both from New Castle County Court House).

[27] - *Delaware Free Press* (Wilmington), Dec. 3, 1831.

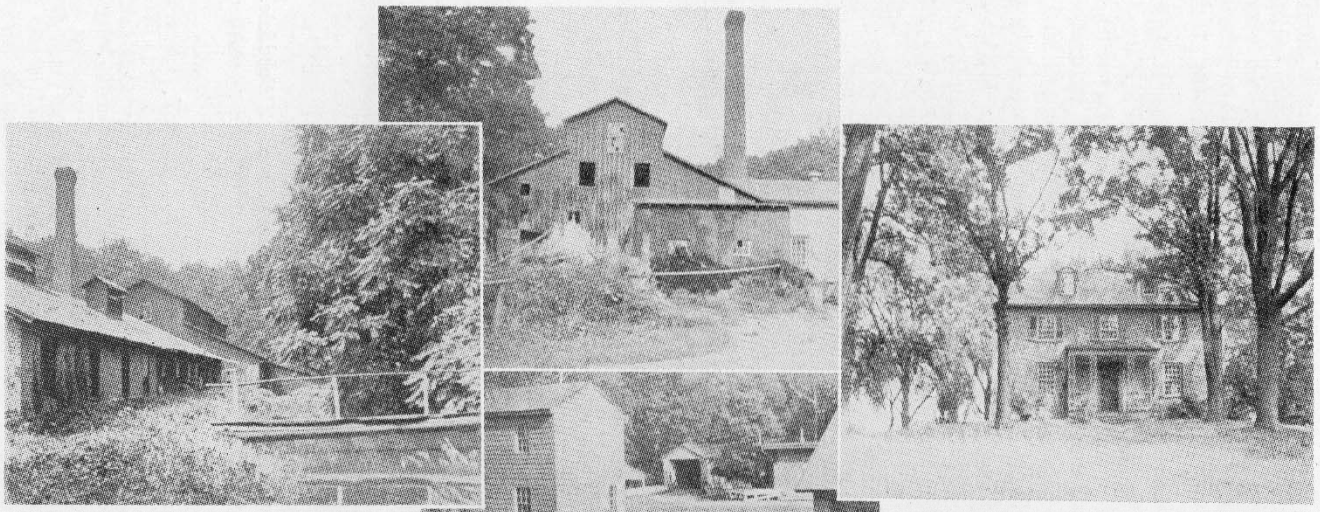
[28] - Deed Book 0-4, pp. 142 to 145 (New Castle County Court House); Policy, Delaware Fire Insurance Co. to Dr. William Gibbons, April 22, 1834, Insurance folder (Historical Society of Delaware, Wilmington, Delaware).

name of the operator is not recorded.[29] In 1840 Gibbons advertised the mill as being once more for rent. "The main works of this mill," he wrote, "have just undergone a thorough repair, and are now fitted up for rolling both sheet iron and boiler plate."[30]

It appears that this advertisement was answered by the Wood family, which was seeking to further expand its iron production. Alan Wood had been one of a family of 20 children and some of his brothers were now beginning to enter the firm of James Wood & Son. John Wood (1816-1898) was put in charge of the Delaware mill at this time and remained for four years.[31] At the same time another brother, William, entered the firm at Conshohocken. Subsequent shuffling of financial and managerial responsibilities within the family were extremely complex, but the result seems to have been that John Wood, returning to Conshohocken in 1844, became head of the firm of J. Wood & Bros., which included finally, John, William, David, and Thomas.

Alan Wood withdrew at this time and returned to Delaware where, on April 5, 1844, he purchased the Red Clay mill from Dr. Gibbons.[32] The Delaware Iron Works remained in Alan Wood's possession until his death in 1881, and here he raised and trained his own sons in the iron business.

The stock and trade of the Red Clay mill after its purchase by Alan Wood in 1844 was name of the operator is not recorded.[29] In 1840 Gibbons advertised the mill as being once no longer shovels or plain sheet iron, but a new patented product called "imitation Russia



Delaware Iron Works and Residence on Red Clay Creek, Delaware

[*Note covered bridge in lower center picture which is still standing. To right is old Wooddale depot on Wilmington and Western R.R., no longer standing*]

Thos. Wood, Son of Alan Wood; James W., Son of John Wood; Richard G. and Alan W. Wood (Sons of W. Dewees Wood) were born here.

[This residence now owned by John Biggs, Jr.]

(Courtesy of Alan Wood Iron and Steel Company)

[29] - This record is in the Manuscript Book Collection of the Historical Society of Delaware.

[30] - *Delaware State Journal* (Wilmington), March 6, 1840.

[31] - [Frank H. Taylor], *History of the Alan Wood Iron and Steel Company, 1792-1920* (n.p., n.d.), p. 17.

[32] - Deed Book N-5, 66-68. For various partnership agreements, see Alan Wood papers (Eleutherian Mills Library), and Wood, *Alan Wood*, pp. 11-13.

sheet iron." For years Russia had been the only source of a very high quality, finely-rolled sheet iron[G], which was given a protective finish of a deep, glossy, blue black appearance. In the mid-nineteenth century, a number of individuals came forward with claims of having discovered the secret process used in Russia.[33]

In defense of his family's claim to the process, Alan Wood wrote in 1852 that "I have (with my brothers) been supplying that great desideratum since 1842, in which year we obtained United States Letters Patent [no. 2,813][H] for the successful discovery of a process of giving to sheet-iron (in its manufacture) that beautiful finish and durable gloss and luster, heretofore only known in Russia; last year we obtained another patent, from the U.S. [no. 8,048][I], for an improvement made in our *modus operandi* – and we now have in successful operation [3 mills] . . . making an article equal to the Russian, of which we sold in New York alone, last year, 200 tons or more. Whether we have hit upon the secret mode of Russia or not, we do not pretend to know – nor do we believe that it is yet known out of Russia; there have been so many different candidates claiming that honor, with as many different modes that nothing less than the most substantial and conclusive proof of the discovery of the secret, should satisfy anyone."[34]

The original patent in 1842 described the process of making Russia sheet iron in the following terms. After being rolled into sheets, iron tends to acquire a surface layer of rusty scales. This was to be removed by bathing the plates in sulphuric [sic] or some other acid, "the procedure being the same as when plates of iron are prepared to be tinned." The plates were then cleaned, dried, and treated on both sides with linseed or some other type of oil. Finally, the plates were stacked into packs, heated to "a cherry red," and rolled to the desired thickness.[35]

The subsequent improvement, patented in 1851, was to remedy the fact that, under the process described above, "nearly one third part of the sheets, namely, the two outside sheets of each pack of six or seven, were left very defective, they having become oxidized beyond remedy." The improvement contemplated "the employment of thick plates; or, in other words, placing four (more or less) thin plates between two shield plates of double weight, in forming packs for rolling, so that each shield plate will make two plates of proper size to constitute the inside plates of another pack, for the smoothing and finishing process of rolling."[36]

These two patents formed the basis of later Wood family operations, just as the patented shovels had carried them during their early years. The patents had been granted to John and William W. Wood, with James Wood, Sr., sharing in the first. Their operations, after 1844, were carried on at Conshohocken, but Alan Wood, in Delaware, was licensed to use the process as well. Competition between the brothers was keen and those on the Schuylkill were not above claiming that since they held the patents, and had "the

[33] - See *Scientific American*, VII (Jan. 24, 1852), 149; *Ibid.*, VIII (Jan. 15, 1853), 138; *Ibid.*, IX (Oct. 15, 1853), 38. For attribution to Seth Boyden, see sketch of him in *Dictionary of American Biography*, II (New York, 1929), 529.

[34] - Quoted in *Scientific American*, VII (May 9, 1852), 269.

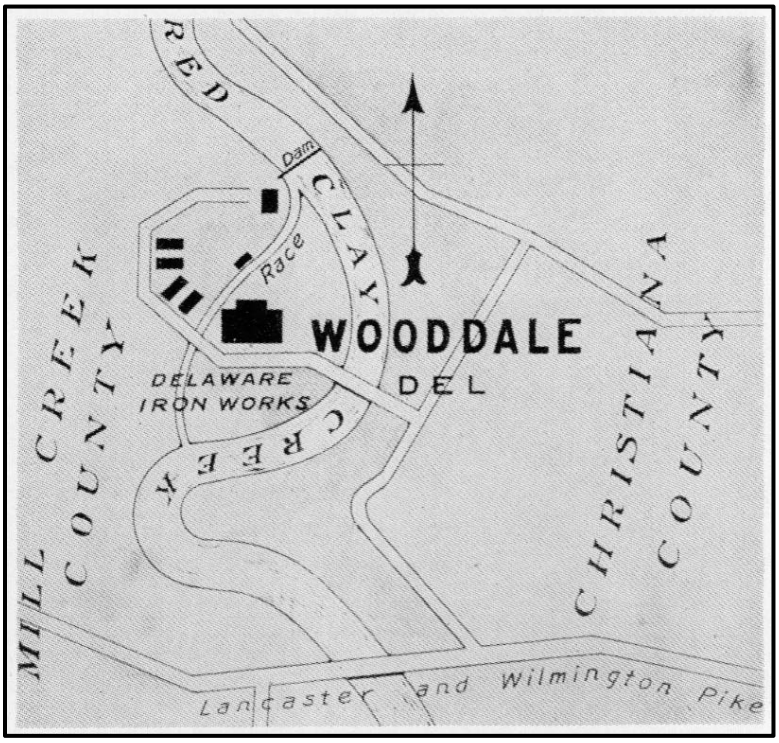
[35] - Copy of patent specification no. 2,813, in possession of the author. {See footnote F for actual patent]

[36] - Copy of patent specification no. 8,048, in possession of the author. {See footnote G for actual patent]

experience of manufactures," they were able to "produce a much handsomer and better article than he [Alan Wood] does."[37]

The family rivalry was still further compounded in 1851 when Alan's oldest son, Waters Dewees Wood (1826-1899), after having managed the Red Clay mill for some time, moved to Pittsburgh and set up a rolling mill in nearby McKeesport.[38] A decade later he made a further improvement in the manufacture of Russia sheet iron by using corrugated rollers, rather than an acid bath, to remove scale from the sheets, and by adding graphite to the oil treatment.[39]

Besides their Russia sheet iron, the Wood family took part in several other pioneering efforts of the American industry.[J] Alan Wood & Sons, for example, are credited with having rolled the first sheet zinc made in this country.[40] Of more significance were their early efforts to produce tin plate. The Woods' "imitation Russia" sheet iron was almost identical to the so-called black plates which Welsh iron makers plated with tin. There is some evidence that they may have sold some sheets for this specific purpose, and it is quite certain that they had some knowledge of the whole process. When Congressman William McKinley was attempting to include tin-plate among other tariff-protected items in 1890, he told the House of Representatives that the Alan Wood Company, among others, had declared "that if a suitable duty was put upon tin-plate they could and would engage in the business of tin-plate making." This promise was greeted by applause from the House, which went on to make a tin-plate schedule a part of the famous McKinley Tariff of 1890; an act which may be taken as the real beginning of the industry in this country.[41]



Location of Delaware Iron Works on Red Clay Creek at Wooddale. (Courtesy Alan Wood Iron & Steel Company.)

[37] - James Wood & Sons to Bruse (?) & Elliott, May 16, 1850, letter book 1847-50, James Wood & Sons, Alan Wood papers (Eleutherian Mills Lib.). Quoted by permission of the owner, the Alan Wood Steel Co.

[38] - See obituary of W. Dewees Wood in *Iron Age*, LXIII (Jan. 12, 1899), 14.

[39] - Copy of patent specification no. 32,341, in possession of the author.

[40] - Swank, *Progressive Pennsylvania*, p. 242.

[41] - William McKinley, *Speeches and Addresses of William McKinley from His Election to Congress to the Present Time* (New York, 1893), p. 416. For the beginnings of the industry see the author's "Tariff and Technology: The Foundation and Development of the American Tin-Plate Industry, 1872-1900," *Technology and Culture*, III (Summer, 1962), 267-284.

Chapter 2

The second rolling mill in the state was built in 1836, only a few miles down the Red Clay from the Delaware Iron Works at Wooddale, by the Marshall family. Like the Woods, the Marshalls were Quakers, as much at home in Pennsylvania as in Delaware. John (1808-1885) and Caleb Marshall (1806-1888) were born in nearby Chester County, Pennsylvania, where their father, Robert Marshall, operated a gristmill near the forks of the Red Clay[K]. Both boys were not only taught to operate the gristmill, but, apparently, were also given so thorough a grounding in the general arts of the millwright that they could turn their hands to nearly any type of milling enterprise. Another son, Thomas S. Marshall (1818-1887) continued the father's gristmill, finally replacing it with the Old Homestead paper mill about 1856.[42] Meanwhile John and Caleb, the first of whom had married a daughter of John C. Phillips, a New Castle County miller, moved to Delaware to go into the milling business.[43]

The mill which they chose had been willed by Solomon Hersey, in 1801, to his two sons Isaac and Benjamin.[44] Isaac Hersey tried unsuccessfully to sell his half of the mill in 1806.[45] The brothers put the mill up for rent in 1813, by which time Isaac was still living next door, but Benjamin had moved to the Bohemia Mills in Cecil County. At this time it was acclaimed that the "Mill runs two pairs of Burrs, has the most necessary parts of [Oliver] Evans' machinery, . . . is in complete repair, and is capable of manufacturing 2000 barrels of Flour in a season."[46]

Isaac Hersey's half of the mill was seized by the Sheriff in 1818 and put up for public sale.[47] When a neighbor received a judgement against Benjamin Hersey at about the same time, the whole mill was sold by the Sheriff to Jesse Trump, Jr.[48] Two months later, on June 8, 1819, Trump sold the mill to James Buckingham of Mill Creek Hundred.[49] This mill, which Buckingham operated until selling it to John Marshall in 1835, was of moderate size, being operated by one man and a boy. Working sixteen hours a day, they produced in one year (1831-32) 500 barrels of corn meal and 400 barrels of flour. Most of this was sold in Philadelphia for cash.[50]

This, then, was the gristmill that John Marshall bought on November 14, 1835, a short distance downstream from his father-in-law's mill.[51] For some reason, now obscured by time, the Marshall brothers began to erect a rolling mill on the property almost immediately. John remained on the premises running both mills, while Caleb continued flour milling in Chester County. Then, in 1845, Caleb, too, married a Delaware girl and

42 - Wilson Lloyd Bevan, ed., *History of Delaware Past and Present* (New York, 1929), III, pp. 20-21.
43 - Thomas Lynch Montgomery, ed., *Encyclopedia of Pennsylvania Biography* (New York, 1914-54), XIV, 2523.
44 - Deed Book A-3, pp. 309-314 (New Castle Co. Court House).
45 - *Mirror of the Times* (Wilmington), Feb. 5, 1806.
46 - *American Watchman*, Nov. 6, 1813.
47 - *Ibid.*, Dec. 5, 1818.
48 - Deed Book W-3, pp. 490-492 (New Castle Co. Court House).
49 - Deed Book U-3, pp. 414-416 (New Castle Co. Court House).
50 - Documents [McLane Report], II, 766-767.
51 - Deed Book X-4, pp. 130-132 (New Castle Co. Court House).

moved to the Red Clay the following year, relieving John of the direction of the rolling mill so that the latter could devote himself to the gristmill nearby.[52]

In general, the iron business flourished for the Marshall brothers, but they were not immune from the general shocks in the economy which rocked the nation periodically. Alfred Marshall, son of Caleb, remembered in later years that the depression of 1857 was particularly harrowing. “I . . . often heard my father say,” he recalled, “ 'Boys, I want you to work on the farm, as I see nothing for you in the mill . . .'.” It was only by depending upon the farm and gristmill, he claimed, that the family stayed solvent at all.[53]

The depression caught Alan Wood even further extended. In 1857, the very year it had begun, he had expanded his iron interests by leaving one of his sons in charge of the Delaware mill and, in partnership with his brother-in-law, Lewis A. Lukens, building the new White Marsh Iron Works in Conshohocken near his brothers' mills.[54] He was sorry almost immediately. “I will not start a new mill this year, unless things improve,” he wrote his son, “No use making iron, to keep in stores, or sell to *back pay*." With considerable understatement, he confessed that “it's rather a bad time for building new mills and had I . . . anticipated such a crisis, would have deferred building.”[55]

So bad were the times, that he even declared that he had “determined to sell the Delaware mill, as soon as I can at a fair price – it would make a good boiler iron mill – or would suit for Rolling Sheet for Galvanizing &c.”[56] Fortunately, such drastic liquidation was not necessary, although five months later a part of the Red Clay holdings was disposed of. Like the Marshallton works downstream, the Wooddale enterprise was more than just an ironworks. The latter, besides having considerable farm land attached, also had a general store which, with its stock, was placed at public sale in February, 1858. The goods to be auctioned off included not only “the Stock of a country store, consisting of Dry Goods, Groceries, Boots and Shoes &c., &c.,” but also “6 Mules, with 2 heavy Road Wagons, Gears for Team, &c.; 3 Horses, 3 Milch Cows, Wagons, Cart, Carriages, Farming Utensils, &c. Also, several articles of Household Goods.”[57]

The very fact that Alan Wood had built a new mill near Philadelphia was in itself significant. In many respects, and particularly in matters economic, New Castle County was tributary to Philadelphia. When Wood had first come to the Red Clay, the purchasing and selling of the business had been handled by his father at the company warehouse in the city. Philadelphia, rather than Wilmington, was the market for both raw materials and finished products. Added to this economic pull was a subtle but certain cultural attraction. The Woods were generally sent to schools in Pennsylvania, including the University in Philadelphia. When Alan Wood, Jr., and his uncle John Wood were elected to

52 - Charles Robson, ed., *The Manufactories and Manufacturers of Pennsylvania in the Nineteenth Century* (Philadelphia, 1873), pp. 232-233.

53 - Quoted in Montgomery, *Encyclopedia*, XIV, 255.

54 - Wood, *Alan Wood*, p. 12; Lesley, *Iron Manufacturer's Guide*, p. 231.

55 - Alan Wood to son, Sept. 29, 1857, Alan Wood MSS, microfilm (Eleutherian Mills Lib.). Quoted by permission of the owner, Mrs. Henry C. Townsend, III.

56 - *Ibid*.

57 - *Delaware Gazette*, Feb. 12, 1858.

Congress, it was by the votes of Pennsylvania constituents.[58] Even during the most active years of the Delaware Iron Works, Philadelphia was the real home of the family; the place where the business was directed, the children educated, and the family dead were buried.

While the Woods had gotten their start in Philadelphia, and returned there to expand their interests, the Marshalls went to the city as the ultimate reward of their success on the Red Clay. John and Caleb Marshall expanded their firm in 1856 to take Calvin Phillips and Alexander H. McFadden (both local men) into partnership. In that same year, they began to manufacture galvanized iron in Philadelphia under the name of Marshall, Phillips & Co. In 1863 Caleb sold his share of the Marshallton works to John's son-in-law, Edward Mendenhall, and moved his family to the city. John himself followed his brother the next year when his son, Calvin P. Marshall, succeeded him at the Red Clay mill.[59] By the mid-sixties then, all three founders – Alan Wood, John and Caleb Marshall – had expanded their business interests to mills in Philadelphia, leaving their Delaware works in the charge of various relatives.[L]

With the removal of Alan Wood to Philadelphia, the Red Clay mill at Wooddale entered a long period of dwindling importance although its decline was not immediately apparent. The transportation problem, for example, was considerably improved in 1872 with the opening of the Wilmington and Western Rail Road.[60] Previously goods came by railroad or boat to Wilmington or Newport, and then were brought by wagon to the mill. Now they could travel the whole distance by rail. The Chief Engineer of the new road made public a prophecy from Alan Wood that "with a railroad connection that makes the coal mines accessible, he can increase his production of iron five or six fold."[61] This expansion never took place, although Wood did continue to support the railroad, and served on its Board of Directors from 1872 to 1874.[62]

In 1875, a private siding and coal dump[M] were added to the Wooddale mill facilities.[63] The previous year had been a dull one at Wooddale, the mill reportedly being idle three-fourths of the time.[64] Once again the decline of activity probably owed something to the increasing importance of the Philadelphia mills and something to the fact that 1873 saw the beginning of another severe depression, the worst since 1857. Between 1859 and 1886 the productive capacity of the Delaware Iron Works had increased only from 327 to 550 tons per year.[65] When first built, the mill had had no local competitors: by 1886 there were a total of ten rolling mills in New Castle County, the largest of which, The Old Ferry Mill in Wilmington, had an annual capacity of 16,000 tons.[66] Clearly the Red Clay mill, while

[58] - Alan Wood, Jr., served 1875-77; John Wood from 1859-61. *Biographical Directory of the American Congress, 1774-1949* (Washington, 1950), pp. 2038, 2039.

[59] - Robson, *Manufactories*, pp. 232-233.

[60] - See the author's *That Never Failing Stream: A History of Milling along Red Clay Creek during the Nineteenth Century* (unpublished master's thesis, University of Delaware, 1958).

[61] - Quoted in *Wilmington Daily Commercial*, Sept. 10, 1869.

[62] - *Every Evening* (Wilmington), Jan. 9, 1872 and Jan. 13, 1873.

[63] - *Ibid.*, Jan. 11, 1875.

[64] - *Ibid.*, June 22, 1874.

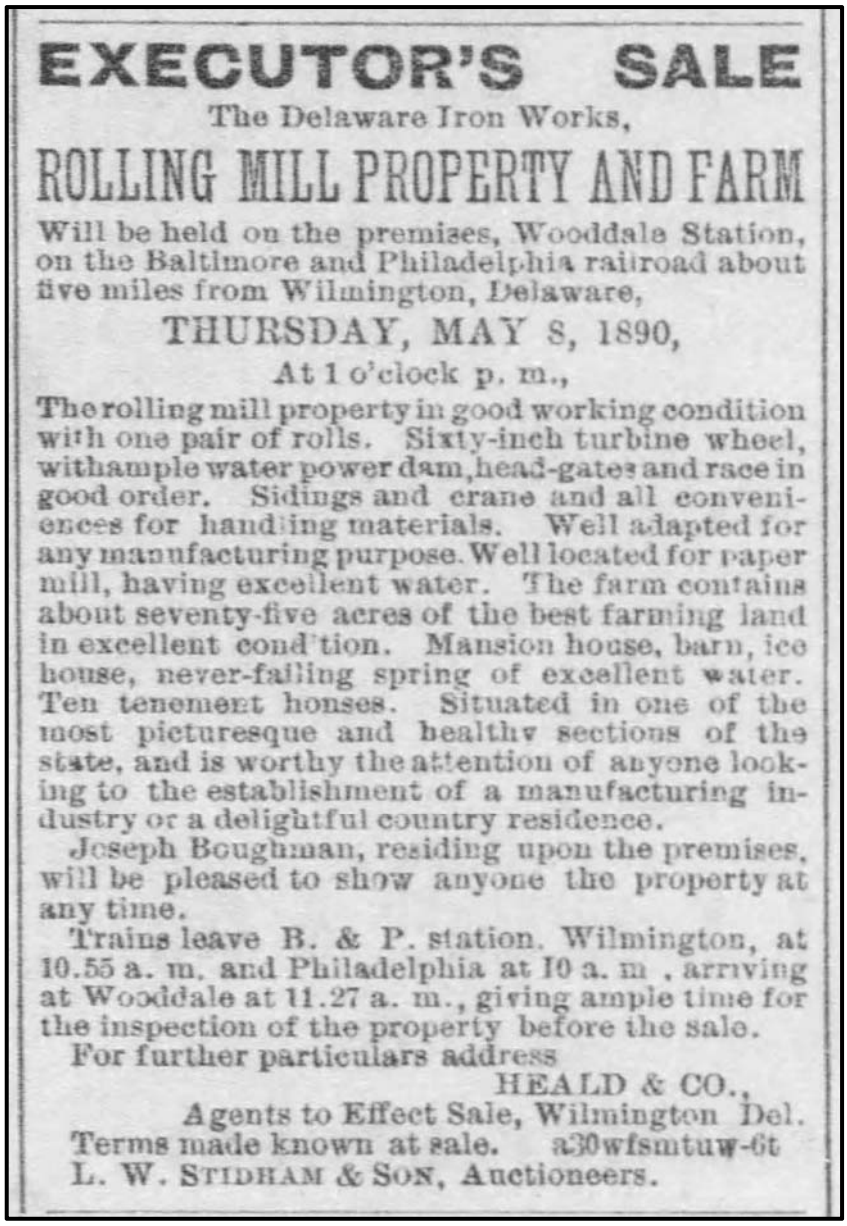
[65] - Lesley, *Iron Manufacturer's Guide*, p. 241; *Directory to the Iron and Steel Works of the United States* (Philadelphia, 1886), pp. 119-120.

[66] - *Directory to the Iron and Steel Works* (1886), pp. 119-120.

experiencing some growth in absolute terms, had become of secondary importance within the economy of the county as well as within the business interests of the Wood family.

Alan Wood, who had retired from business in 1869, died at his home in Philadelphia in 1881.[67] The firm, continued by his sons, kept the Red Clay mill operating for another decade, and then, in 1890, it was exposed to an executor's sale. "The rolling mill property," it was claimed, "is in good working condition, sidings, cranes and all modem improvements and conveniences. It is well adapted for any manufacturing purpose, especially so for a paper mill. The farm contains seventy-five acres of the best farming land, in excellent condition, mansion house, barn, ice house and ten tenement houses. The farm and mill is situated in one of the most picturesque and healthy sections of the state."[68]

It was significant that the notice of sale mentioned the site's suitability for a paper mill. The executors sold the mill and property to Howard Wood, who the following year (1891) disposed of it to Robert Marshall[N] of Kennett Square.[69] The new owner, a member of the Kennett Square and Yorklyn milling family and collateral relative of the founders of the ironworks at Marshallton, proceeded to build a paper mill on the site of the old Delaware Iron Works.[70]



EXECUTOR'S SALE

The Delaware Iron Works,

ROLLING MILL PROPERTY AND FARM

Will be held on the premises, Wooddale Station, on the Baltimore and Philadelphia railroad about five miles from Wilmington, Delaware,

THURSDAY, MAY 8, 1890,

At 1 o'clock p. m.,

The rolling mill property in good working condition with one pair of rolls. Sixty-inch turbine wheel, withample water power dam, head-gates and race in good order. Sidings and crane and all conveniences for handling materials. Well adapted for any manufacturing purpose. Well located for paper mill, having excellent water. The farm contains about seventy-five acres of the best farming land in excellent condition. Mansion house, barn, ice house, never-failing spring of excellent water. Ten tenement houses. Situated in one of the most picturesque and healthy sections of the state, and is worthy the attention of anyone looking to the establishment of a manufacturing industry or a delightful country residence.

Joseph Boughman, residing upon the premises, will be pleased to show anyone the property at any time.

Trains leave B. & P. station, Wilmington, at 10.55 a. m. and Philadelphia at 10 a. m., arriving at Wooddale at 11.27 a. m., giving ample time for the inspection of the property before the sale.

For further particulars address

HEALD & CO.,

Agents to Effect Sale, Wilmington Del.

Terms made known at sale. a30wfsmtuw-6t

L. W. STIDHAM & SON, Auctioneers.

Figure A
The May 5, 1890 Wilmington *Morning News* executor's sale listing for Delaware Iron Works.[O]

[69] - Deed Book H-15, 312-316 (New Castle Co. Court House); Deed Book I-15, 385-387 (New Castle Co. Court House).

[70] - See [Lyman D. Post], *Post's Paper Mill Directory for 1910* (New York, 1909), p. 84. By 1910 the company was operated by T. Elwood Marshall and his brother-in-law, Dr. Taylor S. Mitchell. It was called the Wooddale Paper Mills.[P]

Chapter 3

The fate of the rolling mill at Marshallton, after the removal of the founders, was slower in unfolding than was that of the Wooddale mill. Caleb Marshall had been the first to go, selling his share of the business to John Marshall's son-in-law, Edward Mendenhall, in 1863. John joined him the next year, being succeeded at Marshallton by his son, Calvin P. Marshall, although he did maintain a financial interest in the firm.[71] After this time, the ironworks was the center of an exceedingly complex financial and managerial tangle.

The sequence seems to have been that Calvin Marshall bought out Mendenhall in 1869 becoming, with his father, sole owner of the mill.[72] Then in 1871, John Marshall sold his interest to John and Joseph P. Richardson. Calvin sold his interest in 1874 to John R. Bringhurst, a nephew of the Richardsons.[73] Three years later Bringhurst bought out his uncles in a transaction which caused some degree of family estrangement.[74] On January 23, 1877, Calvin P. Marshall had become a "body corporate for the purpose of manufacturing, galvanizing and selling iron" under the title of the J. Marshall Co.[75] The next month, Marshall, Bringhurst, and the two Richardsons all sold the Marshallton mill to the new corporation.[76] Finally, in August of 1877, the corporation sold the property back to Bringhurst.[77]

When the smoke had at last cleared Bringhurst, now the J. Marshall Co., was in firm and undisputed possession of the Marshallton Works. The old mill, which had had a capacity of 393 tons in 1859, was expanded until, in 1880, it had an annual capacity of 700 tons.[78] Not satisfied with the growth, Bringhurst in 1880 added a large section to the mill, installing "a steam engine and boilers to furnish the power, water being too uncertain."[79]

The mill was enlarged again in 1884, and, two years later, had reached a capacity of 2,500 tons a year – still small as compared to some of the large mills in Wilmington, but over four times as large as that at Wooddale.[80] It should be noted that even with the iron business grown to such proportions, the old gristmill which had nourished and sustained the enterprise back in the 'fifties was still carried among the corporation's assets as late as 1889.[81] The State Directory for 1894-95 listed the Marshallton Iron Works as "manufacturers of drip pans, sheet iron, dealers grain and coal."[82] Although still operating

71 - Robson, *Manufactories*, p. 233.

72 - *Wilmington Daily Commercial*, Feb. 17, 1869.

73 - In February, 1874, John Marshall of Kennett Square had been awarded a lien on the lands of Calvin Marshall, a development which no doubt had some influence on this whole transaction. Deed Book G-11, pp. 97-100 (New Castle Co. Court House).

74 - J. Thomas Scharf et al., *History of Delaware, 1609-1888* (Philadelphia, 1888), II, 927; C. A. Weslager, *The Richardsons of Delaware* (Wilmington, 1957), p. 98.

75 - *Every Evening*, March 27, 1877; *Laws of Delaware*, XV, 661.

76 - Deed Book V-10, pp. 285-289 (New Castle Co. Court House).

77 - Deed Book Y-10, pp. 479-481 (New Castle Co. Court House).

78 - Lesley, *Iron Manufacturer's Guide*, p. 241; *Directory to the Iron and Steel Works of the United States* (Philadelphia, 1880), p. 126.

79 - *Every Evening*, May 29, 1880.

80 - *Directory to the Iron and Steel Works* (1886), p. 120.

81 - Marshallton Iron Works, journal (1889-1892), pp. 7-9, Old Stone Office Records (Eleutherian Mills Library).

82 - *Delaware State Directory, 1894-95* (Wilmington, 1894), p. 213.

and employing eighty men in 1908, the Marshallton rolling mill, like that at Wooddale, was soon to be replaced by another type of mill, this one making vulcanized fiber.[83]

Although from the 1860's on, Philadelphia was the major focus of the Marshall family's iron interests, they did not lose all of their Delaware connections when Bringhurst took over the Marshallton mill. In 1872 Calvin Marshall and the Richardsons had begun the construction of a new rolling mill on the Christiana at Newport, to be operated in conjunction with the Marshallton mill.[84] The new mill was put into operation in August of the following year and proved so successful that it was enlarged in 1874.[85] A whole new facet was added to the enterprise when, in 1877, the Volta Galvanizing Works, formerly of Frankford, Pennsylvania, was moved down to Newport.[86]

Some disruptive force, perhaps the aftershock of the previous Marshallton reorganization, struck the Newport mill early in 1879. Subject to liens of about $50,000, the property was offered at sheriff's sale and purchased by John Marshall for $100.[87] For the next two years the Newport Rolling Mills and Volta Galvanizing Works, as it was now called, was run from the Girard Avenue offices of the Marshall Bros. & Co. in Philadelphia.[88]

Sometime during 1880-81 the mill was allowed to shut down for an indefinite period. Then in March, 1881, a new company was incorporated by the State of Delaware as the Marshall Iron Co. of which Edward Mendenhall was president.[89] The new stock company repaired and reopened the mill the same month, rounding up workmen who, faced with uncertain prospects at Newport, had mostly drifted up to Marshallton to find jobs.[90] This Newport mill was still in operation under the same officers in 1895. The exact date of its eventual abandonment is not known.[91]

[83] - Henry C. Conrad, *History of the State of Delaware from the Earliest Settlements to the Year 1907* (Wilmington, 1908), II, 477; C. A. Weslager, *Delaware's Forgotten River, The Story of the Christiana* (Wilmington, 1947), p. 173.

[84] - *Every Evening*, Oct. 21, 1872.

[85] – *Ibid.*, June 20, 1873; Scharf, *History of Delaware*, II, 895.

[86] - Delaware Gazette, March 15, 1877; see also Volta Works advertisement in *Every Evening*, July 20, 1877.

[87] - *Delaware Gazette*, Jan. 30, 1879; *Every Evening*, Feb. 8, 1879.

[88] - *Directory to Iron and Steel Works* (1880), p. 127.

[89] - *Laws of Delaware*, XVI, 760; *Directory to Iron and Steel Works* (1886), p. 120.

[90] - *Every Evening*, March 22, 1881.

[91] - *Del. State Directory*, 1894-95.

Chapter 4

When Alan Wood first came to the Red Clay in 1826, New Castle County had no iron industry of any importance. From that date forward, and especially after 1836 when the Marshallton mill joined that at Wooddale, this type of manufacturing gained rapidly in importance. By 1880 the value of iron products made in the country far outstripped the value of such traditional products as lumber, flour, and cotton and woolen textiles.[92] Wilmington was referred to as "this American Glasgow" and a local newspaper claimed in 1872 that "the manufacture of iron will undoubtedly be the chief source of wealth to this city in all time to come."[93]

Part of this enthusiasm was based upon the vain hope that a flourishing primary iron industry could be nourished. A farmer at Hockessin believed that "iron ore of excellent quality and in large quantities" could be taken from his property.[94] "Some of the learned mineralogists" of Delaware were quoted as saying that "there is enough iron ore in Iron Hill . . . to supply the whole demand of the United States for the next ten centuries."[95] Most of this was newspaper boosterism but there was enough faith at the core of the boast that mines were opened and worked.[96]

New Castle County never produced important quantities of pig iron. The foundation of the local industry, and its unique importance for the nation as a whole, lay in the making of sheet iron. The assignment of priorities is always a hazardous and seldom a rewarding practice. It is safe to say, however, that the Wooddale and Marshallton mills were among the very earliest of mills to engage in the production of sheet iron.[97]

These mills not only pioneered in the rolling of sheet iron, but each mill developed a specialty, covered by patents, which advanced the range and quality of sheet production.[98] The Woods rose to success with their imitation Russia glazed sheet. The Marshall's special product was galvanized iron.[99] The priority in the making of this familiar product in the United States has been assigned to Jethro J. McCullough.[100] Although his first mills were located at North East and Elkton, in Cecil County, and his production of galvanized iron began in Philadelphia, McCullough had received his first training in the iron business from 1842 to 1847 as an associate of the Marshalls, at Marshallton.[101] Because of the early and special interest which Wood, Marshall, and McCullough had in the production of

92 - *Report of the Manufactures of the United States at the Tenth Census (June 1, 1880) . . .* (Washington, 1883), p. 206.

93 - "Wilmington and Its Industries," *Lippincott's Magazine*, XI (1873), 526; *Every Evening*, Oct. 8, 1872.

94 - *Every Evening*, Oct. 21, 1873.

95 - *Ibid.*, July 15, 1873.

96 - *Wilmington Board of Trade Journal*, VII (June, 1905), 1. These mine pits are still in evidence on Iron Hill.

97 - Victor S. Clark, *History of Manufactures in the United States* (New York, 1929), II, 275.

98 - *Ibid.*, I, 513.

99 - Caleb Marshall took out U.S. patents on this process in 1871 (no. 114,956) and 1873 (no. 144,403).

100 - See his advertisement in *Delaware Gazette*, Jan. 10, 1854.

101 - See his obituary in *Every Evening*, May 27, 1878. In later life, he also owned mills in Wilmington.

special-finish sheet iron, all three firms were leaders in the beginnings of the tin-plate industry in this country.[102]

Iron is no longer produced along the Red Clay. Pennsylvania families moved to the stream, perhaps mainly attracted by its fine water power, and founded mills. At these sites they learned to roll iron and developed their own special products. When success was assured, they moved their main business interests to Philadelphia, allowing their Delaware mills to languish or pass into local hands. But the abandoned ironworks on the Red Clay were signposts of success, not of failure. In these a generation of leading iron manufacturers was trained and new processes developed. For their season, they were the cradles of an American industry.

It is noticeable how many men prominent in the manufacture of sheet iron in this country are natives of Delaware. That little State seems to have been the nucleus of that branch of business in times past, from which came the men who have built up establishments elsewhere, all of which should redound to the credit of the "Diamond State" and her "Blue Hen's Chickens." Among them may be mentioned Delaplaine McDaniel, Edmund A. Harvey, and Jethro J. McCullough, (of the McCullough Iron Company and the McDaniel & Harvey Company,) Alan Wood, Sr., and Alan Wood, Jr., of Conshohocken, W. Dewees Wood, of Pittsburgh and McKeesport, George F. McCleane, of Moorhead & Company, Pittsburgh, Charles L. Gilpin, of Pittsburgh, John Marshall, Caleb Marshall, and Alfred Marshall, of Philadelphia, W. K. McClees and George Danby, of the American Sheet Iron Company, at Phillipsburgh, New Jersey, and probably others.

Figure B
Editor's comment from the American Iron and Steel Association's *The Bulletin*, January 28, 1885.[Q]

[102] - For a good description of Marshall Bros. & Co. efforts in this line, see *Iron Age*, XLVII (May 28, 1891), 1009.

Chapter 5[R]

Timeline of the Marshall iron interests

1692 – First iron produced in Delaware at what is now known as Iron Hill Delaware. Iron Hill is located half way between Newark and Glasgow, DE near the MD border. New Castle County was part of PA in the 1600s as DE had not been formed until the mid-1700s. Sir William Keith operated the iron furnace at Iron Hill starting in the mid-1720s. An early iron mill at the site of what is now called Hagley on Brandywine Creek, operated from 1787 until around 1812 rolling Swedish and Russia iron for use by a New York cut-nail slitting mills.

1801 – Solomon "Hersey's grist mill is willed to his sons Isaac and Benjamin "Hersey.

1819 – "Hersey's grist mill is sold at Sheriff sale to Jesse Trump, Jr.

1819 – Trump sells the grist mill and property to James Buckingham.

1835 – Buckingham sells the grist mill and property on November 14th to John Marshall.

1836 – John and Caleb Marshall construct an iron rolling mill on the property keeping the existing grist mill in operation as well. The brothers operate the mills and expand the capabilities of the iron rolling mill.

1856 – John and Caleb Marshall expand their business taking in Calvin Phillips and Alexander H. McFadden (both local men) into a partnership. They move the firm's offices to Philadelphia and began to manufacture galvanized iron in Philadelphia under the name of Marshall, Phillips & Company. The Marshall's eventually change the company name to Marshall Bros. & Company when they obtain full ownership. The Marshalls establish the Penn Treaty Iron Works near Philadelphia on the land where William Penn held his deliberations with the Indians and where the famous treaty was signed. The Marshalls would eventually operate multiple iron milling and working sites around Philadelphia.

1863 – Caleb Marshall sells his share of the Marshallton Works to brother John's son-in-law, Edward Mendenhall.

1864 – John Marshall turns over daily operation of the Marshallton Works, but not ownership, to his son, Calvin P. Marshall.

1869 – Calvin Marshall buys out Edward Mendenhall's interest in the Marshallton iron rolling mill. Marshallton Works iron mill is now owned by John Marshall and his son Calvin.

1871 – John Marshall sells his Marshallton interests to John and Joseph P. Richardson so that he may concentrate his efforts growing the Philadelphia operations.

Caleb Marshall is awarded his first patent; patent 114,956 – "Improvement in the Manufacture of Sheet-Iron and Removing Scale from Iron for Coating with Other

Metals". The Marshalls share this and future patents between the Marshallton and Philadelphia mills.

1872 – Calvin Marshall and the Richardsons expand their business by constructing a rolling mill on the Christiana River at Newport, DE. This mill is operated in conjunction with the Marshallton mill.

1873 – Caleb Marshall receives patent 144,403 for "Improvement in Coating Iron and Other Metals with Protective Alloys".

1874 – Calvin Marshall sells his interest to John R. Bringhurst, a nephew of the Richardsons. The ownership of the Marshallton property passes out of Marshall family ownership.

Caleb Marshall receives patent 154,334 for "Improvement in Furnaces for Heating and Annealing Sheet-Metal and Etc.".

1876 – Caleb Marshall receives patent 175,365 for "Improvement in Sheet-Metal Straightening Machine".

1877 – Volta Galvanizing Works located in Frankford, PA is purchased and relocated to Newport, DE. It is operated in conjunction with Marshallton operation under John Bringhurst's direction and ownership.

Calvin P. Marshall forms J. Marshall Company. Marshall, Bringhurst, and the Richardsons sell their individual interests in the Marshallton iron mill to Calvin P. Marshall owner of J. Marshall Company who subsequently transfers those interests to the Marshall Company. The transfer and consolidation of assets through Calvin Marshall into the J. Marshall Company might have been a "straw man" real estate transaction.

Calvin P. Marshall and J. Marshall Company is sold back to Bringhurst making Bringhurst the full owner of the J. Marshall Company and the Marshallton and Newport operations. The Marshallton and Newport operations have passed completely out of Marshall family involvement. The Marshall family continue operating their iron and steel business from their offices in Philadelphia. The Marshalls operate several iron rolling mills in the Philadelphia area.

1878 – Caleb sells his interest in the Philadelphia operations to his three sons, Wilmer W., Alfred, and J. Howard Marshall, who had become his partners in the family business now known as Marshall Brothers & Company.

1879 – Newport Rolling Mill which includes the subsidiary operation, Volta Galvanizing Works, is bought by John Marshall. Bringhurst still owns and operates the Marshallton facility.

1881 – A company is incorporated in the State of Delaware as the Marshall Iron Company with Edward Mendenhall as president having succeeded John Bringhurst.

1892 – Marshall Brothers & Company of Philadelphia becomes the first company to manufacture tin plate commercially. The Marshall family operation in Marshallton, DE was one of the first to commercially manufacture galvanized sheet iron.

1900s – Within the first few years of the 20th century, the iron rolling and galvanizing operations at Newport and Marshallton have closed down. Neither location was of sufficient capacity to compete with larger competitors such as the Alan Wood Steel Company and Luken Steel Company in the Philadelphia area.

The site of the former Marshallton Works once owned by the Marshall family is sold in 1906 to the Delaware Hard Fibre Company and turned into a vulcanized fibre manufacturing facility. In 1933 Haveg Industries purchases the site for manufacturing heat and corrosion-resistant equipment. Haveg Industries is purchased by Hercules Incorporated in 1964 and becomes a subsidiary of Hercules. Hercules sells the operation, now making Teflon tubing and phenolic resins, to Ametek in 1980. While flooding of the Red Clay Creek in 1999 (Hurricane Floyd) nearly destroyed the operation, the creek's flooding in 2003 (tropical storm Henri) did irreversible damage to the manufacturing operations and the site was closed in 2004 ending over 200 years of milling and manufacturing operations along the Red Clay Creek at Marshallton, DE.

Figure C
Marshall Iron Works shortly after the 1906 sale to Delaware Hard Fibre Company.
From a 1907 postcard. Courtesy Delaware Public Library.

Chapter 6[S]

This monograph was written and issued in the early 1960s. Alan Wood Steel Company was still a profitable business when the monograph was published. With the availability of cheaper steels from Japan and China, the American steel industry began to fail. By 1977 economic hard times were affecting the Alan Wood Steel Company. The following historical information is adopted from the "Description of Records" contained at the Hagley Museum and Library's Soda House. Additional records are maintained at the Conshohocken Historical Society and at the University of Pennsylvania.

The Alan Wood Steel Company was incorporated in Pennsylvania as the Alan Wood Company on January 23, 1929, and was renamed the Alan Wood Steel Company on February 16, 1929. It represented a reorganization and recapitalization of an earlier firm, the Alan Wood Iron and Steel Company. The firm was a small, family-controlled integrated steel company, producing primarily steel sheets.

The company traced its roots to James Wood (1771-1852), the grandson of an Irish Quaker immigrant. During the early 1800s he had worked at a number of forges in the Philadelphia area, mostly engaged in the manufacture of scythes and other agricultural implements. From 1826 to 1832 he operated the Delaware Iron Works on Red Clay Creek at Wooddale, Del., in partnership with his son Alan (1800-1881) and engaged in the manufacture of shovels.

In 1832, the entire operation was moved to Conshohocken, Pa., to obtain better access to the iron and anthracite coal coming down the Schuylkill Canal. The rolling mill and shovel factory was operated as James Wood & Son until 1840, when Alan and William W. Wood took over as Alan Wood & Brother. Alan left that same year to resume operation at the Delaware Iron Works, and his father came out of retirement and reconstituted the firm as James Wood & Sons. Puddling furnaces were built in 1847. In 1848 James again retired, and leadership was assumed by his son John (1816-1898) as J. Wood & Brothers. The Corliss Iron Works was constructed in 1864, and the firm was incorporated as the J. Wood & Brothers Company in 1886.

The Delaware Iron Works was leased by John Wood in 1840 and purchased outright by Alan Wood in 1843. Leaving his sons to operate this mill, Alan Wood established the Schuylkill Iron Works in 1857, next to the J. Wood & Brothers mill. It became an important producer of steel sheets and was incorporated on December 28, 1885, as the Alan Wood Company. The Delaware Iron Works was abandoned in 1889.

W. Dewees Wood, the son of Alan Wood, moved to western Pennsylvania and in 1851 established the McKeesport Iron Works with his uncle, Lewis A. Lukens, and several other partners. It produced a fine "planished" iron equal or superior to the best Russia sheet iron. A branch plant was established in Wellsville, on the Ohio River, in 1880. Both Wood and Lukens died in 1899, and their heirs sold the property in the following year.

In 1901, the Alan Wood Company was producing 25,000 tons of steel, and the family decided to become a fully integrated steel producer. The Alan Wood Iron & Steel Company

was incorporated on December 1, 1901, and over the next two years constructed the Ivy Rock Steel Works just upriver from Conshohocken. The new firm absorbed the old Alan Wood Company on July 1, 1903. However, the J. Wood & Brothers Company remained independent and was not absorbed until March 14, 1917.

On December 1, 1911, the Alan Wood Iron & Steel Company acquired by merger the Richard Heckscher & Sons Company, owning blast furnaces at Swedeland on the west bank of the Schuylkill opposite Ivy Rock. The Rainey-Wood Coke Company was formed on July 11, 1918, as a joint venture of Wood, W. J. Rainey, Inc., a large western Pennsylvania coal producer who provided the coal, and the Koppers Company, who designed and built the by-product coke plant in Swedeland. The Upper Merion & Plymouth Railroad, organized in 1907, connected all the elements of the Wood steel-making complex.

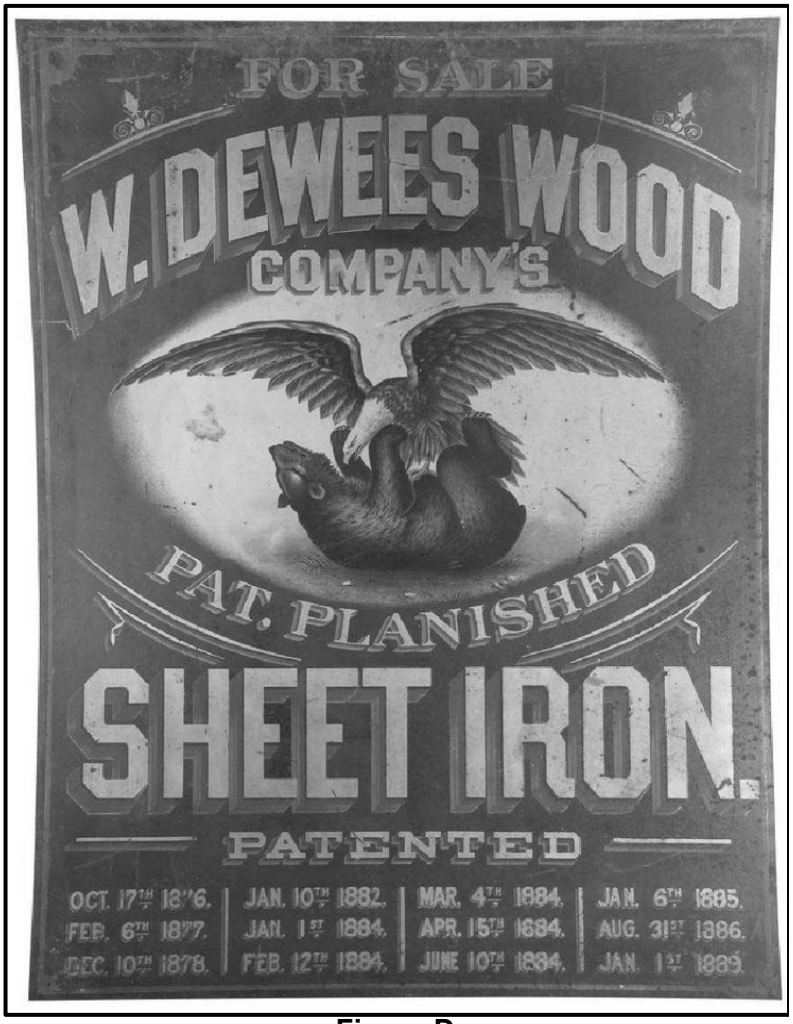
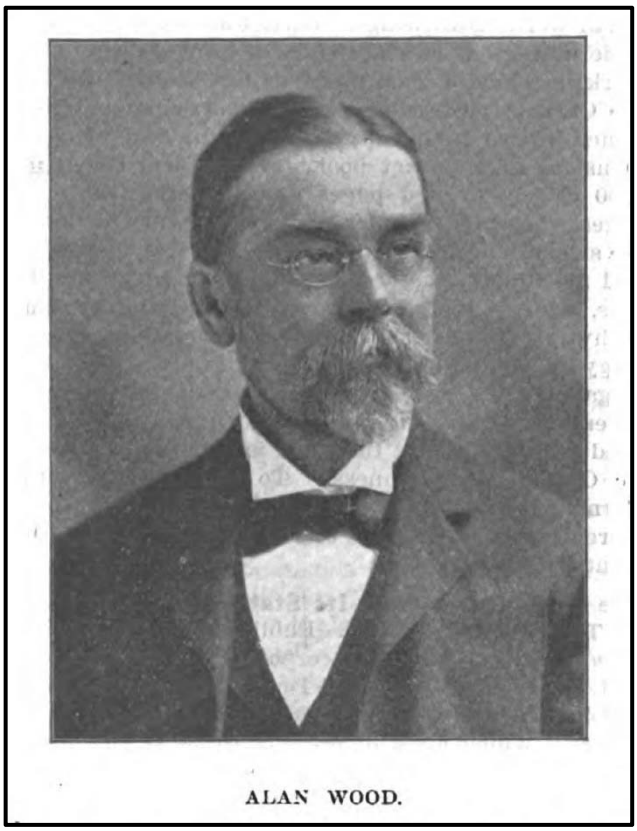


Figure D
W. Dewees Wood Planished Sheet Iron label

In 1929, the Wood family sold a controlling interest to the Koppers Company, and the firm was reincorporated as the Alan Wood Steel Company. The firm leased two iron mines from the Warren Pipe & Foundry Company in 1929. The Scrub Oak Mine was located near Dover and the Washington Mine near Oxford. These mines were purchased outright in 1941. In 1947 the Wood family repurchased control of the company and continued to modernize, installing a Cold Rolled Department in 1954, a Research Department in 1958, an iron powder plant in 1959 and a basic oxygen furnace in 1968. It also attempted to integrate forward by buying the steel locker and shelving business of the Penn Metals Company in 1955.

As a small producer, Alan Wood Steel was particularly vulnerable to the competitive pressure that hit the American steel industry in the 1970s. The firm went into receivership and steel operations were shut down on August 1, 1977. The company was reorganized as the Vesper Corporation and continues in the steel shelving business. Part of the rolling mill complex was sold to Lukens Steel of Coatesville, and the rest of the works was razed in late 1990.

The following is the obituary of Alan Wood as written for *The Iron Age*, November 13, 1902



ALAN WOOD.

The death of Alan Wood, which occurred in Philadelphia on October 31, 1902 after several years of failing health, removes from the scene of his earthly labors and successes a man who was for many years a prominent figure in the sheet iron trade. Mr. Wood was a member of the family whose name is inseparably connected with the development of the manufacture of light sheets in this country. One branch of his family attained distinction in Western Pennsylvania and the other in Eastern Pennsylvania. The subject of this sketch belonged to the Eastern branch.

He was born July 5, 1834, near the Delaware Iron Works, owned by his father and located about 5 miles from Wilmington. DE. He was educated in Philadelphia, and at the age of 16 took charge of the iron works. Together with his father he made improvements in the manufacture of sheet iron, which enabled a product to be successfully turned out of a quality equal to Russia sheet iron and known as "patent planished sheet-metal".

In 1851 Mr. Wood removed to Conshohocken, PA, a short distance from Philadelphia, where he was instrumental in establishing the Schuylkill Iron Works, now owned by the Alan Wood Company, which under his management speedily grew into a large plant for the production of sheets. He retained charge of the works until his retirement from active business ten years ago, continuing to serve as a director of the company until his decease. In 1876, he was elected to Congress, but only served one term, as he had no liking for political life. Since his retirement, he has spent his time in traveling in this country and abroad. He was a member and a former director of both the Union League and Manufacturers' clubs and a member of the Franklin Institute. He was greatly interested in charitable work, and was a yearly contributor to the University of Pennsylvania.

It is a singular coincidence that on October 30, 1902, only a few hours before Mr. Wood's death, Charles Lukens, another of the directors of the Alan Wood Company, had passed away. Mr. Lukens was 66 years of age and had also been connected with the iron trade for most of his life.

The following biography for Waters Dewees Wood, a son of Alan Wood, is excerpted from the *National Cyclopaedia of American Biography*. It provides a good history of W. Dewees Wood's life and accomplishments.

> Waters Dewees Wood, manufacturer, was born in Philadelphia, PA, April 17, 1826, son of Alan and Ann Hunter (Dewees) Wood, grandson of James and Tacey (Thomas) Wood; great-grandson of John and Catherine (Davis) Wood, and great-great-grandson of James Wood, a native of England. His father (1800-1881), was one of the first to manufacture sheet-iron in America. He was educated in the Quaker schools of Philadelphia, and in 1846, he became associated with his father in the Delaware Iron Works at Wilmington, where he remained until 1851.
>
> He was the inventor of the process of making what is called "Russian" sheet-iron and in 1851, he associated with him Richard B. Gilpin, and founded the McKeesport Iron Works to manufacture the sheet-iron by his patented process. The latter retired in 1855, but the company was continued under the name of Wood, Moorhead & Company. In January 1859, Mr. Wood leased the works to M.K. Moorhead and George F. McCleane, who had been his partners, and resumed the management of his father's mill in Wilmington, Delaware.
>
> Upon the expiration of the lease in 1861, he took up his own business with Alan W. Lukens. In 1871, Mr. Lukens retired, and the firm of W.D. Wood & Company was formed, the partners being his three sons, Alan W., Richard G., and Thomas D., and in 1858, the W. Dewees Wood Company was incorporated, with Mr. Wood president; Richard G. Wood, vice-president and general manager; Alan W. Wood, secretary and treasurer; and Thomas D. Wood, superintendent.
>
> The annual capacity of this company is now about 5,000 tons of patent planished sheet-iron which has a world-wide reputation, and which has almost entirely displaced the Russia iron in America. Other products of these works amount to 25,000 tons of additional per annum; 1,200 men are employed.
>
> Mr. Wood also owned the Wellsville, Ohio, Plate and Sheet Iron Company of which his son-in-law, Perifor F. Smith, is president, and he built the KcKeesport Illuminating Gas Works which he sold to the United Gas Improvement Company, in 1897.
>
> He was married in 1847 to Rosalind Howell, daughter of Richard B. Gilpin, of Wilmington, Delaware, who died in 1883; and he was again married in 1889 to Gertrude, daughter of Newton St. John of New York City. He died in Pittsburg, Pennsylvania, January 2, 1899, survived by his wife, four sons and four daughters.

Chapter 7[T]

Earlier in this monograph Carroll Purcell discusses Jethro J. McCullough and John R. Bringhurst and their association with the Marshall family. Two additional individuals, Edmund A. Harvey and Delaplaine McDaniel were also familiar with the work of Caleb and John Marshall as well as the Wood family.

The application of one or more metals, including copper, zinc, lead, tin, and gold to iron was well known for centuries in the ability to reduce iron's tendency to oxidize or "rust". In the mid-1800s a lot of experimentation producing smoothly rolled sheets of sheet metal, as well as various coating processes and formulas, occurred in America. Two of the Marshall patents (see footnote L) specifically focus on rolling sheet metal and its coating.

Caleb and John Marshall were the first to produce coated sheet metals in Delaware. While today the term "galvanized" generally refers to a primarily zinc coatings, in the 1800s the terms "tinning", "galvanizing", and "zincing" were used interchangeably to describe the application of any metal plating to iron sheet. While many processes relied on acids to remove scale and prepare the rolled sheet iron for galvanizing, Caleb Marshall patented a preparation that involved the use of a saline solution and heat treating the sheets in a specially designed furnace. After leaving the furnace the sheets were dipped in an alkaline solution before being further processed by galvanizing or polishing operations.

While Purcell points to Jethro McCullough as the first to roll galvanized sheet metal in North America (in Maryland), it is perhaps Delaplaine McDaniel who should be given credit for developing the process along with Edmund Harvey for the coatings. McDaniel and Harvey both partnered with McCullough who worked for the Marshall brothers to form McCullough & Company in 1847. They purchased the Northeast Works (Northeast, MD), which subsequently burnt down a few months later and then was rebuilt. The "McCullough's" brand of galvanized sheet metal was produced using Harvey patents. The galvanizing portion of the business moved to Philadelphia in 1857, and was incorporated separately in 1878 as McDaniel & Harvey Company. In 1865, McCullough & Company incorporated as McCullough Iron Company. McDaniel served as company president until his death in 1885 and Harvey succeeded him. McCullough Iron Company ceased operations in 1898.

An obituary appearing in *The Bulletin*, American Iron and Steel Association, January 28, 1885, p. 29, provides more detail on the arrangement between McCullough, McDaniel and Harvey. All three men had multiple patents related to rolling and coating iron and as young men were associated with Marshall family practices.

> <u>Delaplaine McDaniel Obituary</u>
> Prominent for nearly forty years among manufacturers of sheet iron in this country, and especially of galvanized iron, has been Delaplaine McDaniel, who died on Wednesday, January 21st (1885), at his residence in Philadelphia, in the sixty-eighth year of his age.
>
> Born in Newport, Delaware, March 16, 1817, he served an apprenticeship at blacksmithing from the age of sixteen until he was twenty-one years old.

Soon after he became of age he opened an iron store in the city of Wilmington, Delaware, forming a partnership a year or two after with Mr. E. A. Harvey, under the name of McDaniel & Harvey. Sheet iron was among the articles in which they dealt, and seeing a favorable opportunity to enter upon its manufacture Messrs. McDaniel & Harvey joined with themselves Mr. Jethro J. McCullough, then a mill wright engaged at Marshall's old mill in New Castle county, and, forming the firm of McCullough & Company, they purchased the forge and water-power at North East, Maryland, and built a small sheet mill, containing one pair of rolls. This was in February 1847. After the mill had been in operation only five weeks it took fire and burned down, but such was Mr. McDaniel's indomitable pluck that in five weeks from the day it was burned it was rebuilt and again put in operation. Their output, necessarily very small at first, met with ready sale, at remunerative prices.

Mr. McDaniel's motto in entering upon this business was the same that guided him in all its future growth and extension, namely, "Make your iron the best of its kind, or not make it at all." While selling English-made steel, before the thought of becoming a manufacturer himself had ever taken shape, he was so much annoyed by the variable quality of successive importations, some very good, some extremely bad, that he vowed he would either make something that would be uniformly good or else uniformly bad. He was never lukewarm nor uncertain, and his iron was *good*.

In 1851 Mr. McDaniel inaugurated in the United States the business of galvanizing sheet iron. All the galvanized sheets then used (not a very large quantity) were imported from England. There was an establishment in New York that galvanized bars, nails, ship-work, etc., but the first Americans to make a regular business of galvanizing sheets were McCullough & Co., under the leadership of Mr. McDaniel, in the city of Wilmington, Delaware, at the "Rocks," (a historic spot, it being the first landing place of the Swedes in Delaware, in 1638.) It was uphill work at first, and the company had many difficulties, but Mr. McDaniel was never discouraged. In spite of a low tariff, prejudice in favor of foreign-made iron, and limited capital, his tenacity of purpose, his cheerfulness under trials, his perseverance and pluck, all won for him a triumph in the end, and by adhering to his principle of maintaining a uniform standard of the highest excellence of quality he soon had the satisfaction of seeing his American-made galvanized sheets supplant the English in this home market.

The increased demand necessitated enlarged capacity for production, and three new mills were added to the original one of McCullough & Company; also, in 1859, a forge in which to make their own charcoal blooms. Successive enlargements of these properties enabled them to keep pace with the growth of the consumption until 1875, when another large mill was erected at Wilmington. Meanwhile the firm became a corporation, the McCullough Iron Company, in 1865, and in 1878 the galvanizing business, which had been removed to Philadelphia in 1857, was separately incorporated in

Pennsylvania as the McDaniel & Harvey Company. Of both these corporations Mr. McDaniel was not only the founder, but the guiding and animating spirit, and as president, with two short intervals he conducted their affairs with the greatest ability down to the close of his life. He died "in the harness."

Mr. McDaniel was also one of the founders of the Diamond State Iron Company, manufacturers of bar iron, fish-plates, etc., in Wilmington, and a director and large stockholder in it at the time of his death. He had accumulated an ample fortune, and his possessions were many and varied, but in his later years nothing gave him greater pleasure than a tract of several thousand acres of land in Cecil county, Maryland, near North East, on which he had built a pleasant summer residence, "Shady Beach."

Of his qualities as a man of business all who came in contact with him acknowledged his high character. He was far-sighted, tireless, of the strictest integrity, just and honorable in all his dealings, a warm friend, and a thoroughly upright and conscientious man. He leaves two daughters and one son – Mr. J. L. McDaniel, who is vice-president of the McDaniel & Harvey Company.

Marshall Brothers opened their Penn Treaty Rolling Mill at Beach and Marlborough Streets in 1856. There was an office at 24 Girard Avenue, Philadelphia PA. There were three heating furnaces and one 3-high puddle mill. There was a single 3-high bar mill, six 20 x 36-inch cold mills used to make sheet and black plates for tinning. The annual capacity was 7,500 gross tons with bituminous coal used for fuel.

A tinning plant added to the rolling mill in 1891 which added one 26 x 36 and five 24 x 32-inch hot tin plate mills. The first terne plates (an alloy coating, terne was historically made of lead (80%) and tin (20%) and was used to cover steel) were rolled in January. The first tin plates were made in April 1891. The mill had 6 rolling lines, four for tin plates and two for terne plates. The mill's weekly capacity reached 4,000 boxes of tin plates and 500 boxes of terne plates within a short time. The tin plate brands offered was "Penn Treaty". For terne plates the brands were "Penn Treaty," "Girard," and "Marshall."

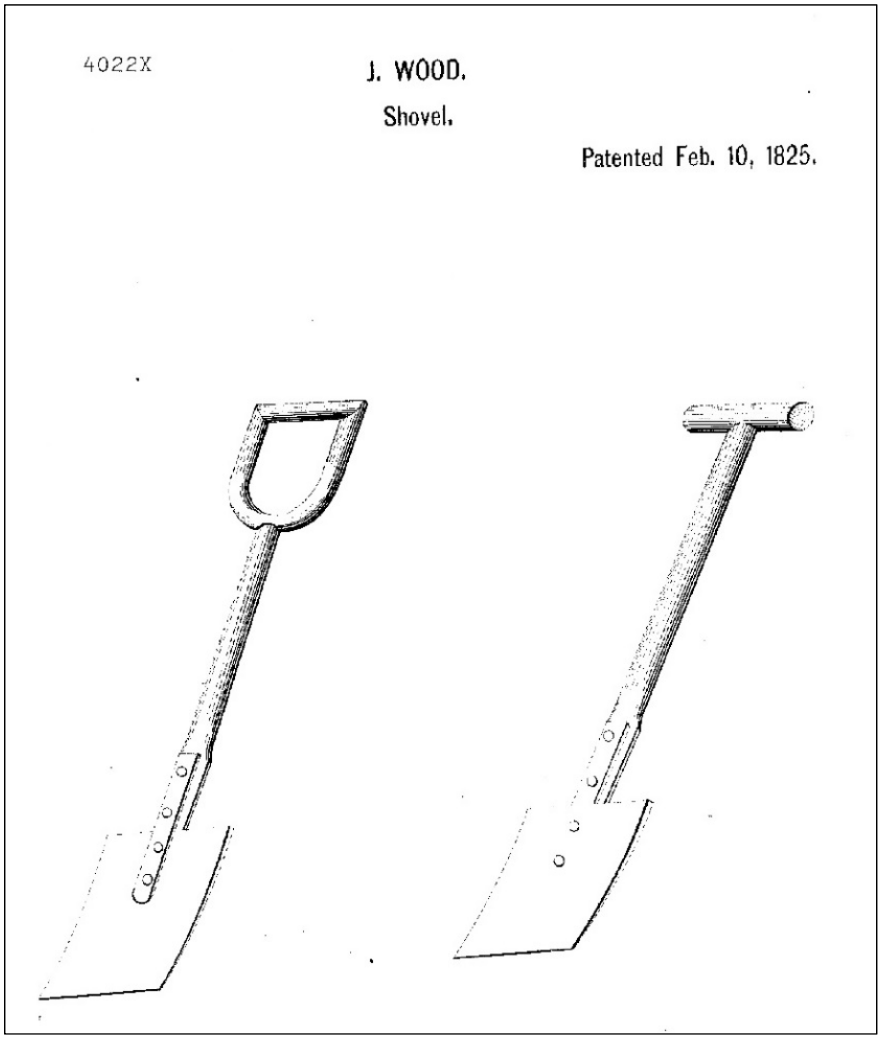
2019 EDITION LETTER FOOTNOTES

Chapter 1 – Added Footnotes

[A] – When the railroad was initially chartered in 1867 the name was the Delaware & Chester County Railroad Company. After the company was reincorporated in 1869 the name became the Wilmington & Western Rail Road Company. Initial Delaware and Pennsylvania documentation use "rail road" for the company's incorporation. By the time the railroad began operations in 1872 both "rail road" and "railroad" were in use by the organization both in print and in legal documents. In 1877, after a bankruptcy, the line was incorporated as the Delaware Western Railroad.

In the paragraph that follows Purcell states "Driving westward from Wilmington to Newark, one may look to the right as he crosses the bridge over the Red Clay Creek just beyond Prices Corner, and see the old millrace which delivered power to Marshall's rolling mill." Purcell is referencing the Old Capitol Trail for making the trip and not the Robert Kirkwood Highway.

[B] – The US Patent Act was passed on April 10, 1790 with the first patent granted to Samuel Hopkins (Method to Produce Potash – July 31, 1790). On December 15, 1836, a fire destroyed the patent office (another fire occurred on September 24, 1877 but as a result of changes made after the 1836 fire no issued patent records were lost). Records for 9,957 patents that had been issued and for pending patents that were in the process of being examined were lost as a result of the 1836 fire. About 2,845 patents issued prior to the fire have been recovered from documents not in possession of the patent office at the time of the fire. Early patents were not assigned a serial number but recorded by date and title. As a result, patents that were issued before the fire that were recovered are given a "X" designation along with a unique serial number based on their date of issue.



James Wood of Philadelphia, PA was granted the 4,022nd patent issued for his "Improvement in the Manufacture of Shovels & Spades", issued February 10, 1825. Wood's reconstructed patent is reproduced below.

4022X

UNITED STATES PATENT OFFICE.

JAMES WOOD, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN THE MANUFACTURE OF SHOVELS AND SPADES.

Specification forming part of Letters Patent dated February 10, 1825.

To all whom it may concern:

Be it known that I, JAMES WOOD, of Philadelphia, Pennsylvania, have invented an Improvement in Making Shovels and Spades, of which the following is a specification.

This improvement in the making or manufacturing of shovels and spades consists in making the blades entirely of steel and attaching the blade to the handle by means of the steel or iron straps fastened to the blade, and also to the handle by rivets on the front and back side of the blade and handle, or by a strap on the back side only, the support of the front side formed from the plate of which the said plate is made, and in making the said blades each from a single piece of steel rolled to the proper dimensions and not hammered.

The difference between this improved mode of making or manufacturing shovels and spades and the modes heretofore in use is that heretofore they have been made of iron, and none have been made of steel. The supports by which the blade is fastened to the handle by the old method are formed from and are part of the blades themselves, instead of being fastened to the blades by rivets, and the whole formed from a sheet of iron doubled and welded together by hammering, instead of being rolled from a piece of steel, as by this method.

In testimony that the above is a true specification of my said improvement I have hereunto set my hand this 22d day of January, A. D. 1825.

JAMES WOOD.

Witnesses:
WILLIAM T. SMITH,
GEO. C. GODDARD.

[C] – The image was replaced with a better-quality version.

[D] – The rolling of "puddled iron" into sheets began as early as 1480 in Europe. In the 1600s the cold rolling of iron into thick shapes was occurring at different locations in Europe. The rolling and slitting of iron into shapes (generally called "plate" today) for use by blacksmiths continued into the 1700s with much of the thick sheet material rolled being slit and turned into nails, wooden keg bands, wooden wheel tires, and similar items. England, by an Act of Parliament, passed the Iron Act of 1750 which was intended to suppress the manufacture of finished goods and hardware in the colonies. However, as England needed to exploit the iron resources available to the Colonies, the Act also served to spur the production of unfinished cast and wrought iron and to increase export to England but forbid export to other European countries. Only existing foundries were allowed to continue as new foundries were illegal to construct and operate.

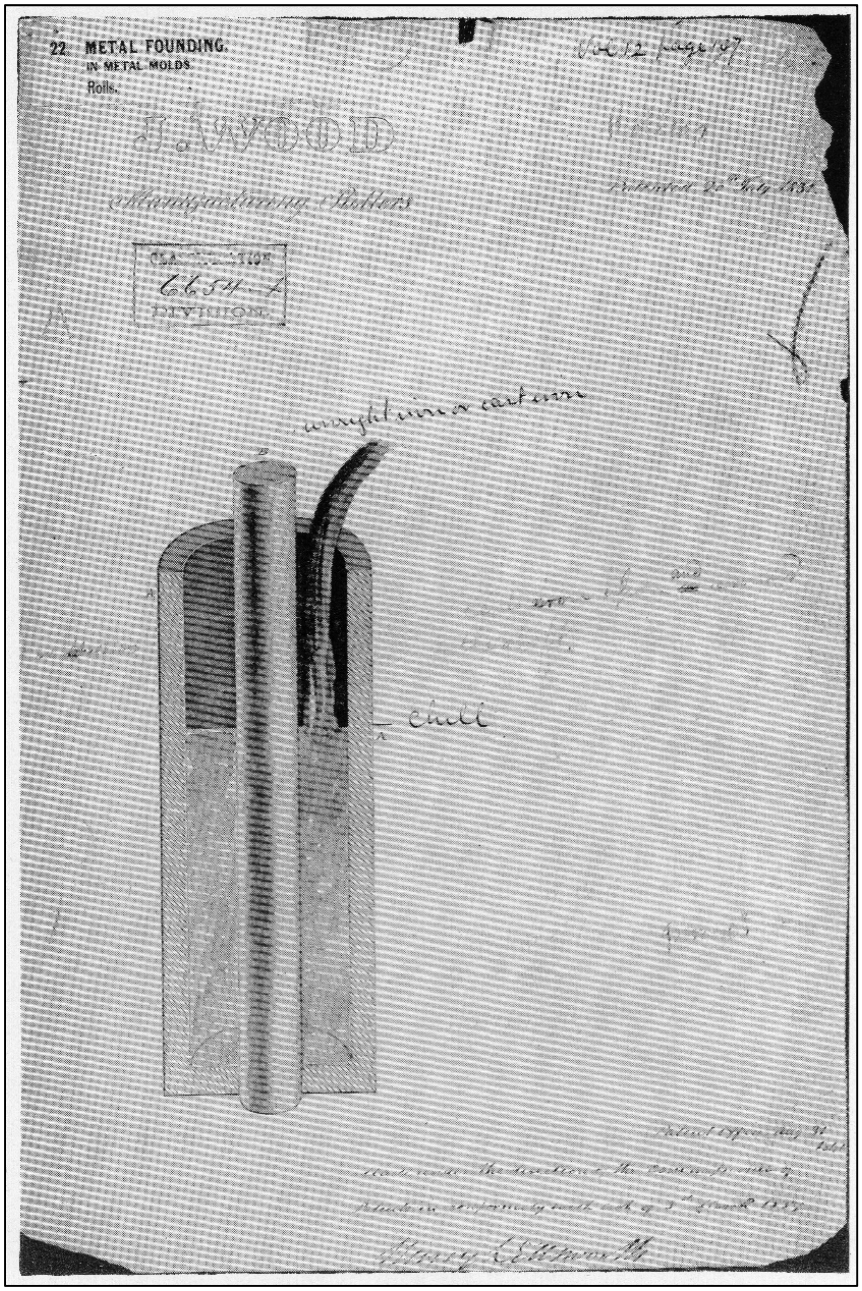
It wasn't until the end of the American Revolution that iron production in North America again became a growing industry. The iron ore being mined could be turned into tinplate or sheet-iron for making articles. In the early 1800s, large dimension thin sheets were uniformly rolled (generally less than 3/16" thick) for processing into finished products. These large, thin sheets of rolled iron were intended for covering the insulation on locomotive and stationary boilers, making of tinplate kitchen utensils, and other light durable products.

While it started life as a slitting mill making nails and thick rods and shapes, the mill at Wooddale became the first large, thin sheet-iron rolling mill in Delaware and second, large, thin sheet-iron rolling mill in America. The first sheet-iron rolling mill in America had been established by the Townsend family at the Sterling Iron Works constructed in New Jersey shortly after the revolution. In Delaware, the rolling of sheet-iron (as opposed to the slitting and rolling of iron for

railroad rail or other thicker shapes) expanded with the development of the Marshall Rolling Mill which began operation in 1836. The Marshall mill was followed by the Wilmington Rolling-Mill in 1845 and the Diamond State Rolling-Mill in 1853.

[E] – The image was replaced with a better-quality version.

[F] – The image below was replaced with the actual US Patent Office patent sheet.



Patent drawing for James Wood's improved plan for making rollers, July 20, 1831. Restored Patent Drawings, Record Group 241, Records of the Patent Office, National Archives, Washington, D. C.

[G] – Russia Iron is also known as "Planished Iron". From *An Elementary Outline of Mechanical Processes* by George W. Danforth in 1912; Russian or Planished Iron is a high-grade, smooth, glossy sheet iron, not liable to rust; once made by a process that was long a secret with Russian

manufacturers. This name is also applied to sheet iron of very highly polished or glazed surface also known as planished iron. It is used for protecting the lagging of engines and boilers and for other uses where a non-corroding black iron of finished surface is desired.

These sheets are made by piling together about fifty pickled sheets of soft steel or iron (Pickling of iron involves exposing the sheets to a heated "pickle liquor" of strong acids (usually hydrochloric acid) to remove surface impurities. Pickling is a form of descaling or cleaning iron and steel before working it.). The sheets are stacked with powdered or dusted with charcoal sprinkled uniformly between adjacent sheets. The pile is wrapped in old sheets, wired tightly into a uniform mass, and heated in a furnace to a cherry-red heat for about 6 hours. Upon cooling, each sheet is swept free of loose charcoal and is then sprayed with steam to form a thin oxide. Again, the sheets are piled together, heated and then placed on the hammer table, several in a bundle, and pounded with a steam hammer. This brings about a grinding action which grinds the carbon and oxide on the surface down to a highly-polished coating.

[H] – A copy of the original patent is provided below.

UNITED STATES PATENT OFFICE

JAMES WOOD, SR., JOHN WOOD, AND W. W. WOOD, OF WILMINGTON, DEL.

IMPROVEMENT IN THE PROCESS OF MANUFACTURING SHEET-IRON, WHICH IRON IS DENOMINATED "AMERICAN GLAZED SHEET-IRON."

Specification forming part of Letters Patent No. **2,813,** dated October 12, 1842.

To all whom it may concern:

Be it known that we, JAMES WOOD, Sr., JOHN WOOD, and WILLIAM W. WOOD, of Delaware Iron Works, near the city of Wilmington, in the county of New Castle and State of Delaware, have invented a new and useful Improvement in the Manufacture of Sheet-Iron, which, when made made by our process, is similar to the Russian sheet-iron in the glaze upon its surface, and is denominated by us "American Glazed Sheet-Iron;" and we do hereby declare that the following is a full and exact account of our process for manufacturing the same.

We roll our iron in the usual manner of performing that process, and when it is intended to receive a glazed surface we leave it thicker than it is designed to be in its finished state, the glazing being effected during a second rolling. We put these plates into an acidulated bath for the purpose of removing the oxide from the surface, using for this purpose a dilute solution of sulphuric, muriatic, or any other acid which will effect this object, the procedure being the same as when plates of iron are prepared to be tinned. When these plates have been cleaned and dried we coat them over on each side with oil or with fatty or resinous matter, preferring to use linseed-oil, which we have found to give good results. We then take two or more plates thus prepared and place them between other rolled plates, either prepared in the same manner or simply rolled, which we place on the outsides of the prepared plates and make the whole into a pack. This pack we heat in a suitable furnace to a cherry red, or somewhat beyond this, being governed by the nature of the materials used and as experience may dictate. We then roll the pack in its heated state between the rollers ordinarily employed for that purpose. This process of preparing or oiling, of heating and rolling, is to be repeated as often as may be necessary to communicate the required glaze to the sheets and to reduce them to the intended thickness. By this procedure the surface of the iron will be made to assume a black color and a smooth and brilliant surface resembling that possessed by the sheet-iron manufactured in Russia.

What we claim as new, and desire to secure by Letters Patent, is—

The giving to rolled sheet-iron such a glazed surface by the process or in the manner above set forth—that is to say, by covering the surfaces of the plates after they have been freed from oxide with a coating of linseed-oil, or with other oil or fatty matter, or with resinous solutions, making the sheets so prepared into a pack, heating them to redness, and then rolling them in this state, for the purpose and substantially in the manner above set forth.

JAMES WOOD, SR.
JOHN WOOD.
WM. W. WOOD.

Witnesses:
FREDK. LEONARD,
GEO. W. CHAYTOR.

[1] – A copy of the original patent is provided below.

J. & W. W. WOOD.

PROCESS OF MANUFACTURING GLAZED SHEET IRON.

No. 8,048. Patented Apr. 15, 1851.

FIGURE 1.

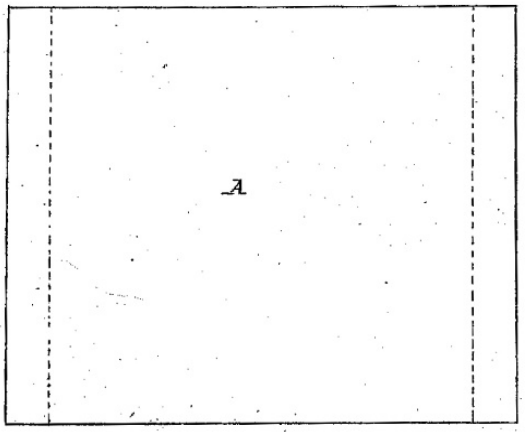


FIG. 2.

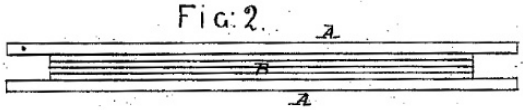


FIG. 3.

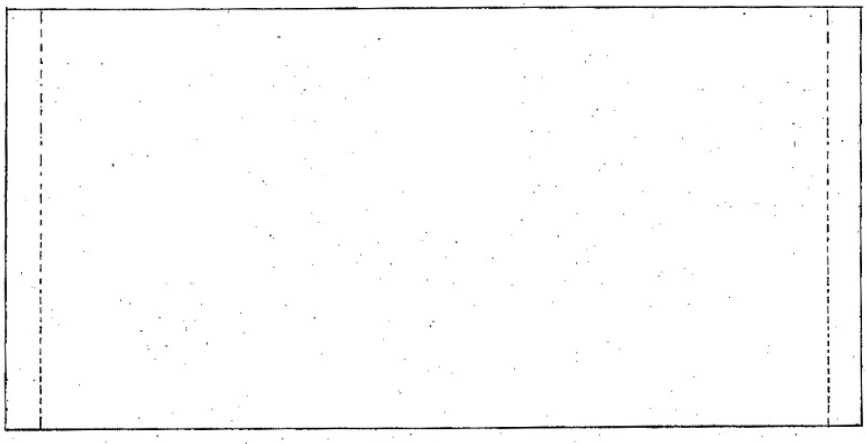
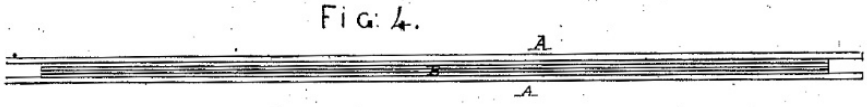


FIG. 4.



UNITED STATES PATENT OFFICE.

JOHN WOOD AND WM. W. WOOD, OF CONSHOHOCKEN, PENNSYLVANIA.

PROCESS OF MANUFACTURING GLAZED SHEET-IRON.

Specification of Letters Patent No. 8,048, dated April 15, 1851.

To all whom it may concern:

Be it known that we, JOHN WOOD and WILLIAM W. WOOD, of Conshohocken, in the county of Montgomery and State of Pennsylvania, have discovered a new and Improved Process in the Manufacture of Glazed Sheet-Iron; and we do hereby declare that the following is a full and exact description thereof, reference being had to the annexed drawings.

Figure 1, is a plan showing the pack of plates before it is subjected to the rolling process. Fig. 2, is a side view of ditto. Fig. 3, is a plan showing the pack after being subjected to the rolling process. Fig. 4 is a side view of ditto.

This improvement consists in a new and peculiar *modus operandi*, whereby every sheet or plate is finished with fine glazed and lustrous surfaces, equal to the best Russia sheet iron, whereas by the ordinary process, even with our former improvement (for which we and James Wood, Senr., obtained Letters Patent in 1842, and of which the principal feature consisted in coating the surfaces of the plates with linseed oil or other oil or fatty material prior to finishing by heating and rolling them,) nearly one third part of the sheets, namely, the two outside sheets of each pack of six or seven, were left very defective, they having become oxydized beyond remedy. In our new and improved process, after having prepared the plates by deoxidating and oiling as described in our former specification, we place four (more or less) of the plates thus prepared, between two shield plates A A of double the thickness of the inside plates; the two shield plates A being as heavy as the four plates B which are placed between them. The shield plates, prior to being applied as such, are deoxydated by being immersed in sulphuric or other acid, and are also coated with oil. These plates are nearly of equal surface, but a trifle longer than the thin plates. When a convenient number of packs are made up as above described, each containing four thin plates between two shield plates, we submit one to a red heat in a suitable furnace, and pass it between iron rollers, and repeat the process of heating and rolling until all the plates are extended to nearly double the area of the original pack as shown in Figs. 3 and 4. By this process of rolling, the surfaces of the four inside plates are rendered beautifully smooth and glossy; and these thin sheets being removed, the shield plates A are each cut in two, and prepared with acid and oil for constituting the inside sheets of other packs, by being placed between other heavy shield plates. All the shield plates are thus wrought into smooth finished sheets, and the production of defective sheets is avoided. The thin smooth sheets, either before or after being squared and trimmed to the proper size, are straightened by being placed between shield plates, and passed, in a cold state, between the rollers. In this process we place two thin sheets between two shield plates of double thickness, and while they are cold, pass them once or more between the rollers, giving them a heavy pressure, whereby they are rendered smoother and more glossy.

What we claim as our invention and desire to secure by Letters Patent, is—

The employment of thick plates of iron as shield plates; or, in other words, placing four (more or less) thin plates between two shield plates of double weight, in forming packs for rolling, so that each shield plate will make two plates of proper size to constitute the inside plates of another pack, for the smoothing and finishing process of rolling.

In testimony whereof we have hereunto signed our names before two subscribing witnesses.

JOHN WOOD.
WM. W. WOOD.

Witnesses:
WM. P. ELLIOT,
RUFUS PORTER.

[J] – A listing of the known Wood family patents is included in the following table. The two 'X' patents are discussed in the monograph in detail. Three patents include the 'R' designation serial number indicating there is a "reissue". There are numerous reasons to reissue a patent including to correct an inaccuracy, revise the claims made thus reflecting a more specific context, and to change references to previous of pending co-patents either with the same or a different inventor. One patent is a "design patent" and is designated with a 'D'.

Most of the patents in the list are for Alan Wood's eldest son, Waters Dewees Wood. Waters Dewees Wood managed the Red Clay mill for some time but eventually moved to Pittsburgh where he set up the Waters Dewees Wood Company with a rolling mill in nearby McKeesport, PA.

According to historical sources the family shared patents between the McKeesport, PA operations as well as the Philadelphia, PA and Wooddale, DE locations.

Patent Number	Patent Title	Granted To	Date Issued
X-4,022	Improvement in the Manufacture of Shovels and Spades	James Wood	February 10, 1825
X-6,654	Casting Rolls	James Wood	July 20, 1831
2,813	Improvement in the Process of Manufacturing Sheet-Iron, which is Iron Denominated "American Glazed Sheet-Iron"	James Wood John Wood William W. Wood	October 12, 1842
8,048	Process of Manufacturing Glazed Sheet-Iron	John Wood William W. Wood	April 15, 1851
8,427 R-361 R-666	Improvement in Machines for Making Nuts, Washers & etc.	William Kenyon assigned to James Wood	October 14, 1851 R-March 18, 1856 R-February 15, 1859
32,341	Manufacture of Sheet-Iron	W. Dewees Wood Assigned to Alan Wood, Jr.	May 14, 1861
46, 841 R-7,547	Improvement in Furnaces for Finishing Sheet-Iron	W. Dewees Wood	March 14, 1865, R-March 6, 1877
61,034	Improved Process of Treating Cleaned or Scaled Iron	W. Dewees Wood	January 8, 1867
66,546	Improvement in Annealing Sheet Iron	W. Dewees Wood	July 9, 1867
137,585 R-5,474	Improvement in the Manufacture of Sheet-Iron	W. Dewees Wood	April 8, 1873 R- July 1, 1873
142,316	Improvement in Rolling-Mills	Alan Wood, Jr	August 26, 1873
142,754	Improvement in Hammers for Planishing Sheet-Iron	W. Dewees Wood	September 9, 1873
155,691	Improvement in the Manufacture of Sheet-Iron	W. Dewees Wood	October 6, 1874
172,235	Improvement in the Manufacture of Planished Sheet-Iron	W. Dewees Wood	January 11, 1876
183,356	Improvement in Cases for Packing Metal Sheets	W. Dewees Wood	October 17, 1876
186,969	Improvement in Processes and Compositions for Finishing Sheet-Iron	W. Dewees Wood	February 6, 1877
210,735	Improvement in the Manufacture of Cleaned and Planished Iron	W. Dewees Wood	December 10, 1878
252,166	Manufacture of Sheet-Iron	W. Dewees Wood	January 10, 1882
283,269	Machine for Bending Sheet-Metal Fence-Posts	Thomas R. Morgan Assigned to W. Dewees Wood	August 14, 1883
291,260	Process of Manufacturing Planished Sheet-Iron	W. Dewees Wood	January 1, 1884
293,611	Feed-Table for Hammering-Machines	W. Dewees Wood	February 12, 1884
294,559	Apparatus for Treating Sheet-Iron	W. Dewees Wood	March 4, 1884
297,097	Manufacture of Sheet-Iron	W. Dewees Wood	April 15, 1884

Patent Number	Patent Title	Granted To	Date Issued
300,184	Manufacture of Sheet-Iron	W. Dewees Wood	June 10, 1884
310,354	Method of Making Sheet-Iron	W. Dewees Wood	January 6, 1885
348,258	Art of Making Sheet-Iron	Richard G. Wood	August 31, 1886
358,370	Pipe	W. Dewees Wood	February 22, 1887
395,605	Method of Manufacturing Planished Sheet-Iron	W. Dewees Wood	January 1, 1889
490,236	Process of Manufacturing Sheet-Iron	W. Dewees Wood Assigned to W. Dewees Wood Company	January 17, 1893
638,829	Apparatus for Treating Metal Sheets	George Woolsey Assigned to W. Dewees Wood Company	December 12, 1899
D-17,621	Design for the Ornamentation of Sheet Metal	James Wood	August 9, 1887

Chapter 2 – Added Footnotes

[K] – The Marshall family home was at Elton, in northwest Derbyshire, England. John Marshall (1661-1729), son of John and Mary Marshall, was born in Derbyshire in 1661. At the age of 23 he crossed the Atlantic to settle in Blockley Township in what was then known as the Province of Pennsylvania (in 1854 Blockley was absorbed into the city of Philadelphia). After about a year John moved to Darby, Delaware County, Pennsylvania Province. He married Sarah Smith in 1688 and they had three children, John (1690-1740), William (1692-1727), and Thomas (1694-1740).

Thomas Marshall would marry Hannah Mendenhall and together they would raise nine children. John Marshall, the eighth child of Thomas and Hannah, marries and has two children before his wife dies in 1764. John learns of a 174-acre property, known as Joshua Taylor's Mill (a saw mill), that is available in Kennett Township for $1,090 from the estate of William Levis. The farm was located where the east and west tributaries of the Red Clay Creek joined to flow south into what was known at that time as "the three lower counties of the Province of Pennsylvania" (today Delaware).

After purchasing the property for his family, John continues operating the saw mill and names the farm "Marshallvale". The log cabin farm house, dating from the 1600s, is enlarged with a stone addition and John marries Susanna Lamborn in 1768. They raise six additional children in addition to John's two girls from his first marriage. John expands his business interests by adding a grist mill to the property just past were the two branches of the Red Clay Creek merge. The John Marshall family continues the sawing of lumber and the milling of flour and other grains at Marshallvale.

After John passes away in 1815, his son Robert (1771-1859) inherits Marshallvale and continues operating primarily the grist mill. Robert marries Mary Hoopes (1781-1825) and together they raise five children; Caleb H Marshall (1806-1888), John Marshall (1808-1885), Martha Marshall (1810-1890), Abner Marshall (1814-1905) and Thomas Smedley Marshall (1818-1887).

Robert and his family continue operating Marshallvale as a grist and saw milling operation however his eldest sons take an interest in the manufacture of iron sheet materials. Caleb and

John partner and purchase the "Hersey mill north of Kiamensi, DE and soon add an iron rolling mill to the property. The area eventually becomes known as Marshallton, DE.

Abner Marshall purchases a farm east of Hockessin. While plowing he discovers a kaolin deposit on the property and begins to mine and make white clay pottery on the property. As the kaolin deposit is significant, Abner begins the first commercial mining of kaolin in Delaware and ships dried kaolin clay bricks to New Jersey pottery makers over the newly operating Wilmington & Western Rail Road.

With the Gilpin family developing a papermaking machine on Brandywine Creek in 1803, Robert's son Thomas takes an interest in papermaking and in 1856 he is permitted to convert the family flour mill at Marshallvale to the production of paper. Thomas concentrates on the manufacture of news and wrapping papers including difficult to make tissue papers in the paper mill which becomes known as the Homestead Mill. Thomas' two sons, Israel Way (1850-1911) and Thomas Elwood (1855-1929), eventually take over their father's papermaking business. In 1890 they expand their papermaking business by renovating the burned-out woolen mill at Yorklyn and the closed former iron rolling mill at Wooddale. In the early 1900s Israel and Elwood invent the endless vulcanized fibre machine and go on to revolutionize the manufacturing of vulcanized fibre making Yorklyn the "Vulcanized Fibre Capital of the World" for most of the 20th century.

[L] – There is little doubt that Caleb Marshall started developing at Marshallton the processes he later patented while living in Philadelphia. Caleb pioneered and patented the making of galvanized sheet becoming the first to do so in the US. He also improved and patented processes related to the tin plating of iron sheet. Like Wood, Marshall patented various machines and furnace arrangements associated with the rolling and coating of iron sheets. The Caleb Marshall patents are listed below and involve the manufacture of galvanized sheet metal.

Patent Number	Patent Title	Granted To	Date Issued
114,956	Improvement in the Manufacture of Sheet-Iron and Removing Scale from Iron for Coating with Other Metals	Caleb Marshall Assigned to Marshall, Philips & Company	May 16, 1871
144,403	Improvement in Coating Iron and Other Metals with Protecting Alloys	Caleb Marshall	November 11, 1873
154,334	Improvement in Furnaces for Heating and Annealing Sheet Metal & c.	Caleb Marshall	August 25, 1874
175,365	Improvement in Sheet-Metal-Straightening Machines	Caleb Marshall	March 28, 1876

[M] – HRCV historian Thomas Gears documents that an article in the Wilmington Every Evening for January 11, 1875 reported that the Wilmington & Western Rail Road held its annual stockholder's meeting. The railroad's annual report for 1874 included an expenditure for installing a coal dump at Wooddale so as to provide coal deliveries to the mill. The report also indicated that the two year, three-month-old railroad had handled 33,144 tons of freight and moved 24,142 passengers in 1874.

[N] – The sale to Robert Marshall cannot be correct as he died in 1851. Records associated with the Marshall papermaking operations in Kennett Township and at Yorklyn indicate the Wooddale Mill sale might have occurred between Howard Wood and either Caleb Marshall or Calvin P. Marshall.

The Marshall paper mill in Kennett Township was supplying the majority if not all of the rag paper needed for the more than half dozen vulcanized fibre businesses in New Castle County. Israel and Elwood recognized that demand for industrial rag fibre paper would soon outgrow their Homestead Mill's production capabilities (which also produced wood pulp papers as well). Not wanting to create an opportunity for a new rag paper manufacturer to become competition, the Marshall brothers sought out locations that had ample quality water supply and where a second, more modern and efficient paper mill could be placed in operation and dedicated to industrial rag paper products. Israel and Elwood knew the former iron rolling mill at Wooddale was available and standing unused. In 1891 (some reports suggest 1894) they most likely took control of the mill under a lease to purchase agreement (similar to what they had for Auburn Factory). Israel, Elwood and Dr. Taylor Mitchell, the husband of their sister Mary, founded Marshall & Mitchell Company at Wooddale, DE and started to convert the former iron rolling mill to making wood-pulp paper. Three 600-pound beating engines and a 62-inch Fourdrinier paper machine were installed at Wooddale. Relying on both water power and steam power, the widest trimmed sheet the mill could produce was 58-inches.

Figure E

Marshall & Mitchell Company paper mill at Wooddale on October 19, 1895, Charles S. Philips photographer. Courtesy of the Chester County Historical Society. Image is a digital scan from a glass plate negative.

According to US Congressional filings, the Marshall & Mitchell Wooddale Paper Mill was turning out wood pulp paper products by late 1891. By 1905 the Wooddale operation was producing 3,000 pounds of Manila paper per day on a 62-inch Fourdrinier machine; more than what their Homestead Mill was capable of. Wooddale Mill would eventually turn to making rag paper in the early 1900s which was shipped to Yorklyn, DE for conversion to fiber at the Marshall's National Fibre & Insulation Company. The Marshall & Mitchell mill was capable of producing 4,000 pounds per day of rag paper when the plant was destroyed by fire in 1918. The Insurance Press noted that the mill burned on October 2, 1918. The Marshall & Mitchell Company declared a $40,000 total loss including 6,050 tons of rag paper. The mill was not rebuilt and over a century of milling operations at Wooddale ceased.

[O] – The May 5, 1890 Wilmington Morning News executor's sale listing for Delaware Iron Works was added to this publication. It is courtesy of the Tom Gears collection.

[P] – Footnote 70 contains errors. The footnote reads in part: "By 1910 the company was operated by T. Elwood Marshall and his brother-in-law, Dr. Taylor S. Mitchell. It was called the Wooddale Paper Mills." The Marshall & Mitchell Company at Wooddale, DE was established with Thomas Elwood Marshall's brother Israel Way Marshall as a partner although Israel was a silent partner. Dr. Taylor S. Mitchell, a general practitioner in Hockessin, was husband to Israel and Elwood's sister Mary. The Wooddale operation was managed by Elwood while Israel concentrated his focus at Auburn Factory in Yorklyn. Both brothers continued to operate the Homestead Mill at Marshallvale in Kennett Township until about 1906-8. Auburn Factory was initially owned by the Marshall & Ewart Company having been purchased by Israel W., T. Elwood and Franklin Ewart in 1890. Israel and Elwood eventually bought out Ewart's 1/3-share of the company and became known as Marshall Brothers Company.

[Q] – James M. Swank, Editor and Publisher, *The Bulletin*, American Iron and Steel Association, January 28, 1885, p. 29.

[R] – Chapter 5's timeline was added to provide the reader with a better sense of the significant events occurring during more than 200 years of milling and manufacturing that occurred along the Red Clay Creek at Marshallton, DE.

[S] – This monograph was published in 1962 when the Alan Wood Steel Company was still a thriving concern. Chapter 6 has been added to close out the story of the Wood family and their involvement at Wooddale. The historical information is provided from the "Description of Records" contained at the Hagley Museum and Library's Soda House location in Wilmington, DE (Item ID: 08073317, Call Number 0333). Hagley's collection of documents related to the Wood family include company and family records and correspondence from 1728 to 1950.

[T] – Chapter 7 has been added to provide additional detail related to the Marshall family's involvement in the iron rolling industry.

Original Preface Map