

"VIRGINIA'S LOST INDUSTRY."

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"VIRGINIA'S LOST INDUSTRY."

In the century from 1830 to 1930, the blast furnaces of Virginia produced Pig Iron valued at \$317,183,274.79. Since 1930 not a single ton of Pig Iron has been produced commercially. Yet Virginia Iron was the finest iron available on this side of the Atlantic. It is interesting to trace the history of these Virginia furnaces. And it is particularly interesting to investigate the reasons this once thriving industry no longer exists.

The First Blast Furnace.

To Virginia, the first English settlement in America, belongs the honor of inaugurating within her limits as a colony that most important industry, iron manufacture. In 1619 the London Company brought over workmen and built an iron furnace on Falling Creek near the present site of Richmond. Funds for this venture were "appropriated" by Sir Edwin Sandys from monies contributed for a college at Henrico. He planned in this way to assure a regular income for the college which was to be built later. A mine was opened and a test run successfully made. However, on the morning of March 22, 1622, before the furnace could be put into regular operation, there was an Indian attack. Most of the colonists were slain and the furnace was destroyed.

So great was the discouragement which resulted, that it was almost a full century before the production of iron commercially was again attempted in Virginia. This lapse was encouraged by England where competition from the Colonies was never welcome. The exportation of iron from the Colony was forbidden by an act of the General Assembly for Virginia in 1662 and the prohibition was renewed in 1682. Governor Alexander Spotswood was the first to break the spell. Discovering iron ore on his property he built a furnace at Germanna near Fredericksburg.

This furnace was named for the settlement of German miners who operated the works. The exact date that this furnace was constructed is not known but the furnace is mentioned in a book published in 1724 ("The Present State of Virginia," by Hugh Jones).

Early Charcoal Furnaces.

In 1732 Colonel William Byrd wrote his interesting narrative "A Progress of the Mines." At that time there were three blast furnaces in Virginia as well as an air furnace or cupola at Massaponax. These furnaces have been identified as Germanna, Accokeek and Fredericksville. At least two of these furnaces continued to operate until the middle of the 19th Century.

The next famous writer to throw some light on this subject was Thomas Jefferson. In his "Notes on Virginia," published in 1781, he wrote as follows:

"The mines of Iron worked at present are Callaway's, Ross's, and Ballandine's on the south side of James river, Old's on the north side in Albemarle, Miller's in Augusta, and Zane's in Frederick. These two last are in the valley between the Blue Ridge and North mountain. Callaway's, Ross's, Miller's, and Zane's make about 150 tons of bar-iron each in the year; Ross's makes also about 1,600 tons of pig-iron annually; Ballandine's, 1,000; Callaway's, Miller's and Zane's about 600 each. Besides these, a forge of Mr. Hunter's at Fredericksburg makes about 300 tons a year of bar-iron from pigs imported from Maryland; and Taylor's forge, on Neapsco of Potomac, works in the same way, but to what extent I am not informed. The undertakers of Iron in other places are numerous, and dispersed through all the middle country. The toughness of the cast-iron of Ross's and Zane's furnace is remarkable. Pots and other utensils cast thinner than usual of this iron may be safely thrown into or out of the wagons in which they are transported. Salt pans made of the same and no longer wanted for that purpose, cannot be broken up in order to be melted again unless previously drilled in many parts."

The rate of production that Jefferson gives was remarkably high and many a furnace man of a century later would have been proud of these records.

As the success of these furnaces became known more furnaces

were built in Eastern Virginia. Although at one time around 1850 there were eighteen furnaces in this section, they could not compete with those located in the Blue Ridge area. So the entire industry shifted northward and westward to regions where there were abundant supplies of power, ore and fuel.

In any event, Virginia's iron industry continued to expand and more and more furnaces were built. Even at this late day we are able to identify 109 charcoal furnaces that operated in Virginia during the 18th and 19th Centuries.

Coal and Coke Blast Furnaces:

Although coke furnaces were introduced into this country about the middle of the 19th Century, Virginia was slow to take up this innovation. This was due to two factors; there was still plenty of wood in the state for making charcoal and Virginia charcoal iron was in great demand. The Powhatan Furnace near Richmond was built in 1860 and used the local coal for smelting. However, this could not have been entirely satisfactory as the furnace later used both charcoal and coke.

Beginning in 1870 the swing to coke started and after that time we find most of the furnaces built used coke for fuel. In fact, where possible charcoal furnaces were rebuilt to burn the new fuel. The short haul of the fuel from the West Virginia beds of coking coal made this highly profitable. In all there were thirty-one coke furnaces which operated in Virginia. These furnaces ranged in size from the Ferrol Furnace with a capacity of 3,200 tons as originally built, to the 90,000 tons capacity furnaces at Buena Vista and Pulaski. Where these great furnaces stood there is today nothing but a pile of ruins.

WAR AND VIRGINIA IRON

Although iron and steel are an essential of civilization, it is in war time that we find the greatest demand for this material. So it is to war that we attribute both the rise and fall of the Virginia iron furnaces.

War of the Revolution.

The Second Revolutionary Convention of Virginia which met March 22, 1775, included such men as George Washington, Richard Henry Lee and Patrick Henry. They foresaw the need of organizing their natural resources. One of their recommendations was that the manufacture of iron and steel articles be encouraged. There were two major results of this action, the construction of a Government arms factory at Fredericksburg and the construction of a foundry for casting cannon at Westham. This latter project materially increased the demand for pig iron. Virginia Furnaces which supplied iron during the Revolution were the following:

Neabsco Furnace
 Oxford Furnace
 Ballandine's Furnace
 Bear Garden Furnace
 Old's Furnace
 Callaway's Furnace
 Mossy Creek Furnace
 Zane's Furnace
 Albemarle Iron Works Furnace

This latter furnace was aided by a loan from the Government of £ 2000 to be repaid in pig iron. In addition to the furnaces listed, Redwell's Furnace was built during the war but we have no record of any Government aid in the work. Unfortunately for Virginia, the expansion of the iron industry from 1775 to 1782 did not last. After the war, the decrease in demand, aided by an inflated currency, resulted in the closing of most of the furnaces that had played such an important part in the victory of the colonies.

The Mexican War.

In the Mexican War, Virginia furnaces played an even more important part. In a letter appearing in the "Virginia Star" of Fredericksburg in 1882 we find the following statement:

"During the Mexican War of 1846-7 every shot and shell thrown at the enemy was shipped from this furnace." (The Catherine Furnace). The letter also referred to the part this furnace played in supplying shells for the Confederacy.

The War Between the States.

It was not until the War Between the States that Virginia Iron became vitally important. The Tredegar Iron Works at Richmond was the most important source of munitions for the Confederacy and this plant drew its supply of pig iron from the mountain furnaces of Virginia. The failure of the Union forces to discover and destroy these self-contained sources of supply undoubtedly prolonged the struggle many months. It was in June 1864, that Hunter in his raid to attack Lynchburg stumbled upon three of the Tredegar furnaces. Mount Torry Furnace was destroyed on June 10th, Cloverdale Furnace was burned four days later and Hunter reached Grace Furnace on the Nineteenth. Aided by a loan of \$150,000.00 from the Nitre and Mining Bureau these furnaces were all rebuilt within six months. They and other Virginia furnaces continued to ship pig iron for munitions until the fall of Richmond closed the Tredegar Iron Works. As one authority has said, so far as the basic need of the Confederate Ironmasters for war pig iron was concerned, "their fate, be it success or failure, lay buried in the Virginia valleys and mountains."

The First World War.

In 1914 to 1918 we found the steel mills and foundries of the country demanding more and more pig iron, first to supply "the Allies" with armaments and then to equip our own troops. Every available furnace in Virginia was put in blast and production was stepped up from 281,508 tons to 575,385. This output was sufficient to prevent a serious shortage of pig iron.

Today with the Second World War in progress and the demand for iron and steel going through the same cycle, there is not a single blast furnace in Virginia that can be operated to aid the Country.

Depletion of Ore Supply in Virginia.

The reason usually given for dismantling an individual furnace as well as for the abandonment of the iron producing industry in Virginia is "the ore gave out." It is true of course, that some furnaces were closed by the fact that the ore in the immediate neighborhood was used up. However, to me it is incredible that a source of iron ore, which in forty years produced over 40,000,000,000 pounds of ore, could become completely exhausted overnight.

I am forced to the conclusion that War, the basic cause of the growth of the Iron Industry in Virginia, in the end caused its abandonment. If we study a table showing the production of ore in Virginia per ton of pig iron produced, we find some startling facts. During the years when there was little or no importation of ore into Virginia this ratio was from 1.32 to 1 to 2.41 to 1. During the years 1913-15 some Lake Superior ore was brought in and the ratio dropped to 1.24 to 1, with production averaging 322,372 tons. As the demand for pig iron increased in 1916, due to the requirements of the First World War, the price of pig iron increased from \$13.62 to \$18.93. Virginia

Furnaces wanted to get their share of this profitable business. There was no time to prospect for new ore supplies and it was a costly matter to step up the production of existing mines. The Virginia manufacturers took the easiest way and bought Superior ore even to the extent of letting their own mines close. What did a saving of a few dollars a ton in raw materials amount to with the price of pig iron soaring to \$41.73 and production up to 582,748 tons?

When prices returned to lower levels, there was neither the cash nor the incentive to try to build up the iron ore production in the State. Prospecting for ore had long since been given up and existing mines were in bad condition. Then too, the price of Lake ore was fairly low. This was due to two factors, production had been stepped up to meet the War needs and they were still getting out the cream of the Mesabi Range ore that could be shipped without treatment. Fortunately for the future of Virginia Furnaces this latter condition no longer exists.

Obsolescence of Virginia Blast Furnaces:

One very obvious contributing factor in the abandonment of Virginia furnaces was the fact that there never was a modern blast furnace in the State. The last of the coke furnaces was built here in the early 1890's, long before economical operation was considered important. No modern furnace would attempt to make sand cast pig iron, yet there never was a pig casting machine in the State. However, a much more vital omission was the failure to properly utilize the by-products. In producing one ton of pig iron there is also produced over five tons of blast furnace gas. This gas was originally allowed to escape to the air, today its value is realized and the gas is used or sold. The slag left by the old blast furnaces has now been reclaimed and used on Virginia roads or in local concrete construction. However, this should have been used during the life of the furnace, thus changing an item of

considerable cost into an item of profit. Recent investigation has shown the value of flue dust and this by-product is reclaimed and sold. It has been said that the proper use of the by-products of a blast furnace, is all that makes a profit possible, yet Virginia furnaces could not advantageously reclaim a single by-product.

Freight Rates:

With a heavy material of low selling price, freight rates are very important in determining the size of the market area. And in the case of pig iron, where 3.4 tons of raw material must be transported to make a ton of saleable product, freight rates become doubly important.

As a matter of fact, freight cost increases were among the most important if not the most important cause of the failure of iron manufacturing in Virginia. The market for Virginia iron in the 80's was very wide and we read that the product of a representative furnace was "marketed in Baltimore, Cincinnati, Wilmington and Terre Haute." Yet in 1930 the last blast furnace in Virginia could "only run half the time because the Virginia foundries could only absorb half their output and they could not compete outside the State.

Possibly this condition came about so gradually that furnacemen here did not realize what was happening. The first important step was during the last war. With the Government operating the railroads, all freight rates were increased. This condition was to be remedied after the war emergency. No one thought of objecting in view of the high prices then prevailing. After the war, producers in other areas, notably Birmingham, Pittsburgh and the West, "filed with the Interstate Commerce Commission" for reductions and got them. Virginia was not so successful. We find the freight rates from Virginia furnaces to their more distant markets about doubled between 1908 and 1930, while competitive furnace rates were only slightly increased.

FREIGHT RATES ON PIG IRON TO CINCINNATI:

	From Pulaski:	From Birmingham:
1908 - 1918	\$2.35	\$3.25
1919 - 1920	3.50	3.60
1921 - 1922	4.90	4.50
1923 - 1925	3.95	4.05
1926 - 1938	3.95	3.69
1938 - date	6.20	4.06

Notes: Dates are only approximate.
Several temporary increases are not shown in table.

It is to be noted that the increases mentioned are for interstate shipments. Within the state where the local railroads could fix the rates themselves, everything possible was done to help the Virginia furnaces, and very low rates were established. It was the rates set by the Interstate Commerce Commission that did the damage.

In a recent book, "Blast Furnace Practice" by Ralph H. Sweetser, there is ^{found} ~~found~~ the following:

"Virginia and Tennessee are also handicapped in reaching important consuming markets by reason of the longer haul. The local markets being insufficient to absorb their full production, most of the furnaces in this region have been idle since 1923.

"By 1937 every iron blast furnace in the state of Virginia had been dismantled and scrapped; the only furnace left in operation was the ferromanganese furnace at Reusens, Virginia."

Mr. Sweetser fails to note that the condition today is artificial. Virginia foundries are now supplied with iron from Birmingham by a much longer haul than those to which he refers. In any event, a furnace in Virginia should not be built unless there is a possibility of obtaining equitable freight rates on the product from the Commission.

Blast Furnace Capacities in the United States:

Prior to this year we occasionally found a writer who worried over the reduction of the capacity of the United States for producing pig iron resulting from the continual dismantling of our blast furnaces. It seemed to be a habit to talk of our "adequate furnace capacity, even for emergencies." Yet out of a total of 1,869 furnaces known to have existed in the United States in the past three hundred years, only 232 remained. It was customary to refer to our production for the Country in 1918 when 43,741,200 tons were made and state that there were idle furnaces at that time. Perhaps that is true, but the idle capacity must have been hopeless or it would have been in blast. Pig Iron was so badly needed that the Government was forced to "allocate" the available iron to Industry.

The available capacity was reduced from 58,979,000 tons in 1930 to 55,723 tons in 1939. Before we entered the War it was found that lack of Pig Iron was hampering the war effort. A program to increase the country's Pig Iron capacity was started promptly by the Federal Government. As a result this capacity was increased to 59,437,000 by the end of 1941. A capacity of 65,500,000 tons is expected by the end of 1942 and 67,000,000 tons by the end of 1943.

A number of small merchant furnaces distributed throughout the country in areas where they would be supplied with raw materials locally would solve the problem of peak demands. With this type of furnace, the tendency of the large producers to withdraw their furnaces from the manufacture of merchant pig in order to produce their own raw material for steel making would be avoided.

Steps Necessary to Revive Industry:

Virginia is an ideal location for carrying on this National program. Here we find good ore and limestone within a short distance of

each other, coke is easily available and we have the population to absorb the by-products mentioned earlier. The construction of two small furnaces could be easily accomplished. One furnace could be run continuously and the other used as a standby to be run when there was sufficient demand. This small output would not require large amounts of ore and the iron could be used to a great extent locally.

Obviously the first step is one of education. Until at least a part of the people of this state feel that the iron industry here can be revived, it is hopeless to try to sell the idea elsewhere. The situation is perfectly illustrated by a statement in the last issue of "The South's Resources" which says, "Virginia iron is unimportant at present."

The actual work of locating the site is simple. First, all available authorities should be consulted. In any event the best ore should be located and the amount available should be estimated. The source of supply of limestone must be considered and the cost and availability of coke. A modern furnace such as we are considering should be located with regard to the use of by-products and in this connection the sale of the furnace gas is vital.

Having considered all these factors and chosen the site for the new furnace, one very important step must be taken before anything is done. The attitude of the railroads and the Commission must be determined. Although it is possible that a modern furnace might survive in spite of unfavorable freight rates, the handicap would be terrific.

Need of Virginia Furnaces:

The advantage to the State of Virginia derived from the re-establishment of the iron industry within her borders is obvious. In addition there are two major reasons why this work should be done; both are of National importance.

First, Virginia furnaces supply a grade of iron that is needed by the foundries of the United States. The feeling among

foundrymen that "Virginia Iron" is better than "Southern Iron" or "Lake Iron" is of long standing. Twelve years ago I was told that our plant could not operate on pig iron from the Birmingham District. Of course we do run on the "Southern Iron" today, but it means more work and much more careful controls. We do have a small supply of Virginia Iron for which we paid a premium that we use as "medicine." When we get in trouble, a few pigs of this iron in a charge, usually solves the problem. Granting that this is in part psychological, still it has a basis in experience. Iron from the Catawba furnace was so prized that in the middle of the last century it sold for \$60.00 a ton. Virginia iron has always carried a premium and the last iron made in the State sold for at least a dollar a ton over the price of other iron. And it was worth it.

Virginia Iron as a War Necessity:

Today the need for these small isolated furnaces has become almost a necessity. Recent editorials in Engineering Magazines have shown this fact very clearly. I quote from "The Improvement Bulletin" for October 4, 1940:

"A proposal that army engineers renew consideration of another canal for the Great Lakes between Lake Superior and Lake Michigan has been made by Representative Bradley of Michigan. He declares that in the event of sabotage at the Sault Ste. Marie locks, 86 per cent of the nation's iron ore would be unable to clear by water."

And, I may add, this great tonnage of ore could not be handled by rail even at a greatly increased cost. Mr. Bradley's suggestion will not, however, solve the problem. We must return to the self-contained furnaces that saved us in the past. And Virginia must do her part.

Virginia Furnaces; in 1776 they made this country a possibility, in 1847 they defeated Mexico, in 1863 they prolonged the life of the Confederacy and in 1918 they aided the Allies. Today

they must again play their part in the greatest of all wars.

TABLE NO. 1

FURNACES IN VIRGINIAABANDONED PRIOR TO 1880

<u>Furnace:</u>	<u>County:</u>	<u>Built:</u>	<u>Abandoned:</u>
Accokeek	Stafford	1726	1753
Aetna No. 1	Botetourt	1792	1842
Aetna No. 2	Botetourt	1842	1860
Albemarle Iron Co.	Albemarle	1771	1800
Australia	Alleghany	1854	1865
Ballendine's	Buckingham	1760	1800
Bear Garden	Buckingham	1835	1840
Bell & Kincannons	Wythe	1810	1870
Bristol Iron Works	Westmoreland	1721	1730
Buena Vista No. 1	Rockbridge	1847	1864
California	Rockbridge	1850	1875
Canada	Augusta	1819	1819
Caroline	Shenandoah	1835	1865
Carron	Franklin	1858	1859
Catawba	Botetourt	1830	1875
Catherine No. 1	Spottsylvania	1836	1865
Catherine No. 2	Spottsylvania	1866	1870
Catoctin	Loudoun	1800	1835
Chestnut Creek	Carroll	1810	1830
Clifton	Alleghany	1846	1877
Cloverdale No. 1	Botetourt	1787	1849
Cloverdale No. 2	Botetourt	1841	1864
Cotopaxi	Augusta	1836	1855
Craig's Creek	Craig	1830	1843
Dolly Ann	Alleghany	1848	1873
Elk Creek	Amherst	1835	1850
Esteline	Augusta	1838	1875
Falling Creek	Chesterfield	1622	1622
Fredericksville	Spottsylvania	1727	1750
Floyd County	Floyd	1820	1853
Germanna	Spottsylvania	1716	1750
Harvey's	Roanoke	1809	1825
Henrietta	Shenandoah	1820	1864
Isabella	Page	1760	1841
Jane	Botetourt	1834	1863
La Grange	Appomattox	1839	1843
Little Wythe	Wythe	1810	1849
Lucy Salina	Alleghany	1827	1872
Lydia	Rockbridge	1825	1850
Manakin	Goochland	1848	1864
Marion	Smythe	1860	1864
Massaponax	Spottsylvania	1748	1750
Moore's	Rockbridge	1800	1829
Mossy Creek	Augusta	1760	1865
Mount Hope	Rockbridge	1849	1853
Neabsco	Prince William	1734	1753
Oakland	Rockingham	1837	1838
Occoquam	Prince William	1738	1755
Oxford	Campbell	1768	1875
Paddy	Shenandoah	1833	1880
Panther Gap No. 1	Rockbridge	1800	1837
Parry Mount No. 1	Wythe	1800	1832

TABLE NO. 1 (cont'd.)

<u>Furnace:</u>	<u>County:</u>	<u>Built:</u>	<u>Abandoned:</u>
Paulina	Washington	1830	1860
Pine Hope	Grayson	1800	1845
Poplar Camp	Wythe	1778	1827
Potomac	Loudoun	1839	1860
Rebecca	Botetourt	1819	1875
Retreat	Botetourt	1827	1849
Roaring Run	Botetourt	1832	1875
Rough & Ready	Louisa	1848	1865
Rumsey's	Alleghany	1800	1854
Saunder's	Franklin	1775	1865
Shelor's	Floyd	1800	1825
Shenandoah No. 1	Page	1836	1871
Smith's Creek	Rockingham	1790	1830
Speedwell No. 1	Wythe	1794	1851
Stonewall	Appomattox	1781	1845
Taylor's	Frederick	1845	1865
Union	Patrick	1836	1870
Van Buren No. 2	Shenandoah	1850	1850
Vesuvius	Rockbridge	1828	1858
West Fork	Floyd	1853	1860
White's	Washington	1800	1839
Zane's	Frederick	1732	1828

TABLE NO. 2

A LIST OF CHARCOAL BLAST FURNACES IN VIRGINIA

Charcoal Furnaces in Existence on January 1, 1880, with date originally built:

Amherst (1864)	Grey Eagle (1863)	Salisbury (1869)
Arcadia (1862)	Liberty No. 1 (1821)	Shenandoah No. 2 (1857)
Barren Springs (1853)	Mine Run (1872)	Sinking Creek (1873)
Brown Hill (1870)	Mount Torrey (1810)	Speedwell (1873) No. 2
Catherine (1836)	Mount Vernon (1848)	Van Buren No. 1 (1837)
Columbia (1809)	Panic (1875)	Victoria (1835)
Cumberland Gap (1835)	Panther Gap (1874)	Walton (1872)
Elizabeth (1836)	Parry Mount No. 2 (1832)	Wythe (1873)
Glenwood (1849)	Radford (1868)	
Grace (1850)	Raven Cliff (1876)	

<u>Year:</u>	<u>New Furnaces Built:</u>	<u>Furnaces Abandoned or Dismantled:</u>	<u>Number of Furnaces At End of Period:</u>	
1880-1	Beverly Boom	Foster Falls Irontdale	Cumberland Gap Victoria	30
1882	Cave Hill Ivanhoe		Arcadia	31
1885-6		Barren Springs Catherine Mine Run Mt. Torrey	Grace Panther Gap Shenandoah No. 2 Mt. Vernon	23
1887			Glenwood	22
1888-9	Cedar Run	Amherst Ivanhoe Elizabeth	Parry Mount No. 2	19
1890-1	Liberty No. 2	Cave Hill Columbia Liberty No. 1	Salisbury Walton Wythe	14
1892-3		Beverly Grey Eagle Irontdale	Raven Cliff Sinking Creek Speedwell	8
1894-5		Brown Hill	Van Buren No. 2	6
1900		Radford		5
1908		Cedar Run		4
1910		Boom		3
1914		Panic		2
1919		Foster Falls		1
1920		Liberty No. 2		0

TABLE NO. 3

PRODUCTION OF VIRGINIA CHARCOAL FURNACES.

			<u>Average Production Per Week</u>
Mine Run Furnace	1872 - 1883	32' x 6 $\frac{1}{2}$ '	
Barren Springs Furnace	1853 - 1873	40' x 7'	17.3 tons in 1855
Mine Run Furnace	1883 - 1885	32' x 7 $\frac{1}{2}$ '	
Wythe Furnace	1819 - 1891	25' x 8'	37.0 tons in 1880
Wythe Furnace	1819 - 1891	25' x 8'	42.0 tons in 1882
Cumberland Gap Furnace	1861 - 1881	28' x 8'	
Liberty Furnace No. 1	1821 - 1872	30' x 8'	19.3 in 1855
Mount Vernon Furnace	1848 - 1874	31' x 8'	28.8 in 1857
Catherine Furnace	1846 - 1886	32' x 8'	23.9 in 1856
Barren Springs Furnace	1873 - 1885	35' x 8'	40.0 in 1882
Foster Falls Furnace	1881 - 1919	35' x 8'	48.0 in 1882
Columbia Furnace	1829 - 1872	30' x 8 $\frac{1}{2}$ '	23.6 in 1855
Liberty Furnace No. 1	1873 - 1890	30' x 8 $\frac{1}{2}$ '	42.5 in 1881
Liberty Furnace No. 1	1873 - 1890	30' x 8 $\frac{1}{2}$ '	32.4 in 1881-1882
Grace Furnace	1850 - 1864	33' x 8 $\frac{1}{2}$ '	34.6 in 1856
Walton Furnace	1882 - 1890	33' x 8 $\frac{1}{2}$ '	35.0 in 1882
Brown Hill Furnace	1882 - 1895	40' x 8 $\frac{1}{2}$ '	42.0 in 1882
Raven Cliff Furnace	1810 - 1893	29' x 9'	49.0 in 1880
Raven Cliff Furnace	1810 - 1893	29' x 9'	49.0 in 1882
Mount Torry Furnace	1872 - 1885	32' x 9'	
Brown Hill Furnace	1872 - 1882	32' x 9'	28.6 in 1880
Speedwell Furnace	1873 - 1893	32' x 9'	28.9 in 1880
Speedwell Furnace	1873 - 1893	32' x 9'	35.0 in 1882
Cedar Run Furnace	1832 - 1888	32' x 9'	35.0 in 1882
Walton Furnace	1878 - 1882	33' x 9'	30.0 in 1880
Beverly Furnace	1880 - 1893	33' x 9'	38.2 in 1880
Beverly Furnace	1880 - 1893	33' x 9'	42.0 in 1882

TABLE NO. 3 (cont'd.)

			<u>Average Production Per Week</u>
Boom Furnace	1881 - 1910	33' x 9'	45.0 in 1882
Shenandoah Furnace No. 2	1857 - 1886	33' x 9'	49.2 in 1880
Grey Eagle Furnace	1881 - 1893	34' x 9'	33.0 in 1882
Amherst Furnace	1863 - 1889	36' x 9'	51.8 in 1880
California Furnace	1850 - 1874	36' x 9'	59.8 in 1855
Glenwood Furnace	1849 - 1874	38' x 9'	23.6 in 1856
Sinking Creek Furnace	1873 - 1893	35' x 9½'	42.0 in 1880
Van Buren Furnace	1870 - 1896	37½' x 9½'	50.0 in 1881
Panic Furnace	1875 - 1914	38' x 9½'	49.0 in 1882
Salisbury Furnace	1869 - 1891	32' x 10'	
Radford Furnace	1868 - 1900	35' x 10'	35.0 in 1882
Cave Hill Furnace	1882 - 1891	47' x 10'	35.0 in 1882
Irondale Furnace	1881 - 1893	33' x 11'	46.0 in 1882
Columbia Furnace	1872 - 1890	34' x 11'	14.0 in 1881
Mount Torry Furnace	1853 - 1872	35' x 11'	27.0 in 1853
Liberty Furnace No. 2	1891 - 1920	55' x 11'	
Ivanhoe Furnace	1882 - 1888	42' x 12'	70.0 in 1882

TABLE NO. 4

A LIST OF COKE OR COAL BLAST FURNACES IN VIRGINIA

<u>Year:</u>	<u>Built:</u>	<u>Rebuilt:</u>	<u>Dismantled:</u>	<u>Number:</u>
1827	Longdale No. 1 (Charcoal)			1
1860	Powhatan			2
1864	Ferrol (Charcoal)			3
1869	Buffalo Gap No. 1			4
1873	Buffalo Gap No. 2	Longdale No. 1 Powhatan		5
1874	Callie (Charcoal)			6
1875		Callie		6
1876		Longdale No. 1		6
1878		Ferrol		6
1880	Low Moor "A" Lynchburg			8
1881	Longdale No. 2			9
1883	Crozier No. 1 Gem Victoria	Lynchburg	Ferrol	11
1884	Princess	Lynchburg		12
1885			Buffalo No. 1 Buffalo No. 2	10
1887	Low Moor "B" Pulaski		Powhatan	11
1888	Nannie B.			12
1889	Crozier No. 2 Ivanhoe No. 2	Gem Longdale No. 1	Callie	13
1890	Buena Vista West End	Longdale No. 2		15
1891	Bristol Dora Graham Salem	Gem		19

TABLE NO. 4 (cont'd.)

<u>Year:</u>	<u>Built:</u>	<u>Rebuilt:</u>	<u>Dismantled:</u>	<u>Number:</u>
1892	Alleghany Covington Max Meadows Radford Crane Union	Victoria		24
1893		Ivanhoe		
1898		Pulaski	Lynchburg	23
1900	Radford			24
1901			Salem	23
1906			Nannie B.	22
1914	Oriskany		Longdale No. 1 Longdale No. 2 Radford	20
1917			Bristol Crozier No. 1 Gem	17
1927			Alleghany Covington	15
1928			Graham Ivanhoe No. 2 Princess Victoria	11
1929			Union	10
1930			Low Moor "A" Low Moor "B"	8
1931			West End	7
1932			Max Meadows	6
1936			Buena Vista Crozier No. 2 Dora Pulaski Radford Crane	1

TABLE NO. 5

RELATION BETWEEN PRODUCTION AND COSTIron Ore and Pig Iron in VirginiaProduction in the State of Virginia

<u>Year:</u>	<u>Iron Ore:</u>	<u>Pig Iron:</u>	<u>Ratio Ore to Pig Iron:</u>	<u>Value Iron Net Ton:</u>	<u>Value Ore Gross Ton:</u>
1890	543,583	327,912	1.66	\$ 16.43	\$ 4.50
1891	558,916	330,727	1.69	15.64	
1892	741,027	383,989	1.93	14.05	
1893	616,965	339,199	1.82	12.96	3.25
1894	600,562	333,856	1.80	11.30	2.00
1895	712,241	388,180	1.83	11.70	2.25
1896	859,466	432,630	1.99	11.56	2.60
1897	711,128	344,523	2.06	10.80	2.25
1898	557,713	317,267	1.76	10.41	1.80
1899	986,476	409,350	2.41	17.29	2.00
1900	921,821	549,491	1.68	17.84	4.15
1901	925,394	502,501	1.84	14.17	2.85
1902	987,958	601,682	1.64	19.81	3.00
1903	801,161	609,318	1.31	17.79	3.60
1904	550,253	347,789	1.58	13.90	2.60
1905	752,045	571,435	1.32	15.96	3.20
1906	828,081	541,548	1.53	18.73	3.70
1907	786,856	536,224	1.47	21.33	4.20
1908	692,223	358,913	1.93	15.47	3.70
1909	837,847	438,070	1.91	15.45	3.70
1910	903,377	498,373	1.81	15.06	4.20
1911	614,023	328,879	1.87	13.57	3.70
1912	446,305	286,907	1.56	14.27	3.00
1913	483,843	382,833	1.26	14.79	3.60
1914	378,520	303,775	1.25	13.03	3.00
1915	348,042	281,508	1.24	13.62	3.00
1916	440,492	447,871	.98	18.93	3.70
1917	469,903	582,748	.81	36.43	5.20
1918	414,048	575,385	.72	31.75	5.20
1919	305,096	357,738	.85	29.24	5.70
1920	320,924	480,818	.67	41.73	6.70
1921	74,021	75,308	.98	22.09	5.70
1922	30,971	54,907	.56	24.17	5.20
1923	155,977	310,099	.50	25.07	5.70
1924	89,792	109,468	.82	20.26	4.90
1925	96,272	140,364	.69	20.48	4.40
1926	49,159	115,360	.43	20.65	4.40
1927	64,592	111,101	.58	19.37	4.40
1928	27,902	120,118	.23	18.90	
1929		87,338		19.55	4.65
1930	19,596	112,983	.17	17.90	4.65