

## Iron Smelting in Union County

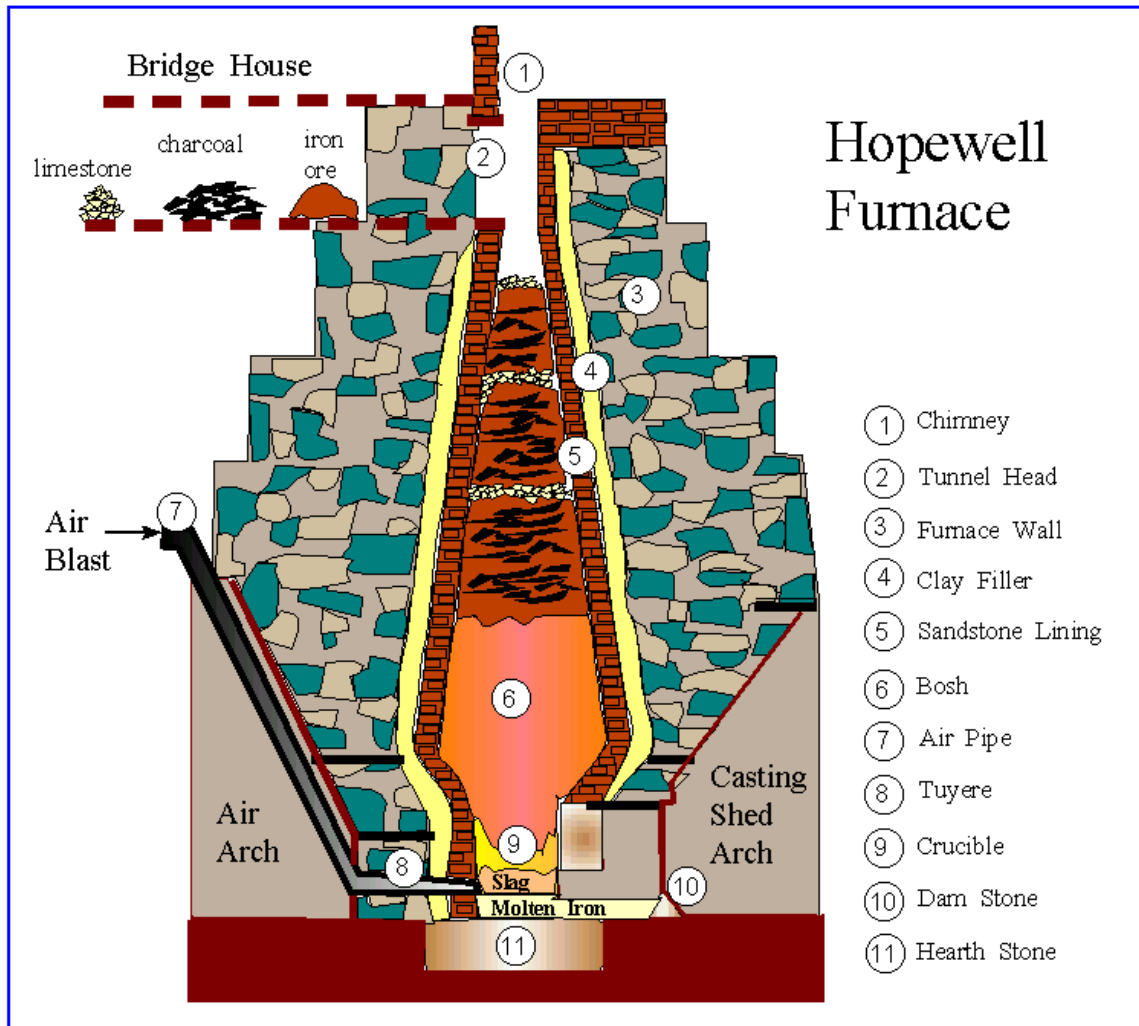
by

**Tom Rich**

Most people in Central Pennsylvania think of Union County as a mainly rural, agricultural area, and it is. However, through much of the Nineteenth Century there was a significant iron making industry in the county. It centered at three blast furnaces: one in Glen Iron, another in Winfield, and a third in the White Deer area. The establishment of these furnaces was made possible by their close proximity to the three essential ingredients in the iron making process: iron ore, limestone and a source of carbon (charcoal or coal).

### **The Smelting Process**

At furnace temperatures around 3,000 °F iron ore, charcoal or coal, and limestone were loaded in layers through the top of the large stone furnace stacks in Union County similar to the one shown in the following drawing of the Hopewell Furnace. One set of these three ingredients in a layer was called a charge. Air was forced into the furnace to assist in the burning of the coal; this forced air blast gave rise to the name, blast furnace. As the ingredients sank towards the bottom of the furnace, the hot carbon stole the oxygen from the iron oxide in the ore and formed carbon dioxide which rose out through the top of the stack. The remaining iron melted under the intense heat and dripped into the bottom chamber of the furnace called the crucible. Impurities from the ore and coal combined with the calcium in the limestone to form slag which floated on top of the molten iron until skimmed from the crucible and dumped into piles around the outside of the furnace as waste. After about ten to twelve hours in the older furnaces, the crucible was opened by removal of the dam stone and molten iron flowed into channels dug into the



Blast Furnace Components as Typified at the Hopewell Furnace in Berks County

Source: [Building Pennsylvania](#) (See last page here)

sandy floor of an adjoining room called the casting shed. When cooled the molten iron solidified into bars or ingots. This was called pig iron because the shape of the channels were arranged to resemble piglets nursing from their mother sow. This process of making iron from ore under intense heat is called smelting.

All three ingredients for iron making were found in or near to Union County. Iron ore is found in nature as rock containing large amounts of iron oxide, commonly known as rust. A form of iron oxide called hematite is located in narrow veins up to a few feet thick running under the surface of Montour Ridge from around Danville to near Jack's Mountain past New Berlin. These veins were mined

with pick and shovel in the 1800's. Some local mine entrances have been reported near Winfield. Other small mines existed in the hills to the south of White Deer. Once dug from the earth, the iron ore was transported to the furnaces by cargo wagons pulled by teams of horses.

Limestone rock is comprised of large amounts of calcium carbonate, which acts as a flux in the smelting process to remove impurities from the molten iron. A primary source of limestone came from local quarries such as the large one near Winfield. Again manual labor was used to drill and wedge chunks of the stone from outcroppings as seen in the following photograph. And here again, horse-drawn wagons were used, and they took the rocks to the furnaces.

The final ingredient in the process was carbon. The early furnaces used



Limestone Quarry near Winfield

Image from Tom Rich



Charcoal Pit Crew, Camp Laurelton in West End of Union County Image from UCHS

charcoal, which was made through a slow burning of timber under insufficient oxygen. This was carried out in pits dug in the floor of local forests, filled with logs, and covered with earth before igniting. After a few days of smoldering, the logs turned into charred pieces of charcoal similar to that used in modern outdoor grills. Upon uncovering and cooling, the charcoal was hauled by wagons to the furnaces. When hiking in the woods around the county, one may still find bits of charcoal in depressions where charcoal pits once operated.

Towards the latter half of the Nineteenth Century many of the forests of the county were depleted through the making of charcoal along with other formal lumbering operations. Anthracite coal became an alternate source of carbon and was used extensively at the furnace in Winfield. This hard coal was mined in the Wyoming Valley and loaded on barges for shipment on both Susquehanna River branches to the furnace at Winfield. Later the railroad replaced barges for transport of the coal.

## The Union County Furnaces

The three furnaces were located within the county as shown on the 1832 map. The oldest was the Berlin Iron Works which later became the Glen Iron

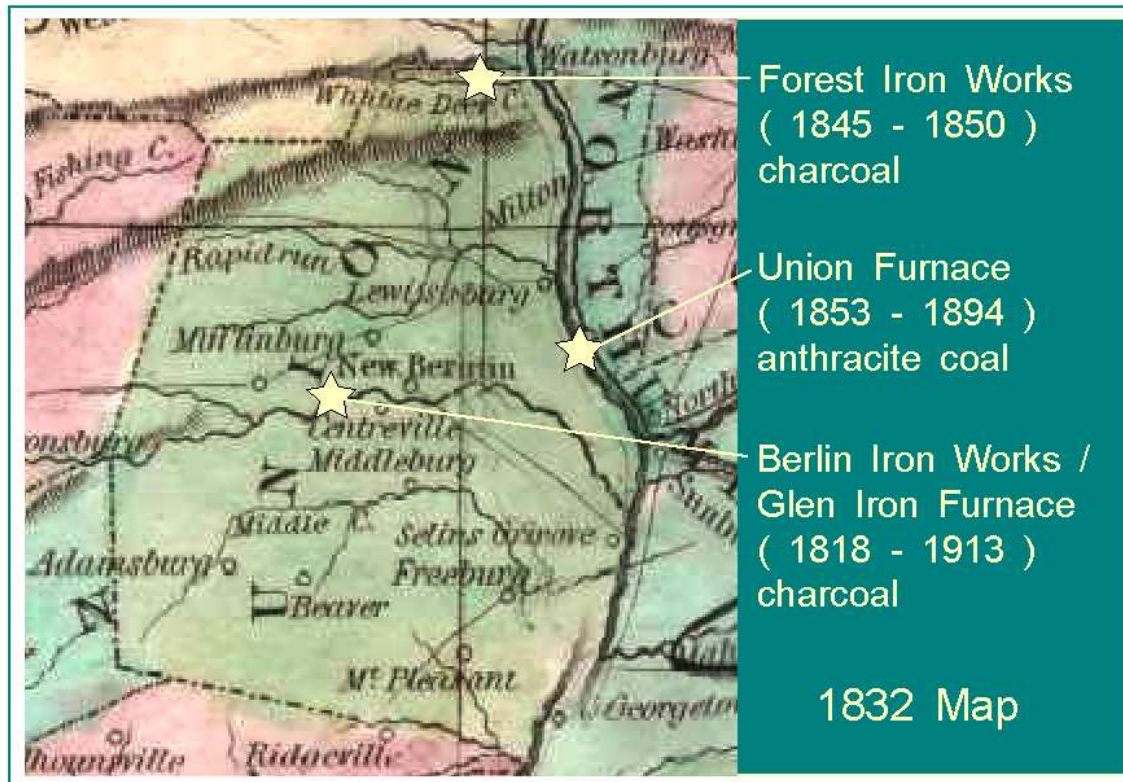
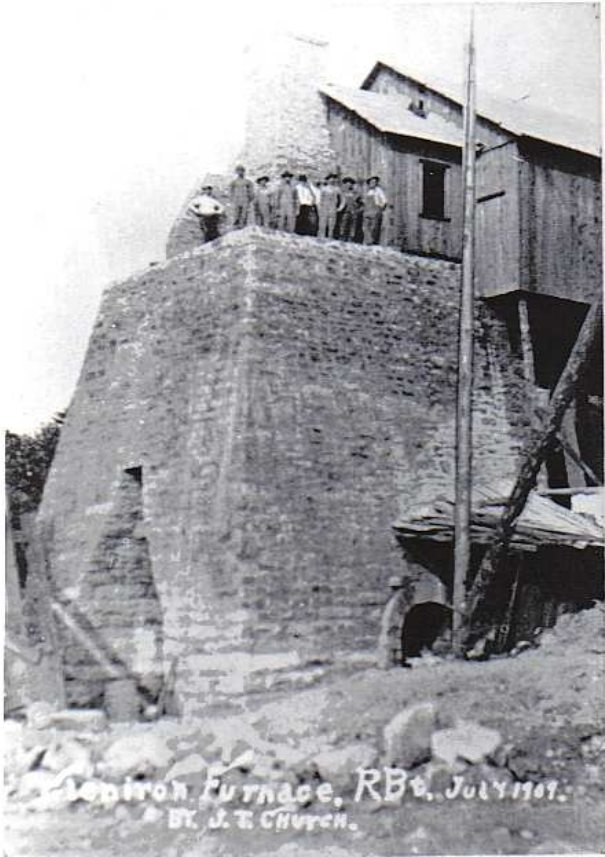


Image by Tom Rich

Furnace. It was a charcoal furnace, and it operated for almost 100 years with some shut-downs in that period due to lagging business in the iron industry. The Forest Iron Works was located west of the town of White Deer and operated for a short period of time. The poor economics at the furnace's location combined with the growth of the anthracite furnaces in the State were primary contributors to its demise.

The newest furnace was the Union Furnace in Winfield. It was built to use anthracite coal. Because the anthracite coal has more compressive strength than charcoal, an anthracite furnace could be built much larger than a charcoal one, and had a larger capacity for daily iron production. The following pages show the people and times associated with each furnace along with historical images of the furnaces.

## The Berlin Iron Works / Glen Iron Furnace

<b>1818</b>	
<b>1826</b>	
<b>1829</b>	
<b>1850</b>	
<b>1880</b>	
<b>1901</b>	
<b>1818</b>	
<b>1826</b>	

Berlin Iron Works: Charcoal Furnace erected. Ore from New Berlin Mtn.

Clement Brooke from Hopewell Furnace operated charcoal iron furnace.

Robert Green & Nathan Mitchell of Lewisburg rebuilt furnace stack with hot blast pipes.

John Church, Dr. Levi Rooke & Jonathan Rooke take over operation. (repaired stack, added steam engine)

Jackson Bros. & B.F. Crispen of Berwick bought property. 1883 operations ceased.

John Church, Sr. returned, bought back and renamed it, Glen Iron Furnace ~1913 operations ceased.

The Glen Iron Furnace

From the Ledgers of the Glen Iron Furnace at the Union County Historical Society Office:

Recorded 1908

One Charge: Charcoal – 20 bushels ~150 pounds

Iron Ore – 400 to 600 pounds

Limestone – 75 to 100 pounds

Number of Charges per Day: 35 to 45

Daily Production of Pig Iron: 3 to 5 tons

### Forest Furnace

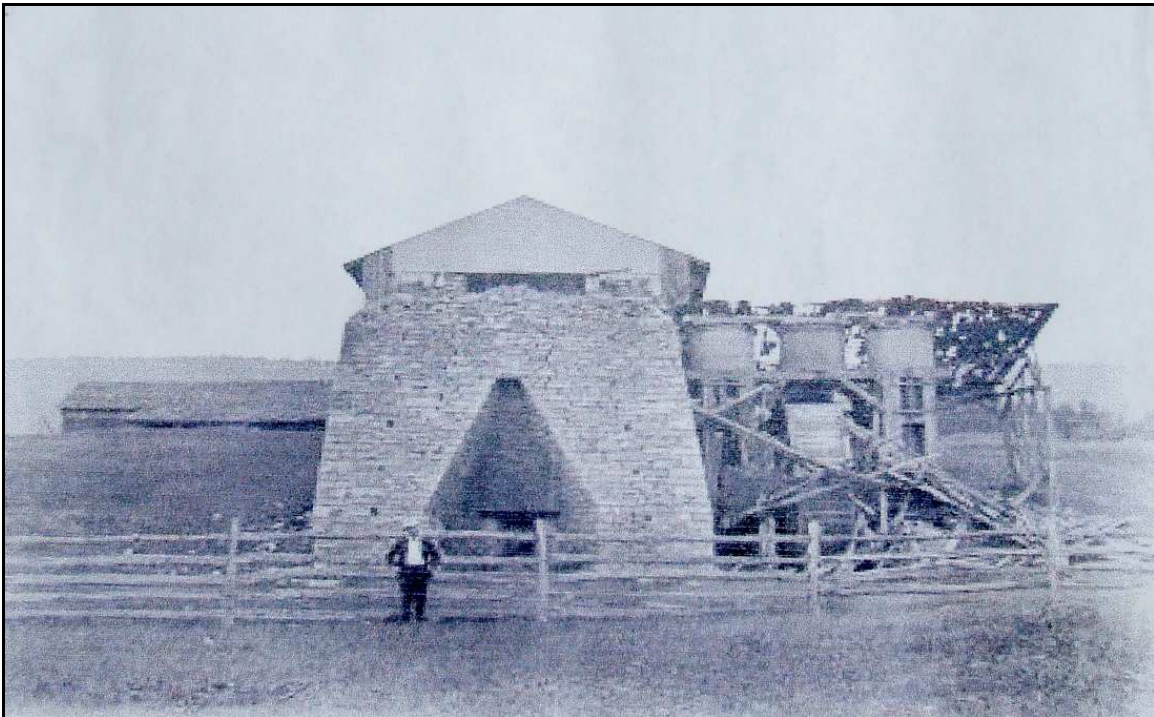


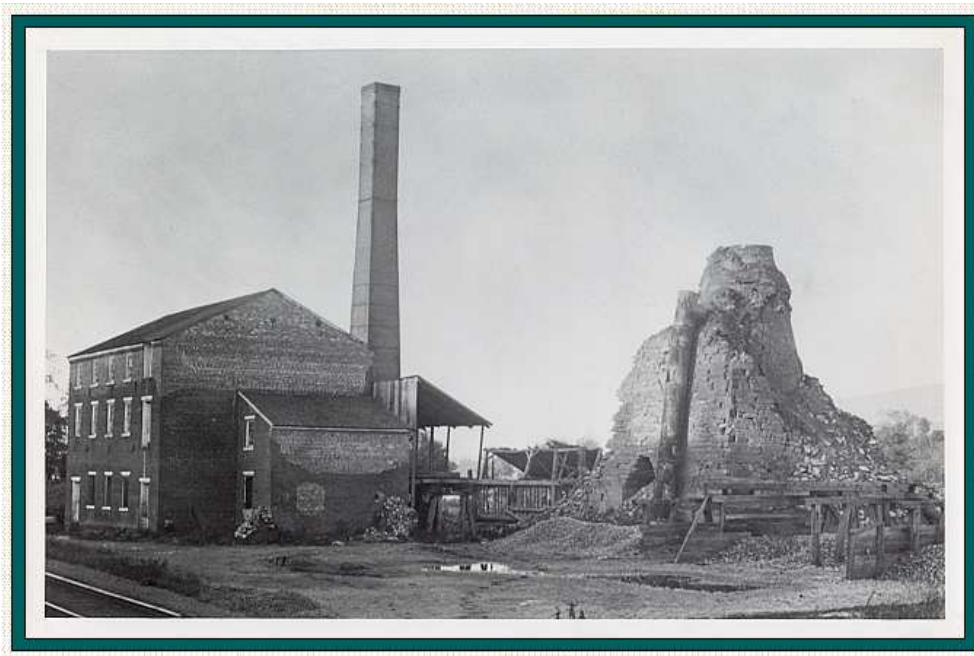
Image courtesy of Jim Wertz, White Deer Township

Little is known about the Forest Iron Works. Linn's Annals of Buffalo Valley, Pennsylvania briefly states, beginning on page 545, In November, [1845] Green, Howard & Green commenced erecting the Forest iron-works, in White Deer Township. ... [1849] The Berlin iron-works were blown out, and Forest iron-works in the hands of the sheriff. ... Kaufman & Reber bought the Forest iron-works for \$7,000.

The rare picture shown of the Forest Iron Works was provided by Jim Wertz. His family ran a gristmill and saw mill adjacent to the Forest Iron-Works along the road running west of the town of White Deer. From the picture one can see a water wheel to the right of the stack. This wheel powered pistons in the wooden tubs above the wheel, which in turn provided the cold blast of air to the stone furnace in the center. The wooden structure above the stack was the bridge house. The iron ore, charcoal and limestone were hauled from the terrace above the furnace across the bridge and dumped down into the furnace.

### **Union Furnace**

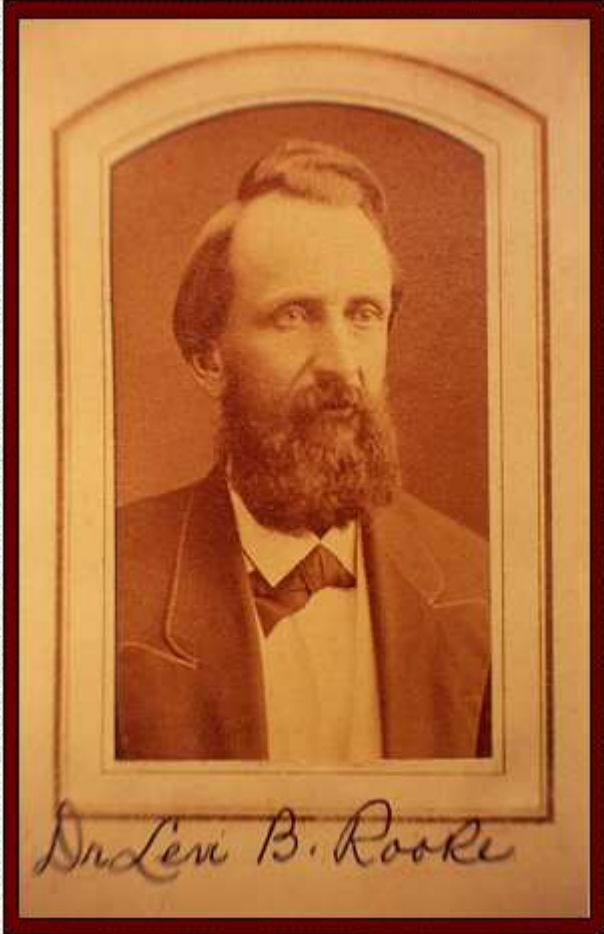
The general manager and eventual owner of the Union Furnace was Dr. Levi Rooke. He was a trained physician and a graduate of Jefferson Medical College in Philadelphia. From some discussions with charcoal iron makers in Chester County, Dr. Rooke learned of the growing iron industry in the anthracite region. It interested him,



Union Furnace circa 1912 from the collection of the Union County Historical Society

and he moved to Union County and became the manager of some iron ore mines. From this job he took over as manager of the Union Furnace in 1854 and supervised the business for almost 40 years.



<b>1853</b>	
The Union Furnace at Winfield built by Beaver, Geddes and Marsh, Co.	
<b>1854</b>	
Ironmaster: Dr. Levi Rooke First Tap: Oct. 30, 1854.	
<b>During Operation</b>	
Stone Stack: >100 feet high 4 Large Boilers                      Stock House Casting Room                        Blowing Room	
25 to 40 workers at furnace	
Limestone used as flux was quarried west of village and transported to the furnace upon a horse-drawn narrow-gauge railway. Anthracite coal came by river barge from coal region. After 1882, the Reading Railroad brought coal and iron.	
<b>1894</b>	
The Union Furnace ceased operations.	

courtesy of University Archives,  
Ellen Clarke Bertrand Library, Bucknell University

The previous Union Furnace photograph shows some interesting aspects of an anthracite furnace. Because anthracite coal requires a high temperature to ignite it, the air blast had to be preheated before it was forced into the furnace. This was accomplished with a heat exchanger mounted at the top of the stack. The hot exhaust from the stack was used to preheat fresh air pumped through the exchanger and then down to the furnace. The large pipe shown on the remains of the stack served that purpose. The building to the left of the furnace contained a steam engine and air pumping system used to circulate the air through the exchanger and

into the furnace. Legend has it that on warm summer evenings the large pistons of the steam engine and air pumps could be heard all the way to Lewisburg as they hissed and pounded to force the hot blast.

The following table shows data from the original Union Furnace ledger located at the Union County Historical Society office in the Courthouse in Lewisburg. As such it provides a unique glimpse into the life at the furnace.

Some Representative Entries from the First Six Months of 1870						
The Ledger of The Union Furnace at Winfield, Pa.						
Expenditures			Monthly Revenues			
date	item	amount	date	item	amount	
Jan 1	100 lb. flour	\$4.00	Jan 15	67 tons pig iron	\$2,526.81	
Jan 5	89+ bush. oats	\$42.09	Feb 12	114 tons pig iron	\$4,129.97	
Jan 12	15 cords wood	\$10.50	Mar 31	pig iron	\$7,002.24	
Jan 17	135 kegs powder	\$506.25	May 31	pig iron	\$8,632.14	
Jan 18	2 old wagons	\$40.00	Jun 7	394 tons pig iron	13,674.38	
Jan 24	53 tons pea coal	\$79.50	Jun 30	pig iron	\$4,131.44	
Jan 24	241 lbs. beef	\$24.10				
Jan 31	91 cords wood for drifts in mines	\$45.50		Typical Monthly Figures		
Jan 31	sharpen 82 drills	\$4.10	Jun 30	Company Store from 87 men	\$2,486.07	
Jan 31	Limestone: 532 perch quarry / ship	\$340.48	Jun 30	Rent Collected from 29 men @ \$2.00	\$61.68	
Feb 10	193 3/4 bush. corn	\$193.75	Jun 30	Heating Fuel from 28 men @ \$2.50	\$71.75	
Apr 8	Ore: 65 1/2 tons	\$75.00				
Apr 15	2583 ft. rails mines	\$46.49				
Apr 16	1 barrel salt	\$3.75				
Apr 30	48 bush. lime	\$3.84				
May 10	15 tons sand	\$4.25				

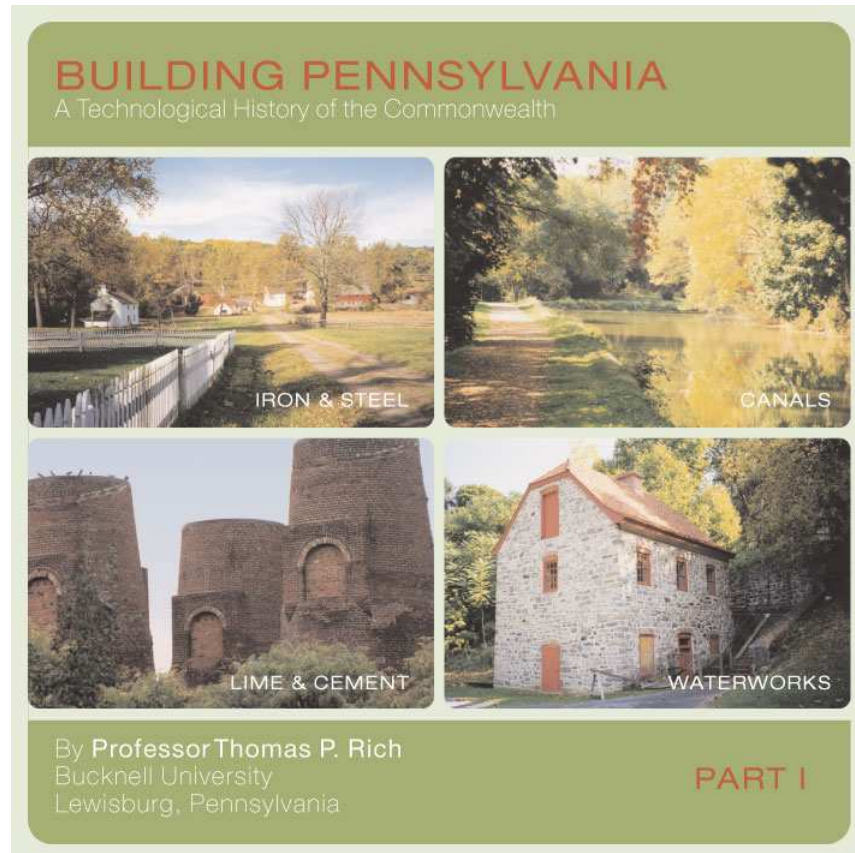
May 15	Ore: 18 tons - hard	\$63.00				
May 27	2 kegs nails	\$9.00			Other Expenditures	
Jun 1	Coal: 711 tons - Kingston Mines	\$783.39			Typical Monthly Payroll	
Jun 1	Ore: 10 tons from Cornwall Ore Co.	\$344.50		Jun 30	37 men at Furnace	\$1,565.12
Jun 18	1650 ft. wire rope	\$300.50		Jun 30	36 men mining & hauling ore	\$3,155.43
Jun 30	Limestone: 490 perch quarry / ship	\$294.30		Jun 30	approx. 52 men at piecemeal labor	\$1,114.75
Jun 30	Quarrying Rts Rights	\$88.29				

### Concluding Remarks

The iron produced at the Union County furnaces provided an important building material in support of local and national development. Pig iron was shipped to secondary manufacturers in towns throughout the county. Foundries (from the verb 'to found' meaning to melt) sprung up in the county to melt the pig iron and recast it into items such as skillets, kettles, pots and stoves. Forges were established to hammer pig iron into stronger 'wrought' iron. The wrought iron was then used to make items such as structural iron bars and rods, nails, hinges, horseshoes, tools and gun barrels. The iron was used in the production of armaments for both the Revolutionary and Civil Wars. Later it provided a basic material for companies manufacturing tools and machinery for the widespread farming of the county.

As the Twentieth Century ensued, the larger, integrated iron and steel mills of places like Scranton and Pittsburgh made it impossible for the Union County furnaces to compete in the marketplace. The fires went out, the workers left and the furnaces fell into ruin. In the early years of the Twenty-first Century, little remains of the Glen Iron and Forest Furnaces. Local folks can point to their original sites. A mound of earth surrounds a crumbling, circular brick liner inside the stack of the Union Furnace. Some evidence remains of the adjacent building

foundations and walls. And nowhere in the county can anyone still hear the roar of the furnace or the pounding of a steam engine or forge hammer.



More information on the iron & steel making history of Pennsylvania along with histories of the canals, lime & cement industry and waterworks are in the above CD eBook, [Building Pennsylvania](#) available through the Union County Historical Society

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