

Charcoal Demonstration

Friends of Pine Grove Furnace State Park

A 19th century iron operation like Pine Grove Furnace (circa 1770-1895) centered on a COLD-BLAST FURNACE.* Raw ingredients — **iron ore, charcoal, and limestone** — were loaded into the top of the 30-foot stone stack to produce iron “pigs” and cast ware (such as stove plates cast in intricate sand molds). The fuel for smelting the ore, and the source of carbon to reduce melting temperatures, was CHARCOAL. The men who made charcoal from wood were highly skilled COLLIERS.

A furnace like Pine Grove Furnace (when “in blast” for many months at a time) each day produced 4 to 5 tons of iron. Daily operation typically required 800 to 1000 bushels of charcoal fuel made from all the trees on one acre of land, or over 300 acres per year. The forest could be re-cut every 20 to 25 years. Thus iron-making required thousands of acres of land to support just one furnace stack through the decades.

To start the process, WOODCHOPPERS felled, cut and split hardwood trees during the winter when sap was low. Snow might ease dragging wood into conveniently placed stacks to “season” though not to full dryness. Woodchoppers cut 2½ cords daily and earned 30 cents per cord.** This was the single largest job category, ½ the workforce. (The whole Pine Grove Furnace community never exceeded 500 people.)

COLLIERS were much less numerous, perhaps 15% of the workforce. Each master collier and a few helpers lived in a temporary crude hut during the April to October “coaling season” as they tended several “pits.” A pit was an above-ground mass of vertically stacked wood covered to block out air. Each pit typically contained 35 to 50 cords of hardwood “billets” in 4 feet lengths split no more than 6 inches across. The billets (plus smaller “lapwood” to fill gaps) were covered by 6 inches of leaves and dirt, resulting in a mound 25-30 feet across and typically 12-15 feet high. (*Our tiny pit for demonstration is only ¼ cord stacked 3-4 feet high.*) It took 3 days or more for colliers to carefully stack and cover the wood.

To light the pit, hot embers from a campfire were dumped into a triangular chimney running up the center, then the chimney was covered up. For the next 10 to 14 days the wood smoldered with very little oxygen. (*In contrast, our tiny demonstration pit takes only 24 hours to become charcoal.*) Guided by the color of smoke seeping out the sides, the master collier might open a few vents in the outer covering as needed. The slow burn drove out water and soluble minerals, leaving behind only the desired carbon.

Tending the pit was a 24-hour-a-day job. If too much oxygen got in, the stack of wood might turn into worthless ash. The colliers needed to cover any openings or “mulls” that developed as the pit reduced to less than half its original volume. At night, a glowing “eye” was a sign that a shovelful of dirt was quickly needed. They also climbed atop the pit to tamp down any hollow voids forming inside, the dangerous task of “jumping the pit.” A shovel carried sideways was a self-rescue tool if they fell into the very hot pit.

When the wood was completely converted to charcoal, it was “damped off” with extra dirt to stop all combustion. Finally, it took a week or more for the pit to cool down enough to be raked open (“coaling out”). The resulting charcoal was loaded onto wagons drawn by mules or horses. TEAMSTERS hauled the finished charcoal for storage in the “charcoal house” near the top of the furnace stack. The teamsters needed to keep a sharp eye: if still-hot charcoal caught fire, an entire wagon-load might be destroyed! If needed they might dump part of the charcoal load, or even drive the whole wagon into a stream.

At a single location in the woods, colliers tended half a dozen or more pits in varying stages of slow combustion. The iron company paid 2 cents per bushel of high-quality finished charcoal, and a typical pit might yield 1000 bushels. An individual collier could earn the equivalent of \$1.50 average daily wage, making them well paid by the standards of the time. But despite their skill and income, colliers were often perceived as rough, dirty mountain men and lowly regarded by other people.

* Pine Grove converted to “hot blast” (pre-heated air) before the Civil War; after 1877 air was pressurised by a steam engine.

** The pay rates mentioned here are based on estimates for the same jobs at Greenwood Furnace, PA in the 1870s.

As a rule the men who chopped and coaled [made charcoal] saw nothing of their families from Monday morning until Saturday night when working on jobs that were remote from the furnaces and forges. The charcoal makers ["colliers"] built simple cabins at the work sites. When the men moved on to new wood sources the cabins would be abandoned. They were built of logs cut from the woods nearby and were covered with leaves and earth for insulation and some protection from rain and snow.

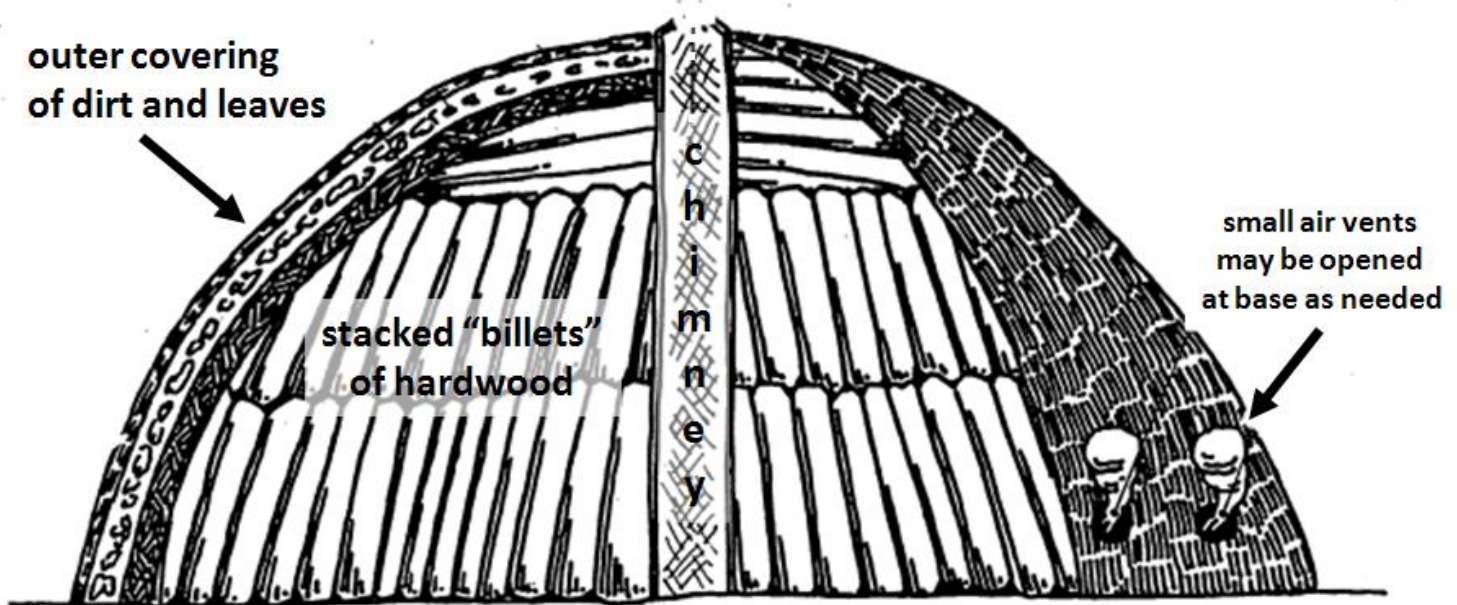
“Rattlesnakes, copperheads and blacksnakes found the cabins to their liking and would 'drop in' from the ceiling or curl up in the occupants' beds. The colliers, knowing that the snakes ate toads, would keep several toads in the cabin. A missing toad served as a snake-alarm, indicating the need for a search of the area to find and evict the visiting snake.

“Menus were simple and unvaried, the prime requirement being that the food didn't spoil quickly: bread, salt pork, potatoes, beans, onions, molasses and coffee were the common fare. The daylight hours were used to cut wood, pile it and burn it. Coaling — making charcoal — was an art. The wood was piled in conical piles; then covered with just the right amount of earth to allow burning with reduced exposure to oxygen, creating conditions for making charcoal.”

— John Birkinbine, 1897
quoted in *The Legacy of Penn's Woods: A History of the Pennsylvania Bureau of Forestry* by Lester DeCoster (1995)

John Birkinbine (1844-1915) was a well-known engineer in the iron & mining industries who among many other activities helped create the U.S. Association of Charcoal Iron Workers and the Pennsylvania Forestry Association. He came to Pine Grove Furnace in 1877-1878 and made major improvements to the iron-making operation.

Interior of above-ground “pit” for turning wood into charcoal



adapted from Eggert, *The Iron Industry in Pennsylvania*

Note that the central chimney was only used to light the mound of wood from the top; after a shovelful of campfire embers was dumped in, the top was also covered with dirt and leaves. During the process, smoke seeped through the sides of the “pit” – the level of the smoke indicating where wood had turned into charcoal. When the bottom edge of the smoke “came to foot” (reached the ground) the process was complete.

“During the winter months the woodsman’s axe was heard in every direction, felling the timber and converting it into cord wood. During the summer the smoke of hundreds of charcoal pits could be seen in every direction, making the mountain from base to summit a veritable hive of industry.”

— from *Blast Furnaces of Cumberland County*
by B. K. Goodyear, 1903



A typical wagon used to haul charcoal off the mountain, attached to a team of mules. Two adult teamsters are with the mules, and 3 boys can be seen sitting atop the wagon. The building is the Pine Grove Furnace “coal house” (it does not exist any longer). The top of the furnace stack is to the right of this view, probably taken around 1880.