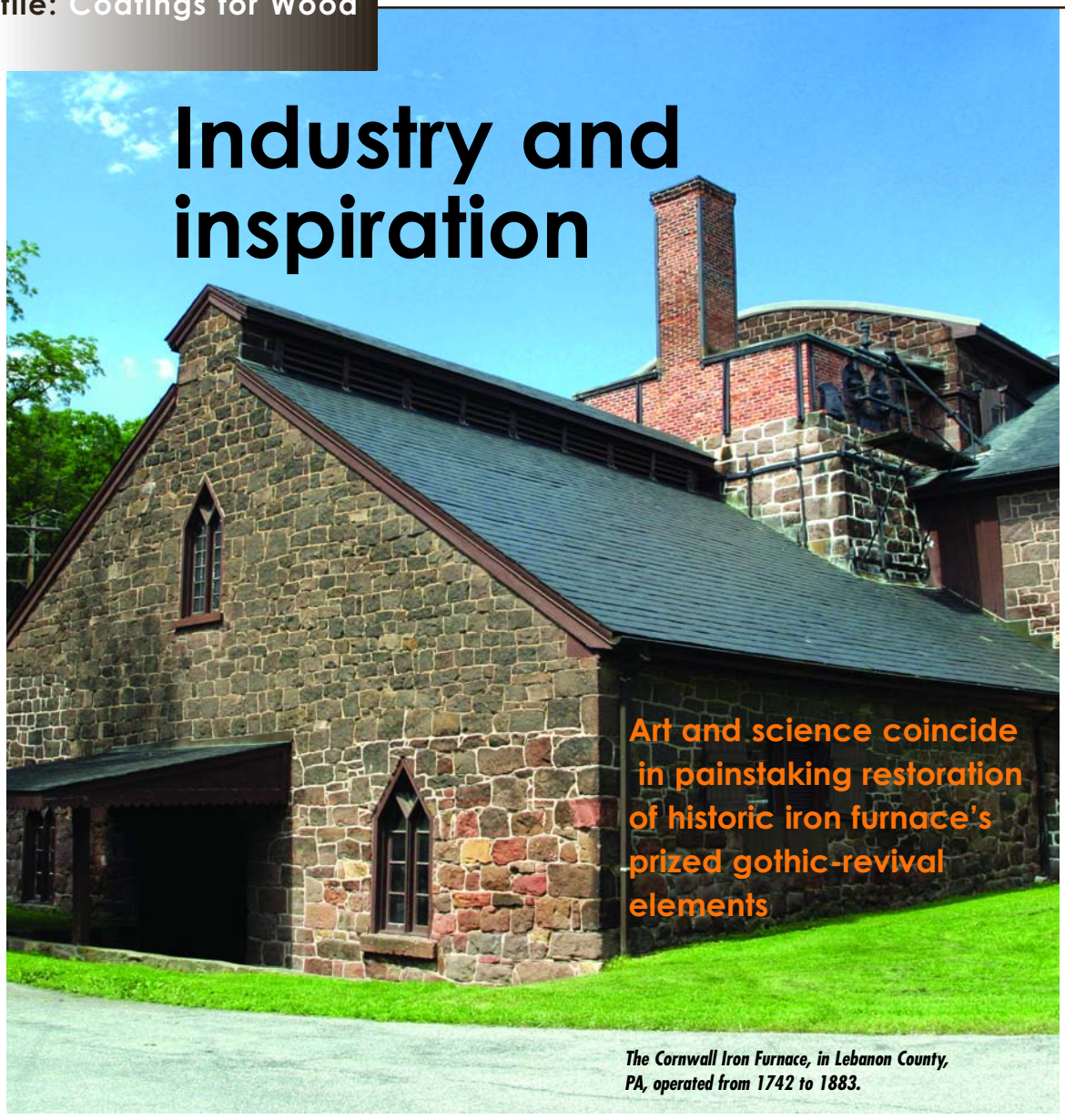
Industry and inspiration



Art and science coincide in painstaking restoration of historic iron furnace's prized gothic-revival elements

The Cornwall Iron Furnace, in Lebanon County, PA, operated from 1742 to 1883.

By Joe Maty, *JAC* Editor

George Washington may not have slept here at the Revolutionary War-era site of the Cornwall Iron Furnace in eastern Pennsylvania. But iron for cannons used by Washington's Continental Army was smelted here, historians say.

A connection to the nation's origins represents just one of many historically and architecturally significant facets of this unique, important historic site in the leafy Susquehanna Valley environs of Lebanon County, PA. No wonder, then, that the red sandstone, Gothic revival iron furnace, which operated from 1742 to 1883, has been carefully maintained and restored by the state's Historical and Museum Commission.

In keeping with this concern for the site's authenticity and long-term preservation, the Historical and Museum Commission called on the expertise of Duffy Hoffman, president of Hoffman Painting & Refinishing Inc., Pipersville, PA, to restore the original wood window frames, sash, and sills at the iron furnace. This daunting task was recently completed after two years of work.

After extensive study of the condition of the wood elements, Hoffman and his team of highly skilled craftsmen, working with the project architects and state officials, devised a comprehensive program involving stripping, repair, restoration, and refinishing of the fragile wood windows.

Joe Lauver of the state's Department of Architectural Services and a key participant in the program to restore the windows, says the grandiose vision of the pioneering industrialists who built the furnace is reflected in the architecture.

"They went through great effort to make a cohesive stylistic statement," which is also evident in other buildings that were part of the sprawling iron plantation, Lauver says. "It was a bucolic, idealistic

notion of what an iron plantation should consist of."

Hoffman, himself descended from a prominent early eastern-Pennsylvania family, offers another take on the cathedralesque, Gothic motif represented in the furnace building and its intricate windows.

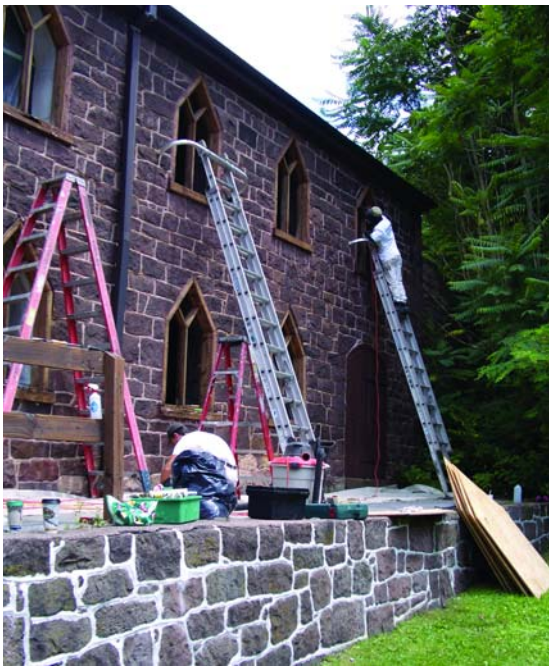
"They thought if something pointed to the sky, it pointed to God," he says.

Storied past

The Cornwall Furnace was built in 1742 near the Cornwall Ore Banks, at one time the greatest known deposit of iron in the country, according to historical accounts. It was upgraded several times over the years as its owners sought to remain competitive with newer, higher-tech iron and steelmaking enterprises. The furnace served as the focal point of a nearly 10,000-acre "iron plantation," a self-sufficient community dedicated solely to the production of iron, and produced various cast-iron products, pig iron, and cannon and cannonballs during the Revolutionary War. During the Civil War, gun blocks were made at the site.

In "A Blast from the Past," a historical account of the Cornwall furnace, author Sharon Hernes Silverman says the furnace was built by the entrepreneur Peter Grubb, taking advantage of the area's extensive iron ore deposits, flowing water to run bellows, timber for charcoal, and limestone to add flux to the iron-smelting furnace. Grubb named the furnace after Cornwall, England, the county from which his family had emigrated.

Silverman's account was originally published in *Pennsylvania Heritage Magazine's* Spring 1998 edition.



Craftsmen with Hoffman Painting & Refinishing at work during restoration of the windows at the iron furnace. Photos courtesy of Pennsylvania Historical and Museum Commission, Craig A. Benner photographer

"Behind its main building—with piercing lancet windows, arching doorways, vaulted ceilings, and thick wooden beams—and the soft russet hues of its sandstone walls, Cornwall Iron Furnace stands fully preserved today as a stunning example of one of Pennsylvania's oldest and proudest industries," Silverman writes. "It is the only place in the western hemisphere where a curious traveler can see intact structures of an early charcoal-burning iron blast furnace in its original plantation surroundings."

In the 30-foot-high blast furnace built by Grubb in 1742, air was "blasted" in under pressure from leather bellows powered by a water wheel turned by Furnace Creek. The blasts generated the high temperatures needed to melt the ore. Charcoal, produced from local hardwoods, supplied the source of the intense heat required. The charcoal production amounted to an industry in itself, as the furnace operated full-tilt to produce as much as 24 tons of iron a week.

Curttis and Peter Grubb, who inherited the iron furnace from their father, Peter Grubb Sr., upon his death in 1754, supported the American Revolution. Their furnace cast cannon, shot, and ironware for the Continental cause.

The furnace later was operated by Robert Coleman and his descendants. Coleman had risen through the company ranks to eventually assume ownership. He made a fortune in the burgeoning Pennsylvania iron industry, but technical innovations such as anthracite blast furnaces and, later, the Bessemer and open-hearth processes, eventually spelled the end for the Coleman iron dynasty. Still, the Cornwall works soldiered on until the late 1800s, as the operation was modernized with the replacement of waterwheel power with a steam engine in 1841, and additional upgrades.

The Cornwall Furnace was donated to the state in 1932 by Margaret Coleman Freeman.

A painstaking task

Fast forwarding back to the present, Hoffman Painting & Refinishing devised a meticulous plan to restore and preserve the iron furnace building's windows.

Hoffman's crew members removed the sash from the openings, and temporarily installed plexiglass in their place. The sash were moved to the company's workshop in Pipersville for the painstaking task of stripping and refinishing.

Resuscitating the sash, slowly

The process started with the placing of the window sash in a steam box to get the stripping work under way. But this isn't just your run-of-the mill steam here. The shop's two steam boxes are fed by fresh rainwater collected in tanks filled by the building's downspouts. This virgin rainwater doesn't contain mineral deposits that can clog up the steam generators, Hoffman points out.

The windows were placed into the steam box for 15 to 30 minutes, then were taken out, and all the old glazing was removed, followed by the glass panes. During the process, the windows are periodically returned to the box to keep them warm and the soft-

ened paint workable. The task, involving a set of scraping tools, is methodical and requires care. "This is all delicate antique glass," Hoffman says. Stripping of paint from interior mutins is facilitated with a heat gun. Following removal of all the old paint, the sash was evaluated for repair needs. Some new pieces were crafted in the "Dutchman" fashion to match the original longleaf-pine sash.

"Any wood replacement is done with 250- to 300-year-old wood, taken from the inside of beams," Hoffman says. The beams have been salvaged from old buildings or from scrap accumulated by the company from various jobs.

The building's windows were charted, with each window opening getting a number. A matching number is stamped into the stile of the sash. "For every frame, we know where the sash goes," Hoffman says. A typical window in the furnace building is composed of 11 panes; in most cases, the fixed diamond window-pane pattern at the top includes four panes.

Window sash was removed, repaired, and refinished at Hoffman Painting & Refinishing's shop in Pipersville, PA. Here, Hoffman journeyman wood restorer Mike Orrell is shown at work repairing window frames and sills, which were restored in place at the Cornwall Furnace historic site.

With stripping completed and following a 48-hour drying period in the controlled environment of the shop, the wood was sanded—by hand on the narrow sash and with an oscillating sander for larger parts such as stiles and rails. A borate and water mixture was brush-applied to the wood surfaces on both the interior and exterior sides of the sash. The mixture penetrates the wood, kills fungi and mildew, and halts further deterioration.

For repair of mortise and tenons in the sash joints, Hoffman says he used Advanced Repair Technology, a polymerized epoxy supplied in a caulk tube and manufactured by Advanced Repair Technology Inc.

After sanding of interior wood, two coats of a translucent sealer called Australian Timber Oil®, a product of Samuel Cabot Inc., was brushed on. The product is described as a combination of linseed, alkyd, and tung oils and iron oxide pigments. In keeping with the original appearance, an opaque paint was not applied to the interior wood.

On exterior wood, Prime-A-Trate, an epoxy consolidant also from Advanced Repair Technology, was applied. The material "locks up" the fibers of the wood after the weathered, gray cell fiber has been removed from the top layer of the substrate. After it is dry, the wood is sanded again to facilitate coating adhesion. A primer coat is applied using a penetrating, linseed oil/alkyd primer from Muralo Co., Ultimate Exterior Oil-Base Primer X200. The glass panes were reinstalled following application of the first coat of primer and another light sanding to restore a smooth surface. Application of the oil-based primer to the ancient wood raises the grain, Hoffman points out.

"When painting very old wood, there is a lot of suction; the wood is porous and soft," he says, referring to this condition as "sponging." When the primer is absorbed in this way, the vehicle soaks in, leaving the paint pigment on the surface of the wood. Hence the light sanding.

The glass panes were reinstalled using an elastomeric caulk as the back bedding for the glass. Missing or broken panes were replaced using pieces cut from Hoffman's antique-glass collection, with care taken to use glass that dates from the appropriate, late-1800s time frame.

Two types of glass were originally installed in the furnace-building windows—"crown" glass, used for smaller panes, and "cylinder" glass, made by means of a different process that produced larger plates. Hoffman figures he has "thousands" of pieces of antique glass. He examines the glass's level of "distortion," or waviness, in judging its suitability as a match for the original.

The bedding of the glass in the elastomeric caulk provides the necessary flexibility to account for the "crowning," or bending, of the glass that had occurred over time. The glazing process employs a linseed oil-based putty, which also retains flexibility. "Sash has joints that move, so the glass moves as well," Hoffman says. Window panes were trimmed as needed and cleaned of any paint residue. Trimming of the glass was required due to repair and squaring of the sash during the restoration work.

A second coat of primer was applied after the glazing had cured for a three-day period. Then, the finish coats were applied. For this, the product used was Muralo's Super-Tred Floor & Trim Enamel, #150 Series, a high-gloss, oil-based alkyd paint billed as a "tough and durable, high-gloss alkyd enamel" for use in demanding exposure conditions. The dark brown color chosen duplicates the shade of the paint applied to the windows in the mid-1800s—in those days, a linseed oil and pigment mixture would have been the material of choice. A thin initial coat was applied—2½ to 3 mils—and a final sanding is done. The surfaces are then vacuum cleaned and

wiped with a tack cloth, followed by application of a second, and final, finish coat of the same dark-brown color.

The windows were hung in the shop's drying room for about two to three weeks to cure. In winter, a temperature of 75 to 80 degrees is maintained. In summer, a dehumidifier is employed if necessary.

In situ treatment for sills and frames

The window frames, or jambs, and sills were restored and refinished "in situ" at the iron furnace. Stripping of old paint was accomplished using an infrared paint remover called a Steed Heater, available from Eco-Strip. The device does no harm to the wood as infrared heat pulls the paint out of the wood, allowing it to be scraped off. No chemical strippers were used.

With all the paint off, a detailed examination of all the wood surfaces assesssed the need for repairs. Here, considerable checking, or cracking, of wood was evident, along with the presence of various types of bonding fillers that were used for previous repair work, but now in various stages of advanced degradation. Highly damaged wood was repaired in the Dutchman fashion, using epoxy repair material to set the new wood in place. In a handful of cases, sills were completely replaced, using Spanish cedar, an imported species highly resistant to rot. The original sills are oak, most likely white oak.

Using a die grinder, the cracks were cleaned of debris and surfaces were sanded. Also removed was all mastic caulk previously applied between the wood window frames and the adjacent sandstone window openings. The borate preservative mixture was spayed into ¾-inch holes drilled into the tops of the sills. The borate was then applied to all bare wood on the frames and sills.

The epoxy repair material was used as needed on the frames and sills, as was done with the sash. The epoxy-repaired surfaces were sanded, and a specially designed, metal abrader tool was employed to give the epoxy surface a hand-planed look to match the texture in the original wood. Areas repaired with epoxy were spot-primed using a gray-tinted latex paint, Muralo Ultimate Exterior Cedar Solution #2201. The water-based, acrylic primer seals the epoxy by means of a proprietary stain-blocking technology to prevent contact with oil in the linseed oil primer, which could react with the amine component in the epoxy.

The restoration and refinishing steps for the sills and frames were completed with a first coat of linseed oil primer; drying; light sanding; application of a second coat of oil-based primer; another sanding; and application of two finish coats using Muralo's Ultimate latex acrylic, medium gloss, dark brown in color.

The water-based, 100% acrylic topcoat is durable but moisture-permeable or "breathable," allowing transmission and evaporation of water vapor originating in the adjacent stone. The oil-based topcoat on the window sash, on the other hand, is chemically compatible with the oil-based glazing and holds up to the wear and tear of the opening and closing of the still-operable windows. The windows turn on butt and pintle hinges, all of which were retained during disassembly—save one missing set that was found in the historic site's archives building by "pure luck," Hoffman says.

The old, hand-carved "turn buttons" used to open the windows were retained for the most part. A number of reproductions were fashioned by Hoffman's father, Clifford, a cabinetmaker and antique furniture refinisher.

Bound by deeply rooted ties to area's past—and to paint

Hoffman says he is descended from the Rittenhouse clan, an old Philadelphia family of clockmakers and business owners. The paint connection also runs deep: his great-grandfather was a house painter. Hoffman Painting & Restoration is currently is engaged in restoration work at Washington's Crossing Park, a Pennsylvania historic-village site located across the Delaware River from Trenton, NJ.

Hoffman describes the Cornwall Iron Furnace job as "painstaking and very educational. We learned a lot about iron making and historic changes in the structures, and about ventilation."

Hoffman says that typically, he confers with a project architect and manager on a narrowly focused aspect of the overall task. But Hoffman is largely left to his own devices when it comes to the details of wood restoration. "We finish up on writing the scope (of the project) using procedures we know must be followed, including repair methods and materials. It's as-you-go," he says, tweaking the methods and materials that will work for each individual job.

"I go against all the painting directions on the back of the can," he says, referring to manufacturer's recommendations for product use. "It's based on field experience, on what works and what doesn't work."

He'll also modify the paint with ingredients and recipes he declines to identify. "Every time I open a can of paint I add something to it," he says, citing as an example the addition of an adhesion-promoting agent. "With coatings, what they write on the can is to cover their risk, their liability.

"In each job, we go back to look at something that didn't work as well as it should have and try to determine why. Everything we do is not written in a book. We get our education from job to job, by doing the job. We take into account climate, moisture, type of wood, compatibility with repair materials. That's how masters become masters; they learn from their mistakes."

Call it intuition, if not inspiration. Still, it's plausible to imagine that the Cornwall furnace's founding families would be at peace, knowing that Hoffman and state officials divined a proper protocol for the resurrection of prized architectural elements in their Gothic monument to industry.

JAC