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Benches to Factories: American Clockmaking from Colonial Times

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Benches to Factories: American Clockmaking From Colonial Times

by Bob Frishman

First a clarification: clockmakers historically have been engaged mostly in servicing and repairing clocks, not fabricating new ones. Until the 19th century, new clocks were costly and unaffordable, except for the most affluent consumers. Existing clocks, standing in dusty, dirty, smoky, and hot-cold environments, kept clockmakers busy with cleaning, repairing, and replacing parts that failed due to dirt, dried oil, wear, inferior metals, poor craftsmanship, and owner abuse.

Secondly, watchmakers often were clockmakers, and vice versa, but my focus is upon craftspeople and later factory workers who made and fixed clocks. Although the basic technology is the same, working on a watch's tiny parts is more demanding and due to the small scale, requires specialized skills and tools not needed with a clock's far larger bits and pieces.

Thirdly, the individual clockmaker rarely created more than the bespoke metal movements and faces, called dials. Carpenters, joiners, and carvers separately produced the floor-standing wooden cases in consultation with the customer, coordinating with the clockmaker only to ensure that the case would properly accommodate the machine. While today we identify an entire tall clock by the dial signature, that name rarely had anything to do with the wood furniture surrounding it.

Clock Technology

As first envisioned and developed more than seven centuries ago in southern Europe, a source of power—a descending weight or a coiled spring—drives a stepped intermeshing train of toothed gears and leafed pinions, which reduce the force and extend the duration.

This force is released, one tick at a time, by a swinging pendulum or by an oscillating wheel or bar, the balance, pushed one way and then the other by rocking pallets. The more regular and unvarying the swings or rotations, the more accurate the timekeeping. If the count of the gear teeth and pinion leaves is computed correctly, the minute and hour hands will properly indicate time's passage. If the machine solely indicates the current time, it is a timepiece.

A machine that also announces the time with bells or gongs may properly be called a clock. Striking and chiming systems also are powered and operated like the time train, but are governed by a spinning fan that regulates the speed of hammer blows on those bells and gongs.

This fundamental technology has been basically unchanged since the 1400's. Two leaps forward occurred in the mid 1600's: the application of the pendulum to hanging and standing clocks; and the fitting of a hairspring to oscillating balances on portable clocks and watches. These innovations increased timekeeping accuracy manyfold from minutes to seconds per day and allowed associated time-sensitive scientific endeavors, such as astronomical observations, to take advantage of these breakthroughs.

Setting clocks to the correct time was another key issue. Well before telegraph, radio, GPS, cellphones, and atomic clocks, local time was fixed by celestial observation. Most common by far was the sundial, which originated in ancient Egypt and was still the standard method until the late 19th century. If marked for the local latitude and corrected by an "equation of time" chart to correlate sun time to clock time, a sundial could be accurate to within a few minutes. Higher accuracy time readings, such as required in navigation and observatories, made use of octants, sextants, transit telescopes, and star positions.

Colonial North America

In colonial North America, a few small wall-hanging weight-driven lantern clocks might have arrived with immigrants in the early 17th century, but by late in the 1600's, there were many domestic and public clocks, including a town clock in Boston. It was imported from England and was first attended by blacksmiths and gunsmiths before actual clockmakers arrived before the end of the century in Boston, New York, and Philadelphia. These cities were sufficiently established and prosperous to support young immigrant artisans who could service clocks exported to America from prolific English makers.

Other colonial centers soon attracted these specialists as well, including Baltimore, Charleston, and Newport. Eventually, nearly every city and town boasted at least one large public clock in a meeting-house or church tower, not only as a point of civic pride, but also as a way to unify local time perception within sight of its dials and the

Fig. 1. Disassembled brass-and-steel movement of a Jonathan Mulliken tall clock.
Credit Author

Fig. 2. Silvered-brass name boss on the dial of a Jonathan Mulliken tall clock.
Credit Author

more distant sound of its bells.

The 1700's represented the age of the handcrafted clock in North America. The English origins of the immigrant craftsmen and the importation of English-crafted clock movements makes it difficult to determine who actually made the clocks with American-maker names and places engraved on their dials. Most movements from that time have parts that closely resemble the one (Fig. 1) that I recently overhauled as a donation to the Custom House Maritime Museum in Newburyport, Massachusetts. This clock's dial has an engraved signature by Jonathan Mulliken (1746-1782) who lived and worked in that seaside town (Fig. 2).

In some instances, the American-signed clocks are relatively rough and primitive and otherwise distinctly different from finished products from England. These definitely point to local origins. However, even those makers could have sourced imported components, given the difficulty of obtaining reliable supplies of brass, iron, and steel. Or they may have turned to local braziers and founders (Fig. 3) who could and did fabricate needed parts that were difficult to produce accurately in single or small quantities.

However, from clockmaker estate inventories we know that some craftsmen had the equipment to make clock movements from scratch. Basic inexpensive tools, such as files, vises, saws, drills, and hammers, would suffice to repair, but creating brass and steel parts from unformed or remelted pieces of metal was

JOHNSTOW, Braſs-Founder,

Is remov'd from Third-ſtreet, to the ſign of the Three Bells, in Second-ſtreet, oppoſite to Mr. John Lawrence's, and next door but two to Mr. William Whitebread's, at the ſign of the King's Arms, Philadelphia;

WHere may be had, all ſorts of braſſes ſuitable for the Weſt-India ſugar-mills, grift-mills, ſaw-mills, &c. braſs furniture of every ſort for coaches, chaiſes, &c. braſs fire-dogs, ſhovel and tongs, candleſticks, gun-furniture, beſt braſs ſhoe-buckles, and ſleeve-buttons, by the quantity or ſingle pair, joiners furniture of ſeveral ſorts, ſpoon-moulds, of all faſhions, bell-metal ſkillets and kettles, of all ſizes, ditto mortars and peſtles, houſe ſpring-bells, of all ſizes, ditto for horſes, copper rivets and braſs cocks for ſtills, of all ſizes, barrel cocks, dog-collars, braſs heads for iron dogs, of all ſizes, braſs ſtirrups, ſaddle heads and nails, knockers for doors, with a variety of other braſs work, at the moſt reaſonable rates. Likewiſe work in the rough, for clock-makers, &c.

Fig. 3. Philadelphia brass-founder advertisement in the Pennsylvania Gazette, offering cast-brass clock components "in the rough." Credit Pennsylvania Gazette, April 23, 1752, 6.

Fig. 4. Clockmaker's gear-cutting engine. Credit Willard House and Clock Museum

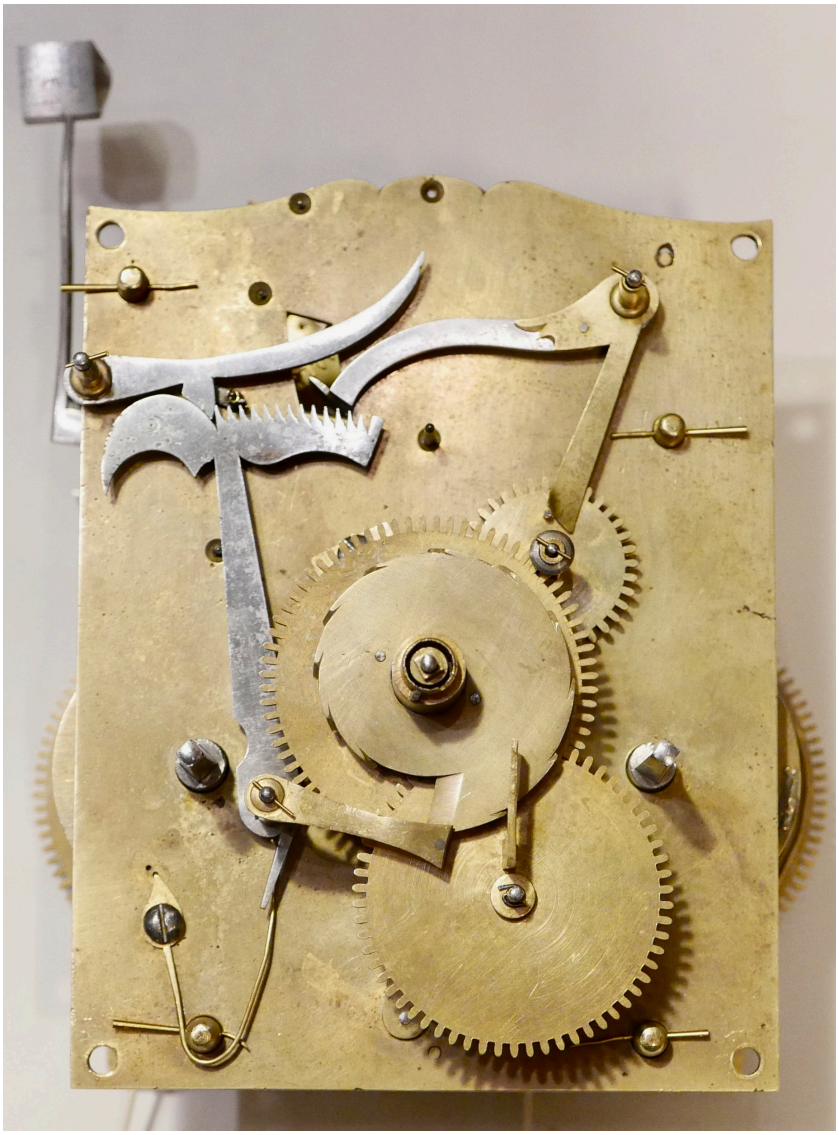


Fig. 5. (Above) Front view of the movement of a Jonathan Mulliken tall clock showing the rack-and-snail strike system.

Fig. 6. (Below) Hardened-steel pallets from tall-clock movements signed by Simon Willard (left) and Edward Duffield (right).

Credit Author

a much taller order. High heat, strength, skill, reliable raw materials, and knowledge of metallurgy were mandatory.

Movement gears, or wheels, and pairs of rectangular plates needed to be cast from imported brass which was costly and often sought by clockmakers advertising for metal scrap and worn-out objects. Wheel blanks of several sizes were cast by copying carved wood templates, then finished in lathes. Equally important were wheel-cutting engines (Fig. 4) that sliced the desired number of teeth on those wheels. Tooth counts of thirty or sixty would be nearly impossible to lay out, eyeball, and cut by hand. Nearly all wheels were crossed out with four or five spokes; heavier solid wheels would waste brass and add to the force needed to keep them turning.

The steel components were even more difficult to fabricate, even if a shop's forge could reach needed temperatures and if tools were sufficiently strong and durable to work the much harder metal. Steel parts included the axles or shafts, known as arbors, on which the brass wheels were mounted, and the integral small leafed gears, or pinions, that meshed with them. Pinions were formed by forcibly pulling steel rods through dies that shaped six or eight leaves from round stock. Imagining the human and tool strength required for this task is not difficult.

Clockmakers centuries earlier had learned that the interactions of brass and steel kept wear to a minimum. Same-metal gears and pinions quickly became grooved and gouged from the constant rubbing, scraping, and friction.

Other steel parts were even more complex and precise. Most hour-striking movements utilized the rack and snail system with crucial shapes, angles, dimensions, and teeth. These parts can be seen on the front of the Mulliken movement (Fig. 5) mentioned above. Trial-and-error fabrication would be horribly inefficient and frustrating, so proper templates and machining were key. Even if the movement used the older and simpler countwheel system of counting the hours, the necessary slotted wheel and steel levers needed to be perfectly shaped.

At the heartbeat of the clock were the hardened-steel pallets that in a longcase clock were pushed sixty times each minute by the precisely-angled teeth of the brass escape wheel, generating the audible tick-tock and keeping the three-foot-long pendulum swinging back and forth. Equally precise were the shapes and angles of the pallet units; errors in fabrication of just a few degrees would destroy any hopes of the clock ticking. Two examples from

Fig. 7 Composite silvered, cast, painted, engraved, and polished brass dial signed by Edward Duffield (1730–1803), Philadelphia. Credit Author

clocks by Simon Willard, Boston, and Edward Duffield, Philadelphia, illustrate this precision (Fig. 6).

The multi-piece brass dials (Fig. 7) also were extremely difficult to fabricate and required special skills and tooling. For example, large hammered flat sheets of brass mounted with movement-attaching posts, large and small silvered-brass circles engraved with numbers and markers, applied silvered-brass plates, called bosses, for maker signatures, revolving painted-metal age-of-moon toothed disks, and elaborate cast-brass spandrels with leaf and dolphin and cherub motifs would all take days and weeks for a lone clockmaker to fabricate, even if he were able.

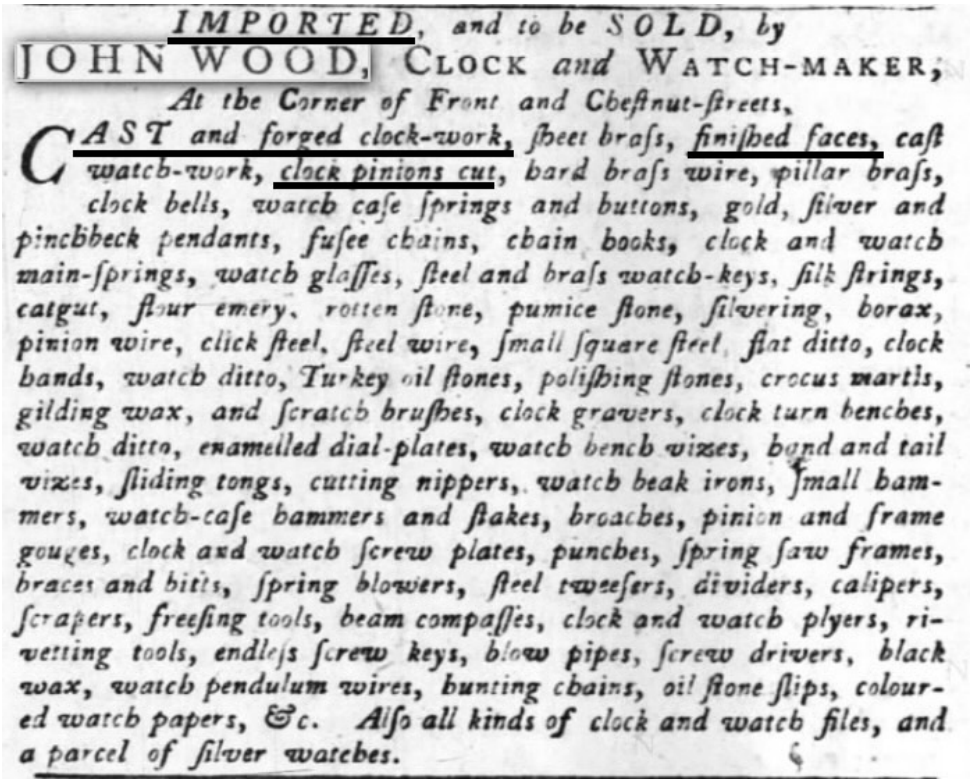
Abell Cottey and Daniel Burnap

One such lone artisan was Abell Cottey, who was perhaps the earliest documented American clockmaker. Born in 1655 in England where he trained and made clocks in Devon, he then emigrated to Pennsylvania and worked in Exeter and Philadelphia before substantial importation of clock materials began. He died in 1711 and his lengthy estate inventory included not only basic tools for repairing, but also many more for fabrication. His "Large Turn Bench" was a lathe for shaping and truing round pieces. His "four Skrew Plates" and "one plate for drawing weyer" allowed him to make threaded screws and pinions from steel rods. "Compases" assisted layout of the clock wheels between the movement plates. His "Old Bellows" and "sand box" and "tongs" enabled his brass-wheel casting, and his "Watch dividing plate" let him efficiently cut teeth on wheel blanks. The inventory's final entry, "a parcel of Cast Clock Work," perhaps sadly indicated that he had incomplete work left when he passed away.

A later clockmaker was documented by Penrose Hoopes in his 1958 *Shop Records of Daniel Burnap Clockmaker*. Burnap (1759-1838) lived in Coventry (now Andover), Connecticut, and his clocks today are treasured in private and museum collections. Hoopes presents many transcribed pages of ledgers demonstrating that Burnap made and fixed clocks, repaired watches, and provided many other hand-crafting services, including making instruments, hinges, buckles, coffin handles, "Brass work for Sleigh Harnice" and a "Sett of Sleigh Bells."

A more general book is highly recommended for a thorough overview of this history. *Two Hundred Years of American Clocks and Watches* is now a popular classic written by Chris Bailey and published in 1975. At that time, Bailey was curator at the American Clock and Watch Museum in Bristol, Connecticut, which is a must-visit for anyone wanting to examine hundreds of clocks produced during the period this article encompasses.

The museum also offers recreations of early American clockmaker benches with displays of tools and hand-powered machines. The relocated Dominy shop at the Winterthur Museum and the workshop at the Willard House and Clock Museum, the only such shop still on its original foundation, offer two other opportunities.



IMPORTED, and to be SOLD, by
JOHN WOOD, CLOCK and WATCH-MAKER,
At the Corner of Front and Cheſtnut-ſtreets,

CAST and forged clock-work, ſheet braſs, finiſhed faces, caſt watch-work, clock pinions cut, hard braſs wire, pillar braſs, clock bells, watch caſe ſprings and buttons, gold, ſilver and pinchbeck pendants, fuſee chains, chain hooks, clock and watch main-ſprings, watch glaſſes, ſteel and braſs watch-keys, ſilk ſtrings, catgut, flour emery, rotten ſtone, pumice ſtone, ſilvering, borax, pinion wire, click ſteel, ſteel wire, ſmall ſquare ſteel, flat ditto, clock hands, watch ditto, Turkey oil ſtones, poliſhing ſtones, crocus martis, gilding wax, and ſcratch bruſhes, clock gravers, clock turn benches, watch ditto, enamelled dial-plates, watch bench vizes, hand and tail vizes, ſliding tongs, cutting nippers, watch beak irons, ſmall hammers, watch-caſe hammers and ſtakes, broaches, pinion and frame gouges, clock and watch ſcrew plates, punches, ſpring ſaw frames, braces and bits, ſpring blowers, ſteel tweeſers, dividers, calipers, ſcrapers, freeſing tools, beam compaſſes, clock and watch plyers, riveting tools, endleſs ſcrew keys, blow pipes, ſcrew drivers, black wax, watch pendulum wires, bunting chains, oil ſtone ſlips, coloured watch papers, &c. Alſo all kinds of clock and watch files, and a parcel of ſilver watches.

Fig. 8 Philadelphia clockmaker and importer advertisement, offering newly imported English clock parts and dials. At this time, "clock" signified only the metal machine; the wood case was named separately and imported much less frequently.

Credit Pennsylvania Gazette, June 27, 1771, pg. 3.

American Made?

Abell Cottey, because he was among the first, and Daniel Burnap, because he was inland rural, were exceptions to more typical urban American 18th and early 19th-century clockmakers. Those city-dwellers had access to complete imported movements and a full range of movement parts needing varying amounts of final forming and finishing. Why would these busy artisans sweat and labor for days when they could walk in minutes to the local merchant importer (Fig. 8) to purchase ready-made movements, parts, and dials? And as an even greater incentive, those

imported parts were more likely to look better, to be of higher and more consistent quality, and to function properly when first tested and then run day and night for years to come.

Naturally, this issue is of major concern to collectors and to those studying early American crafts. It has been appealing to envision our colonial clockmakers alone in their cluttered shops, painstakingly creating complex timekeeping machines from lumps of brass and steel. Some did, but most were small businessmen whose time was valuable and mostly spent repairing, whose funds were tight, whose customer base was small and demanding, whose limbs and eyes were often at risk, and who clearly would prefer light finishing work to long hours of metal-working drudgery with possibly uncertain outcomes.

I have examined, serviced, photographed, and repaired hundreds of American and English-signed clock movements from the 18th century and 19th centuries. Mostly I have seen no discernible differences that would confirm domestic fabrication. On the contrary, most American and English-signed movements and dials look alike, except for small details.

More than twenty years ago, renowned clockmaker and American-clock expert Robert C. Cheney, now Executive Director of the Willard House and Clock Museum, enraged many collectors by strongly making this case. In the April 2000, edition of *The Magazine Antiques*, not only did he cite examples and proof of English exports routinely arriving here, but he reinforced his conclusions by noting that on American-signed movements by the same makers at the same times, there were unexplainable differences. It would make no sense for makers to vary from one day to the next the shapes and dimensions of crucial parts once they had templates for complex parts that functioned properly. The only plausible explanation for such differences is that the parts were imported from various English makers.

Fig. 9 Philadelphia clockmaker advertisement for newly-imported clocks, watches, and painted clock dials.

Credit Pennsylvania Packet, June 16, 1787.

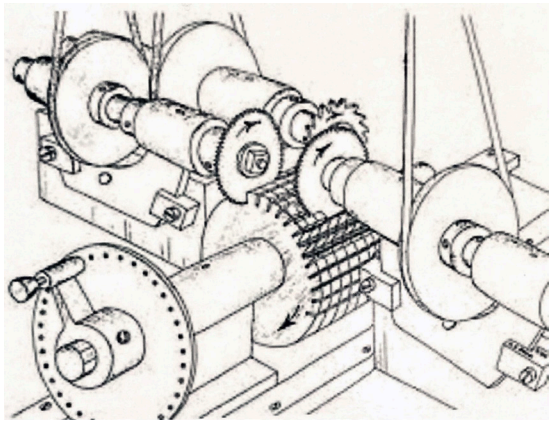


Fig. 10. Diagram of a water-powered belt-driven machine designed and built by Eli Terry for mass-production of interchangeable wooden clock wheels.

Credit American Clock and Watch Museum, Drawing by George Bruno, Author phto

The issue of local crafting versus importation became clearer after the American Revolution ended in 1783 when the American market reopened to a flood of inexpensive British imports that included clocks (Fig. 9). During the long conflict, local clockmakers' markets had dried up and their skills had been redirected to gun-making and other military pursuits. After the war they faced imports that mostly were cheaper and better than what they themselves could produce for their well-heeled customers.

Accompanying those imported movements were the new mass-produced colorful painted-iron clock dials sent from Birmingham. Invented and first produced by Wilson and Osborne, these dials were less costly, easier to see, and often far more attractive than composite brass dials. An American clockmaker could have his name and city prominently inked onto the dials, which came pre-attached to cast-iron intermediate false plates that allowed easy mounting to any movement.

Eli Terry

Some American hand-crafting clockmakers did persist into the early 1800's, but the contract of entrepreneurial Connecticut clockmaker Eli Terry (1772-1852) with merchants Edward and Levi Porter in 1807 further reduced their prospects. Terry's invention of water-powered mass-production machinery (Fig. 10) and interchangeable parts enabled him, in his factory in Plymouth, Connecticut (Fig. 11) to produce an unprecedented four thousand wood grandfather-clock movements in three years. Not only did this bring affordable clocks to humble households,

Fig. 11 Eli Terry's "Ireland" factory in Plymouth, Connecticut. Credit Edward Ingraham Library, American Clock and Watch Museum

but it ushered in an American industrial revolution, first centered in Connecticut factories and machine shops, that eventually led to world domination in factory production of consumer goods.

Claims are made that Eli Whitney initiated this revolution with interchangeable parts for firearm production (often with the assistance of clockmaker-machinists). But it is clear that he did not reach that goal, despite multiple Federal contracts and subsidies, until well after Terry and his successors were producing tens of thousands of clock movements annually. Unlike Whitney's pistol parts in their early years, Terry's clock wheels needed no individual post-production fitting and filing to function properly.

Factory Production

By the second decade of the 19th century, Connecticut multi-story big-windows factories were churning out not only wood movements for floor-standing clocks, with cases made afterwards by local woodworkers, but also scaled-down shelf and wall-hanging clocks entirely con-

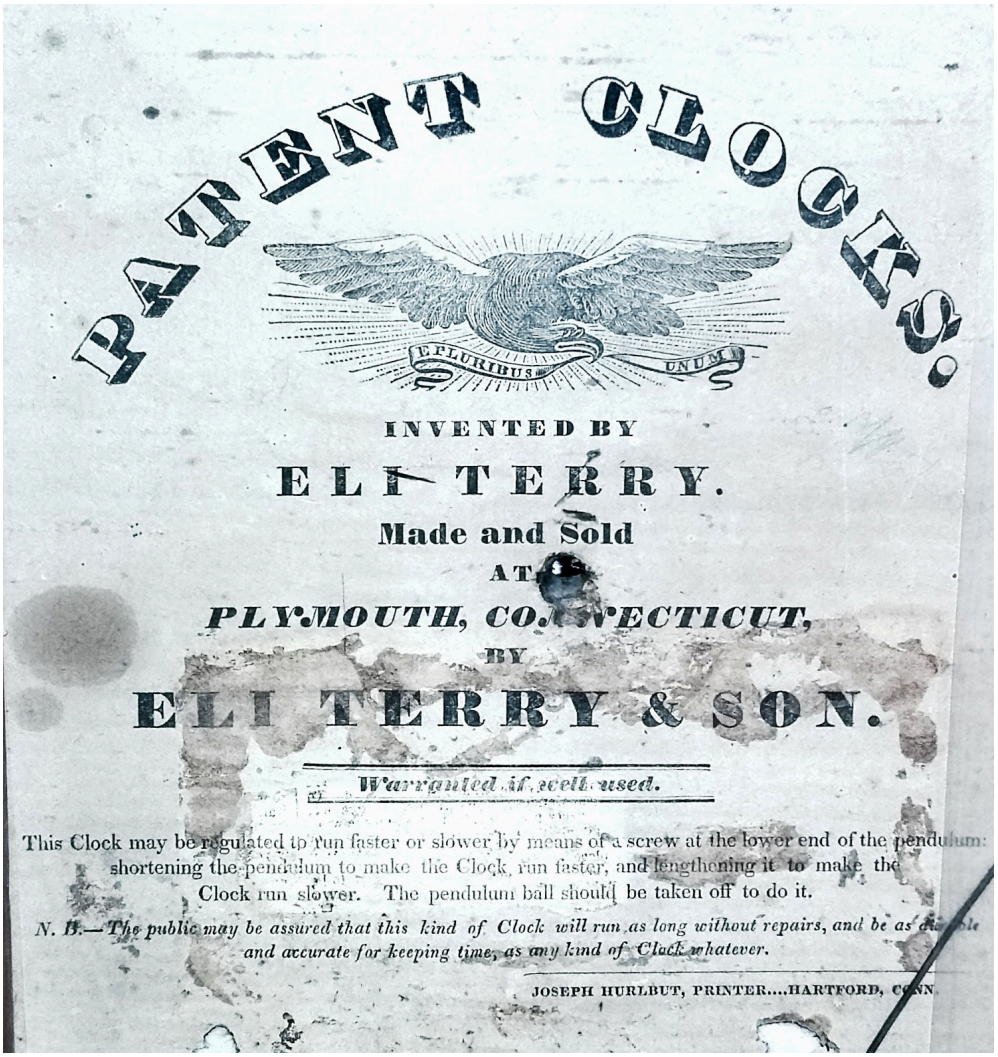


Fig. 12. Patriotic paper label glued on the inside of a circa 1825 Eli Terry shelf clock, with information on its adjustment, reliability, and label printer in Hartford. These labels commonly are found inside early Connecticut mass-produced shelf clocks, and also serve as dust barriers.

structed in those factories. Sold by peddlers at fractions of what hand-crafted brass-movement American and British clocks would cost, these appealing and reliable styles—pillar-and-scroll, column-and-cornice, stenciled-column, etc.—advertised their factory-maker names on ornate interior paper labels (Fig. 12). Seth Thomas, who took over the Terry factory, perhaps is the most familiar, but hundreds of others jumped onto the bandwagon until the financial crash in the late 1830's drove nearly all from the field.

Contributing to the demise of the mass-produced wood-movement clock was Chauncey Jerome's inspired invention of an inexpensive brass-movement shelf clock at that time. Connecticut makers in the 1820's and 1830's had produced such shelf clocks but none inexpensive enough to truly mass-market. Jerome (1793-1868) made a fortune producing his "OG" (Fig. 13) weight-driven shelf clocks, using factory techniques to stamp brass, now being domestically produced in quantity, and efficiently fabricate and finish their rectangular wooden cases. Colorful painted dials and reverse-painted glass tablets added to their allure. Unlike wood-movement clocks that could not survive ocean voyages, Jerome's clocks arrived in England, overcame protectionist barriers, swamped old-fashioned local producers, and are still found today in UK antique shops and at weekend boot fairs.

Another advance in the 1840's accelerated the mass-production of affordable clocks even further. Coiled steel mainsprings, formerly tricky and costly to manufacture, could finally be factory-made cheaply and then could power smaller cheaper shelf and mantel clocks not needing interior height in which weights descended. Many familiar styles—steeple, cottage, figural, black mantel, tambour, etc.—brought prices within reach of the entire population as millions of clocks gushed from Connecticut factories. Not until plug-in electric clocks became feasible after World War I did this Niagara of windup clocks diminish.

The 19th-century proliferation of affordable clocks provided plenty of work for clockmakers, even if none ever cast a gear or sliced a pinion. Every one of those clocks needed frequent cleaning, oiling, and repairs, and even most small towns hosted at least one full-time clockmaker, if not several, who often were watchmakers as well. Homes and offices still were dusty and smoky, organic lubricants dried and deteriorated, brass gear teeth wore and broke, catgut cords broke and cast-iron weights crashed into the case's wood and glass. Steel mainsprings snapped, often explosively and often while the startled owner was twisting the winding key.

Still working at their benches, 19th-century American clockmakers passed their days servicing clocks that were recently made in factories or had survived from earlier days of hand-crafting. Actual clockmaking men stood at loud machinery in big factories making parts that then women assembled, sitting in long rows of tables and parts bins.

The 17th and 18th-century American artisans, who

Figure 13. Chauncey Jerome "OG" shelf clock. Note the dial's large center opening which allowed a view of the brass movement, confirming at the time that it was not an obsolete wood movement.
Credit Schmitt Horan & Co.

could and did make clocks when not repairing them, or who affixed their names to imported clock dials, became obsolete. But today they remain represented by their fine clocks that we have the honor to cherish, preserve, and continue to pass down.

Author

Bob Frishman entered the world of horology on Thanksgiving, 1980. He met a collector/dealer/repairer who started him down the path that has led to nearly 8,000 clocks repaired, nearly 1,800 antique clocks sold, more than 100 articles published and more than 100 lectures delivered. A Silver Star Fellow of the National Association of Watch and Clock Collectors, he chairs its Time Symposium Committee, and he has created international conferences at The Winterthur Museum, The Henry Ford Museum, The Museum of Fine Arts, Boston, and The Museum of the American Revolution. His comprehensive biography of Colonial Philadelphia clockmaker Edward Duffield is awaiting publication, and he is at work on a similar book about the Mulliken family of Massachusetts clockmakers. Residing in Andover, Massachusetts, he is a Liveryman of the Worshipful Company of Clockmakers, the London guild chartered in 1631. Read more about Bob Frishman at www.belltime.com.