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The Clockwork Roasting Jack, or How Technology Entered the Kitchen

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The Clockwork Roasting Jack, or How Technology Entered the Kitchen

When you next set your watch, remember that Tompion was a farrier [blacksmith], and began his great knowledge in the Equation of Time by regulating the wheels of a common Jack, to roast meat.

—Matthew Prior, on the father of English clock-making, Thomas Tompion (1639–1713)

MY HUSBAND HAS BEEN COLLECTING antique clocks and other ingenious mechanical things for over twenty years. Two Aprils ago, he came home from the semi-annual science and technology sale at Skinner, Inc., held at its gallery in Bolton, Massachusetts, with two “clockwork jacks,” as the auction catalogue had described them.

These events at Skinner every spring and fall are a gear-head’s delight, featuring the likes of English pocket barometers and Italian diptych sundials; sphygmomanometers, galvanometers, and ship’s wall clinometers; sextants, octants, and astrolabes; magic lanterns and combination kerosene-powered lamp-and-rotating-fans. I love the brass, mahogany, and real leather ingredients of these unnecessarily beautiful objects. But the guts of them I appreciate only from a distance. Machines are Bob’s passion, not mine. So I was surprised to hear him say he had bought these clockwork jacks for me (in one lot for \$350.00, plus 17.5 percent buyer’s premium). For me? Yes, he said, putting them on the kitchen counter; they had something to do with cooking.

I grew more interested.

They were both from the nineteenth century, said the catalogue. One was English, the other French. The English one was brass and shaped like a bottle with a long neck. Its spring-driven mechanism was meant to be wound with a (missing) key. The manufacturer’s name, “John Linwood,” was pressed into a brass label on the front. The French one had no maker’s name. It was made of black cast iron and resembled a miniature stove. It had a hand crank to wind its spring and an alarm bell. More elaborately designed than the English one, it stood about fifteen inches tall on four

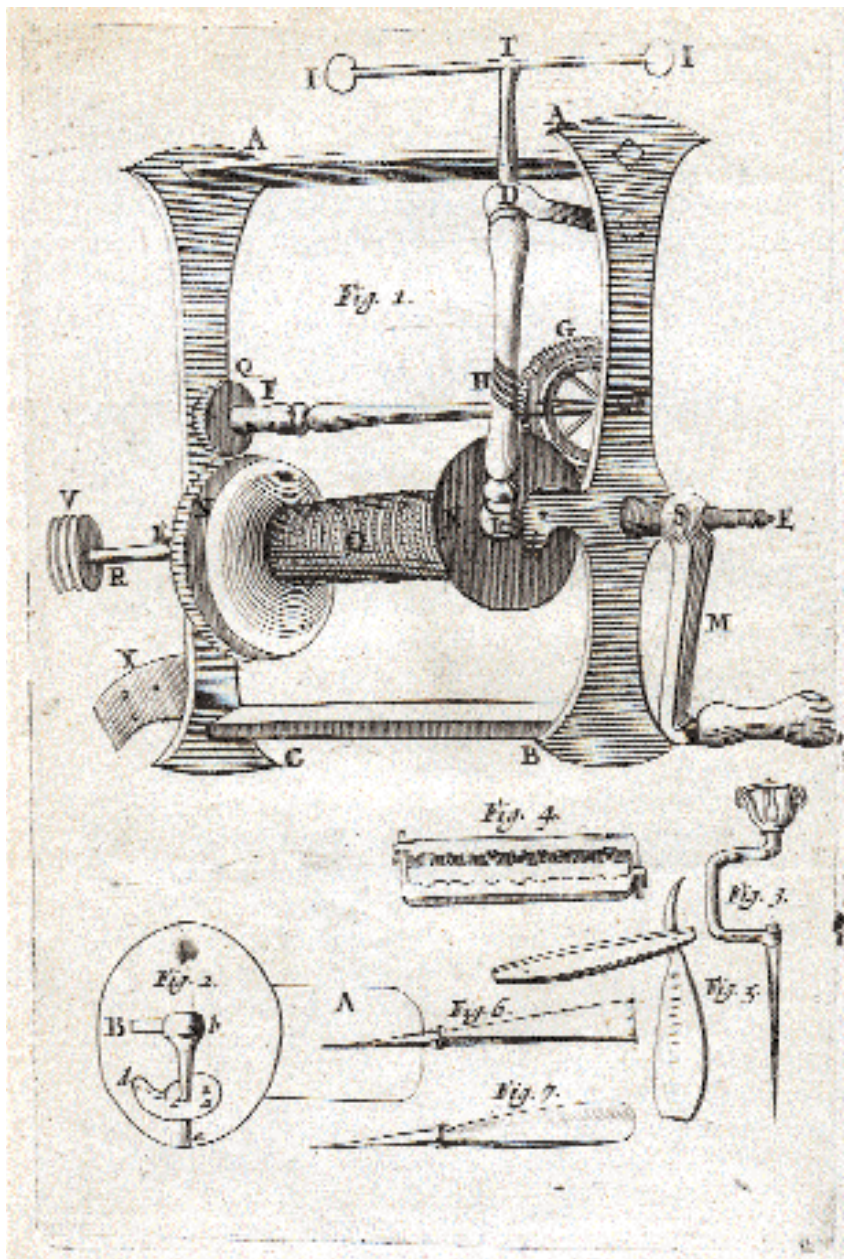
little hooped feet, and its top piece was decorated with a horn-playing cherub.

I began to look through books in Bob’s horological library and found scattered references to “clockwork roasting jacks.” These machines also went by other names, including “spit jacks,” “spit engines”—and, what seems to be most common, the shortened “clock jacks.” Their purpose: to turn spits of roasting meat before a fire without the need of anyone doing it by hand. Our English jack, I learned, would turn a vertical “dangle spit” in front of a fireplace or inside something called a “tin kitchen”; the French one turned a horizontal spit at hearth level, and when its bell rang, the cook would know it was time to rewind the spring. In either case, diners could anticipate that their meal would be “done to a turn.”

Information in clock books was skimpy otherwise. Because clock jacks aren’t actual timepieces, horologists have not written in much depth nor with much enthusiasm about them.¹ But food historians have. And so I was able to piece together the story of this chiefly British phenomenon,² which spanned the centuries roughly from 1550 to 1850. The clock jack, it is true, was not an earthshaking invention, like, for example, John Harrison’s marine chronometer, or the cast-iron stove, but it has its place in annals. British food historian Rachael Feild, for one, cites the clock jack as the first successful mechanical device to enter the realm of the kitchen.³

The clock jack must also have been for many the locus of their first personal encounter with a self-powered machine of any kind, anywhere. For that reason alone, its significance goes well beyond the purely culinary.

Human-powered spit-roasting is, of course, a primeval cooking technique. A wrought-iron “fire dog,” probably from first century B.C., is pictured in C. Anne Wilson’s *Food and Drink in Britain: From the Stone Age to the 19th Century*. Just as andirons are made to balance a log, fire dogs were made to balance the ends of a meat-laden spit. A person sat on the ground and, risking scorched palms, turned the spit by hand. In Feild’s *Irons in the Fire: A History of Cooking Equipment* there is an illustration from



The mechanics of a roasting jack. From Joseph Moxon, Mechanick Exercises. Or the Doctrine of Handy-Works (Printed for Dan. Midwinter and Tho. Leigh, at the Rose and Crown in St. Paul's-Church-Yard, 1703), p.38.

COURTESY OF CHAPIN LIBRARY, WILLIAMS COLLEGE

the mid-fourteenth century of two men spit-roasting a piglet and two small fowl. Eons had passed since the Iron Age and, in terms of culinary technology, very little had changed—but it would soon. For as human groups grew larger, the task of food preparation naturally grew more complex. When knighthood was in flower, cooks were charged with feeding a castle's worth of people, and turning the spits by hand became a specialized task. Assigned to it were male scullions descriptively named "turnspits." Turnspits weren't known as refined characters; the horribly hot, tedious job inspired them to drink (and the word itself became a generalized slur). A drunken turnspit couldn't have been a reliable one, and in Tudor times, the human power of these menials was replaced by dog power.

A canine turnspit ran in a treadmill similar to a hamster's exercise wheel. A pulley system linked the dog's wheel to a smaller wheel attached to the end of the spit by a belt. As the dog ran, both wheels turned, along with the spitted meat. Thomas Rowlandson (1756–1827), the British caricaturist, drew a turnspit working such a wheel after a visit to Wales in the late eighteenth century. The dog in the Rowlandson scene looks the way the breed has been described by many writers of the period: small, long-bodied, short-legged—and wretched. Mary Elizabeth Thurston, a contemporary commentator, illustrated her book *The Lost History of the Canine Race: Our 15,000-Year Love Affair With Dogs* with photos of the turnspit wheel at the Abergavenny Museum in Wales and of the museum's stuffed turnspit, "Whiskey,"

which looks like a cross between a dachshund and a rodent. Thurston is grateful to the inventors of clock jacks, believing that they allowed turnspit dogs to retire and mercifully grow extinct. But the histories of dog-powered and clock-work-powered jacks overlap considerably. Peter Brears, the British food historian who is a consultant to the National Trust, writes that clock jacks were already in use by 1587, “when the ‘jacke which turneth the broche’ is referred to in the will of William Hyde of Urmston in Lancashire.”⁴ One wonders why the term clock *jack* evolved, when the mechanism, too, might easily have been called a turnspit: the 1913 edition of Webster’s says that the word “jack” meant a “mechanical contrivance” that took the place of an “attendant who was commonly called Jack”—the presumed equivalent of our own less than endearing “Bud” or “Mack.”⁵

These earliest clock jacks were the weight-driven type. Their movements resemble the movements of the tall-case clocks that my husband temporarily removes from their cases and repairs for a living.⁶ Clock jacks were traditionally attached high up on one side of the fireplace frame. They were made of iron by clever blacksmiths (as were early clocks). They were not found in small households but in taverns and in the kitchens of country estates,⁷ where large quantities of food were prepared and fireplaces were tall enough to accommodate the long descent of the clock jack’s weights.

The less-than-landed gentry, meanwhile, continued to roast their meat in more primitive ways. Usually, they drove a nail into their fireplace frame and hung a roast by a string. Given a good twist, the string would rotate the roast for a few minutes in one direction, stop, then automatically rotate in reverse until all the energy was spent. (A child who twists himself or herself in a swing initiates a similar momentum.)

Hanging meat by a hook in the chimney was an alternative to the string method. It required no twisting, but to remove the meat at the end of the cooking time must have been a death-defying feat.

The chimney-hook method partly inspired another invention, the smoke jack, which rivaled the clockwork kind. Leonardo da Vinci (1452–1519) is often mentioned when the subject of smoke jacks comes up. Around 1500, he drew a sketch in one of his notebooks of a device meant to hang inside the chimney; it consisted of an arrangement of fan-like blades that turned by means of hot gases rising from the fire below it. A spit connected to that power source would turn a roast continually.

The Leonardo smoke jack was theoretical.⁸ Real ones are mentioned in the diaries of Samuel Pepys⁹ but they existed in Britain even earlier than Pepys’s time—and they

persisted. Brears lauds the smoke jack at Lowther Castle, built near Penrith between 1806 and 1811, as part of what was “probably the finest roasting range ever to have been made in this country.”¹⁰ It could power eight horizontal and four vertical spits at once, and a line drawing in Brears’s book begs a comparison between it and machines in early factories: it dwarfs the man in the apron who operates it.¹¹

However, smoke jacks, as compared to clock jacks, had at least one serious shortcoming: the fires under them had to be fed continually, requiring large amounts of fuel, or the smoke jack’s blades wouldn’t turn properly—and the roast would burn. Steam jacks, another clock jack rival, had a similar drawback. “In practice it may have proved to be a rather impractical machine,” says a Smithsonian Institution appraisal of one in their collection, “inasmuch as uniform cooking requires constant rotation. Therefore interruptions for refilling the ‘boiler’ with water and the pause while it generates more steam would doubtless frustrate the housewife and scorch the supper in preparation.”¹²

The Smithsonian’s steam jack was sold in New York City by Browne and Pearsall in the mid-1790s. (It’s uncertain if the firm also manufactured it.) That fact notwithstanding, jacks of any kind in early America were not a common sight. “The universal use of spit-engines in eighteenth-century England was not copied in Colonial America,” Feild writes. “One new arrival wrote home complaining that her roasts were very poor for they had no spit-engine.”¹³

Benjamin Franklin didn’t improve the situation with what appears to have been an only half-serious idea for an electric roasting jack (foreshadower of the electric rotisserie, a fad of the 1950s that many of us will recall). In a letter to an English friend he wrote “somewhat humorously”¹⁴ about his plans for an all-electric picnic on the banks of the Schuylkill River: “A turkey is to be killed for our dinner by the electrical shock, and roasted by the electrical jack, before a fire kindled by the electrified bottle: when the healths of all the famous electricians in England, Holland, France, and Germany are to be drank in electrified bumpers, under the discharge of guns from the electrical battery.”¹⁵ (Franklin actually did kill a turkey by electrocution, on Christmas Day 1750, and shocked himself in the process.)

Mary Beth Norton, the noted historian of early American life, reminds us that lacking mechanical means to turn roasts was the least of the colonists’ hardships: “A majority of women in eighteenth-century America resided in poor or middling farm households.” Women in the log cabins of the Midwest “had to cope with a far more rough-and-ready existence than did their counterparts to the east and south.” One woman on the Ohio frontier who lacked a churn “was

reduced to making butter by stirring cream with her hand in an ordinary pail”¹⁶—this, while various English lords and ladies, the Americans’ colonizers, were up to their chins in spitted swans and peacocks.

Still, some high-style estates and busy taverns of the American colonial era did have jacks. Mount Vernon, for example, had both clock jacks and smoke jacks.¹⁷ And the Golden Ball Tavern in Weston, Massachusetts, owned by a Tory merchant, Isaac Jones (1728–1813), had a clock jack and did a good business with it on the Boston Post Road, especially with all the traffic that passed by the tavern during the years of the Revolutionary War.

The Golden Ball’s clock jack was sold to the Shelburne Museum in Shelburne, Vermont, in the 1940s, where it remains.¹⁸ Another eighteenth-century inn, Longfellow’s Wayside Inn in Sudbury, Massachusetts (originally Howe’s Tavern when it was established in 1716), still owns a clock jack. It is bolted to a fireplace frame in one of its dining rooms, where it’s been for decades, unused. No one knows if it’s original to the inn or not. There are, as well, reproductions in working order at places like Colonial Williamsburg in Williamsburg, Virginia. However, to see a real one in operation in an authentic setting, you must go to another place in Massachusetts: the Salem Cross Inn in West Brookfield, near Old Sturbridge Village. The owners of the property—the brothers Henry and Bob Salem and their families—say theirs is the only restaurant in the country where an antique clock jack is regularly used to roast meat.

I visited the Salems’ place last January to see this clock jack in the flesh—or, rather, while it was cooking flesh. Henry Salem, a congenial octogenarian, and his son, John, escorted me to the lower level of the inn, where a crowd of over a hundred was drinking mulled wine and cider in anticipation of spit-roasted prime rib, served as part of the inn’s “Fireplace Feast.”

The clock jack was busy working—slowly turning two horizontal wrought-iron spits, each attached to the clockwork above it by a leather belt. As I watched it, I understood for a moment why gear-heads feel the way they do about machines. The spits were formidable; they looked like weaponry—veritable spears laden with six pieces of beef, a total of 120 pounds. The world conspires against a would-be vegetarian; I began to salivate at the sight, and at the sound—the sizzle—and the smell.

Propped against the back wall of the fireplace were four upright logs that blazed with fiery red. Even six feet back, the heat flushed my face. The size of the fireplace frame was mammoth—it looked like a threshold to a radiant room that only devils could enter. “We never have to clean the

chimney,” said Henry Salem. “It’s self-cleaning because the heat is so intense.” Still, I wanted to get closer. As I did, however, Henry and John called out warnings: if I didn’t remove the reading glasses on top of my head, the plastic lenses would melt into my hair. I decided to keep my distance after all.

A slim, white-haired man named Jim Contacos was monitoring the clock jack. Contacos has worked for the inn “since the beginning”—the 1960s—so he was around when the inn first started cooking with the jack in the early 1970s, after another Salem brother-owner, Richard (1924–1996), picked it up “somewhere in Maine,” said Henry.

“Uncle Dick, along with a retired machinist, figured out how to operate it,” said John. “It took about three years. It was not self-evident. And it had not come with all its parts. One gear had two broken teeth, and they’d had to get those fixed.”

“It’s now known,” said Henry, “exactly how many pounds of meat it will cook, how many you can feed with it, and so on.”

“There’s been a lot of interest recently,” said John, “in other restaurants coming here to see how we do this. And they expect us to tell them. Excuse me!”

Henry and John would tell me at least this much for publication:

It’s quite a trick to put the meat on properly. The pieces need to be balanced, or the spits will go around but the meat won’t. That job is handled by the cooks in the kitchen.

It takes three-and-a-half to four hours to cook the meat once the fire gets up to temperature. The jack’s weights are rewound every twenty or thirty minutes.

The inn has cooked other meat besides beef with the jack. On Thanksgiving, they usually cook two 50-pound turkeys. (“A local guy grows them for us,” said Henry. “He keeps them going until they’re about to explode.”) Once, they roasted a pig. (Henry: “It weighed about 140 pounds when we put it on, and it kept shrinking and shrinking, because of the fat. Besides that, it took 16 hours. I was here for maybe 12 hours. It was a big disappointment.”) They have also cooked fish in a basket spit, which looks something like a transparent watermelon, with stripes made of iron. That was good but not something easily cooked commercially.

When the Salems first got their jack, John went to the Essex Institute (now part of the Peabody Essex Museum) in Salem, Massachusetts, to do research on the subject. An architect with a strong interest in history (he has done quite a bit of architectural work on the inn buildings), John is fairly certain that the inn’s clock jack is an import, English-made. “I don’t think this was made in America. The colonists could be as artful as anyone else. But there wasn’t much



Thomas Rowlandson (1756-1827), Kitchen at Newcastle Emlyn.
COURTESY OF THE BRITISH MUSEUM

of a demand for clock jacks on this side of the Atlantic. We didn't have any castles. If you could afford one, you'd probably get it from London."

England was the source of a smoke jack that belongs to a friend of the Salems. But Henry didn't envy him the purchase. "They're a real maintenance problem," he said. A clock jack is far easier to clean and keep in good order than a smoke jack, which gets greasier and is much more difficult to access than its clockwork counterpart. The clock jack at the Salem Cross Inn is cleaned (as a clock is cleaned—taken apart, degreased, and reassembled) twice a year.

After the feast, which was served in a dining room upstairs (the meat was delectable, truly tender; I have tasted nothing else like it), John gave me copied pages from several books. Some of them were from J. Seymour Lindsay's *Iron and Brass Implements of the English and American House*,¹⁹ including a line drawing of an eighteenth-century clock jack from the author's collection that looks nearly identical to the one at the inn, right down to the decorative front plate.

Other pages were from an eighteenth-century cookbook, *The British Housewife: Or, The Cook's, Housekeeper's, and Gardiner's Companion, Calculated for the Service both of London and the Country*, written by Mrs. Martha Bradley ("late of Bath"). The frontispiece shows a woman winding up the weights of a clock jack that is turning what appears to be a spit-roasted lamb.

Mrs. Bradley knew about spit-roasting everything, from venison to quail, I discovered when I read the full text of *The British Housewife* at Radcliffe College's Schlesinger Library. ("Pick and draw the Quails, and have a very clear Fire; put round each a Slice of Bacon, and over that a Vine Leaf, then spit and lay them down; let them be done at a moderate distance from the Fire, for too near spoils them, and if they be kept too far off they never have their right Flavour."²⁰) She knew, too, about the ailments of cattle and about how to scrub spits with a mixture of water and sand. Although she must also have known about jacks, unfortunately she didn't write about them here.

On that same January day at the Salem Cross Inn, John Salem took me into another room in the inn's lower level to see a tin kitchen. It was meant to be used with a bottle jack, like the kind I own. It looked like a small (three-foot tall) tin barrel, halved and painted black. "This can't cook much—just a turkey or a goose," he said. "You're not going to cook for fifty or a hundred people with this."

That turkey or goose could be hung on a dangle spit and suspended from the tin kitchen's top, then rotated by the spring-driven bottle jack whose coiled power, unlike weight-driven power, required no drop. "This is probably



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late 1700s, early 1800s,” John said, lifting it by its top hook to demonstrate that the whole thing was portable, so it could be stored away from the hearth when not in use. “After tin kitchens, bit by bit, comes the cook stove. But it’s this kind of thing, capturing heat with metal, that becomes a twentieth-century oven.”

The inn had never cooked anything with its tin kitchen. “We used to keep it in a dining room upstairs, one of the very refined front rooms. But it just didn’t belong in there. It’s definitely English-kitchen style.” In fact, it was marked *Argyle Street, Glasgow*. “So it’s just, right now”—John smiled—“an objet d’art.”

That the bottle jack was meant for private households rather than inns or other institutions is noteworthy. By the mid-nineteenth century, Victorian kitchens would be positively festooned with mass-marketed kitchen gadgets, but these jacks were, for many, their first purchase—a veritable baptism by gear oil. Think of the weight-driven jack as analogous to a tower clock—communal; the bottle jack was the equivalent of a household clock—as personal as a personal computer.

An eighteenth-century clockwork roasting jack. Frontispiece from Martha Bradley, *The British Housewife* (London, 1756).

COURTESY OF THE SALEM CROSS INN

It was with the bottle jack that American may have made their first contribution to technology—and technological progress in general.

Until 1783, when the Revolutionary War ended, the colonists were impeded as would-be manufacturers, not only by their lack of materials but also by their lack of skill. For example, anyone who called himself a clockmaker in the colonial era was probably primarily an importer who repaired clocks on the side. The age of Yankee ingenuity had not yet begun. However, whenever I mention the subject of clock jacks to any of Bob’s clock-collector friends, the name of America’s best known and most revered clockmaker, Simon Willard (1753–1848), is almost immediately uttered. Willard’s clocks sell today for hundreds of thousands of dollars.²¹ Even in the early nineteenth century, they weren’t cheap. Willard’s clientele were the people whose portraits were painted by the likes of John Singleton Copley.

The keeper of Harvard's clocks for decades, Willard made timepieces for the United States Capitol and for Thomas Jefferson. In 1802, he patented the so-called "Willard Improved Timepiece," known to us today as the American "banjo" clock. With its round face and modified-pyramid body that was about the height of a toddler, it was smaller, more compact, and more portable than a tall-case clock.²²

But in the days directly after the war, as a young man getting himself established, Willard first turned to clock jack making. Does this, then, mean that Bob might well aspire to own a Willard clock jack someday, seeing that a Willard clock is, financially, out of the question? Not exactly. The trouble is, there is scant information about Willard's jacks. No one, not even Willard expert Robert C. Cheney, is sure what they looked like. The Willard House and Clock Museum in Grafton, Massachusetts, owns a bottle jack with a "Simon Willard, Grafton" nameplate affixed to it, but the curator, John Stephens, won't swear that it's authentic. It might well have been an import to which Willard (or some other, unscrupulous, person) affixed the label.²³

Stephens showed me an original document hanging on the wall in the keeping room, where Willard was born. It gives directions for using Willard's "much esteemed patent weight-driven clock jack."²⁴ Stephens also showed me a copy of the patent issued by Massachusetts in 1784 (there was as yet no federal patent office). Another interesting document at the museum is an advertisement from a Massachusetts newspaper that describes what sounds like a Willard spring-driven bottle jack. The mystery only deepens.

Willard's jacks were apparently being sold in Boston by none other than "Colonel Paul Revere,"²⁵ according to correspondence at the Massachusetts Historical Society. I went there to read these tantalizing letters written by Willard to Revere, ca. 1784–1785. (The Revere end of the correspondence didn't survive.) The clockmaker seems to have struggled financially *and* mechanically. He wrote Revere with requests for money advances—and with apologies, because some of his clock jacks didn't work right initially. ("I understand some of the first that I made has got out of order intirely [*sic*] owing to their not being strung with proper strings. I will go around to them all & put in good order. I am your Humble Servt."²⁶)

Willard also wrote to Revere about his efforts to build a striking clock jack, as well as with another request for funds. ("Roxbury March 10, 1784 ...Should you oblige me with the money I will not disappoint you [?], being very busy in fixing a Jack to strike."²⁷) But whether it resembled my striking French clock jack, we'll probably never know. Willard went on to clock-making fame (if not fortune—he was a

notoriously bad businessman) and left the clock jacks behind. What is more, cook stoves began to be produced,²⁸ sending clock jacks on their way to extinction.

The transition to cook stoves was slow, sometimes resisted by cooks who were skilled in hearth cooking. Why should they forsake their proven methods for a contraption that was, at least in its initial stages, unreliable and difficult to operate? Besides, cook-stove-cooked meat didn't taste as good as roasted meat did. Catherine E. Beecher and Harriet Beecher Stowe noticed the difference: "The introduction of cooking-stoves offers to careless domestics facilities for gradually drying-up meats, and despoiling them of all flavor and nutrient—facilities which appear to be very generally accepted," they wrote. "They have almost banished the genuine, old-fashioned roast-meat from our tables, and left in its stead dried meats with their most precious and nutritive juices evaporated."²⁹ The Beecher sisters recommended a giant step backwards, use of a variant of the tin kitchen. "Another useful appendage is a common tin oven, in which roasting can be done in front of the stove, the oven-doors being removed for the purpose. The roast will be done as perfectly as by an open fire,"³⁰ they promised. Ironically (and perhaps horrifyingly to the ghost of an old turnspit), the illustration shows that the tin oven had a hand crank!

By the time *Knight's American Mechanical Dictionary* was published in the 1870s, the definition of "roasting-jack" was "an *old-fashioned* device" (emphasis mine), even though *Knight's*, in describing it, harked back to the superior taste of a spit-roasted supper: "...[All] the jacks have, unfortunately for the meat and the consumers, been superceded by the oven, which bakes but roasts not."³¹

I know someone who has spit-roasted a shoulder of ham, using a bottle jack. He's not a culinary friend of mine, but a clock-collector friend of Bob's. Les Tyralla, while living in England years ago, bought a bottle jack at the famous flea market in Bermondsey for fifteen or sixteen pounds. When he returned home to the United States, he got it working. "Yes, I actually took my roasting jack apart," Les told Bob and me. "I was just curious to see how it works. It was held together by simple set screws, like yours, so it was easy to open."

Les encouraged Bob to open up our model, which is pretty much identical to Les's, whose brand name is "Slater & Co." He hasn't yet. There's too much paying business in his workshop to be done. So the jacks remain inert, as much objets d'art as John Salem's tin kitchen, still waiting for a collaboration of Bob's talents at the clock bench and mine in the kitchen. ©

NOTES

1. The principle of clockwork applies to clock jacks because both take a quantity of stored energy, either in a raised weight (as, for example, in most tall-case ["grandfather"] clocks) or a coiled spring (as in most old alarm clocks), and cause it to be released slowly over a period of time. However, the "heart" of a clock is its escapement, which provides accuracy through regular, regulated ticking; a clock jack does not have an escapement but merely a "transmission" to convert the power of the hanging weight or coiled spring into a slow rotation.
2. Eventually, as cooking in France grew to be a complicated "cuisine," it was the English "beefeaters" who perfected the art of roasting. But the French did have their share of clock jacks. There is a monumental one at the sixteenth-century castle Chenonceau on the River Cher in the Loire River Valley.
3. Rachael Feild, *Irons in the Fire: A History of Cooking Equipment* (Crowood House, Ramsbury, Marlborough, Wiltshire, England: The Crowood Press, 1984), 45.
4. *Lancashire and Cheshire Wills* (Chetham Society, 1860), 190. Cited in *The Country House Kitchen 1650–1900: Skills and Equipment for Food Provisioning*, Pamela A. Sambrook and Peter Brears, eds., (Thrupp Stroud, Gloucestershire: Sutton Publishing, in association with the National Trust, 1996), 95.
5. The horologists' explanation is more elaborate. They say that "jack" is short for *jaccomachiardus*, meaning "man in armour," or *jacquemart*, a compound word made from *jacques* plus *marteau* (i.e., hammer). These were names for the hammer-wielding automatons that used to strike the hours in the earliest public clocks. The figures were modeled after the men who, dressed in protective armor, used to walk the streets counting off the hours with hammer and bell before their jobs were mechanized by the introduction of clocks. See *International Dictionary of Clocks*, Alan Smith, ed. (New York: Exeter Books, 1984), 63–64.
6. Similarly, early weight-driven clocks, ca. 1550–1625, weren't enclosed in cases, either, but were meant to be hung on the wall with movement, weights, and pendulum exposed.
7. Until the mid-sixteenth century, small households in Europe didn't have clocks, either. They relied on public clocks, which began to be built by the late thirteenth century and had become fairly common by the fifteenth century, although they did not have dials and hands, only bells that tolled the hours. It wasn't until the seventeenth century that the domestic-clock making business began to flourish, particularly in England, which, by 1680, was the acknowledged horological center of the world, a preeminence it was to enjoy for about a century.
8. The reason Leonardo never actually made a smoke jack (or "chimney jack," as he called them), at least if vegetarians are to be believed, is because he didn't eat meat, roasted or otherwise, and had no use for one, but the truth about Leonardo's attitudes toward meat-eating are not verified. For the best compendium of primary sources on the subject, see David Hurwitz, "Leonardo da Vinci's Ethical Vegetarianism," www.ivu.org/history/davinci/hurwitz.html (on the Web site of the International Vegetarian Union).
It seems likely that the mind of Leonardo could also have theorized about clock jacks. His notebooks contain many descriptions of clocks and clockwork. He never made a clock, however, and he never sketched or made notes toward the building of a clock jack, either.
9. "So to White Hall, where I met Mr. Spong, and went home with him and played, and sang, and eat with him and his mother. After supper we looked over many books, and instruments of his, especially his wooden jack in his chimney, which goes with the smoke, which indeed is very pretty;" 23 October 1660.
"...The last night I should have mentioned how my wife and I were troubled all night with the sound of drums in our ears, which in the morning we found to be Mr. Davys's jack, but not knowing the cause of its going all night, I understand to-day that they have had a great feast..." 12 November 1660.
10. Sambrook and Brears, *The Country House Kitchen*, 98.
11. *Ibid.*
12. See www.historywired.si.edu/detail.cfm?ID=188.
13. Feild, *Irons in the Fire*, 60.
14. Ronald W. Clarke, *Benjamin Franklin: A Biography* (New York: Random House, 1983), 75.
15. Letter of Benjamin Franklin to Peter Collinson, 29 April 1749. Cited in *Benjamin Franklin*, Clarke, 77–78.
16. Mary Beth Norton, *Liberty's Daughters: The Revolutionary Experience in American Women, 1750–1800* (Boston-Toronto: Little, Brown, 1980), 14.
17. "According to the 1799/1800 inventory, done shortly after George Washington's death, there was '1 Jack and chain,' valued at \$10.00 in the first floor of the kitchen, and another jack, appraised at \$5.00, in storage on the second floor. There is a smoke jack in the chimney of the kitchen at the current time. For many years, we had a clock jack on the wall to the left of the spit rack. It was removed several years ago, when the traffic pattern was changed in the kitchen, which made the clock jack vulnerable to touching by the public." E-mail to the author from Mount Vernon research specialist Mary Thompson, 3 February 2003.
18. *The Golden Ball Grapevine* 11, no. 1 (Autumn 1980): 3 (published by the Golden Ball Tavern Trust, Weston, MA).
19. First published in 1924 in London and Boston by the Medici Society; reprinted by Carl Jacobs, McKenzie Road, Bass River, MA, 1964.
20. Martha Bradley, *The British Housewife* (London: S. Crowder & H. Woodgate, 1770?), 226.
21. There were other clock-making Willards, three generations of them, including Simon's brothers and sons, but Simon's timepieces are the most sought after, and the most expensive. While the whole Willard family established Boston as the center of American clock-making, it was Simon who became known as the true horological genius.
22. One of the ingenious aspects of the Willard Improved Timepiece is its design for the drop of the weights: it requires only inches rather than feet for a week's worth of power. Why didn't he just use a spring? Having been apprenticed to an English clockmaker, John Morris, who had emigrated here, he was doubtless aware of spring-driven technology, and he also must have taken spring-driven imports into his shop for repair, but he didn't have ready access to springs here. It was an expensive technology at the time. Only specialized spring makers had the right kind of steel—and the practiced skill to make springs of sufficient strength not to break under the pressure.
23. For evidence that Willard may have imported some of his clock movements, see Robert C. Cheney, "Roxbury Eight-Day Movements and the English Connection 1785–1895," *Antiques Magazine*, April 2000: 606–614.
24. Original artifact at the Willard House and Clock Museum, Grafton, MA.
25. "This most useful machine was invented by Simon Willard, Clock Maker, Roxbury Street, near Boston, New England. It was recommended by the Academy of Arts; and the General Assembly, in order to encourage genius, have granted him a Patent, for the sole making and vending it for five years. It is valuable above the other roast-meat Jacks, as it is portable, and may be useful in any room. It requires less fire, and will roast meat in a shorter time.
"They are sold by him, at the above place, and by Paul Revere, directly opposite Liberty Pole, Boston." Advertisement in *Thomas's Massachusetts Spy, or Worcester Gazette*, 11 March 1784.
26. The Revere family papers, Massachusetts Historical Society, Boston, Massachusetts.
27. *Ibid.*
28. Thomas Robinson took out a patent for his kitchen range on October 21, 1780.
29. Catherine E. Beecher and Harriet Beecher Stowe, *American Woman's Home* (New York: J.B. Ford & Co., 1869), 181.
30. *Ibid.*, 73.
31. *Knight's American Mechanical Dictionary* (New York: J.B. Ford, 1874).