“I have executed and perfected such an apparatus or Machinery as will make Coin not only superior in Beauty & Workmanship to that of any Nation in Europe but also so manufactured...that Counterfeiting will be prevented.”

– Matthew Boulton, to the Privy Council Committee on Coin, December 1789 (MBP 249/235).

Hello Steam Press; Goodbye Big Problem?

How were upstart commercial coin makers and issuers able to make better small change than the Royal Mint had been making after centuries of practice? And what exactly did the private sector contribute toward the eventual improvement of Great Britain’s official coins?

According to some authorities, the private sectors’ main, if not its sole, contribution consisted of Matthew Boulton’s steam-powered coining press: because that invention was capable of producing counterfeit-proof tokens, the argument goes, the British government had only to embrace it in order to officially renounce bimetallism and establish the world’s first modern coinage system.

This thesis has recently been made prominent in works by economists Angela Redish (1990; 2000, chap. 5) and Thomas Sargent and François Velde (2002, pp. 13-14, 61-3, 261, and 331-2). In The Big Problem of Small Change Sargent and Velde claim that Boulton’s invention made reliance upon a fiduciary or token-coin based small change system possible for the first time in history: “The government,” they observe, “was slow to use this [Boulton’s] technology, but private firms were not. They soon issued substantial numbers of high-quality convertible token coins” (ibid., p. 292). To modernize its own coinage “[t]he government had only to nationalize and administer this [private-market] system, which it began to do in 1816” (ibid., p. 271). Other nations followed Great Britain’s lead.1

1 Although Redish, unlike Sargent and Velde, never says explicitly that steam technology was widely employed in making commercial tokens, she does say that commercial coin issuers suffered “minimally” from counterfeiting (2000, p. 153). Taken in conjunction with her claim (ibid., p. 10) that it was the invention of the steam coining press that made possible the production of coins “that
Steam Presses and the Commercial Coinage.

The argument seems plausible: Great Britain’s small change problem was after all solved, more or less adequately, once the refurbished Royal Mint resumed production of both silver and copper coin. Yet the argument is mistaken. In truth, the solution to the small change problem had very little to do with steam.

The point can be proven, first, by considering of the timing of Boulton’s initial application of steam power to coinage; second, by consulting the Matthew Boulton and Boulton & Watt papers; third, by accounting for each of Birmingham’s pre-1798 steam engines; and, finally, by taking a more general look at sources of motive power in the Birmingham toy trades, and in steel button making especially.

Everyone agrees that Boulton was the first person to strike coins using steam. If one rules out the (as yet un-suggested) possibility of commercial coins having been struck using water or animal power, any commercial coins made before Boulton’s pioneering effort must have been struck manually. The dating of Boulton’s first steam-struck coins is therefore of crucial importance. Although quite a few works give that date as 1786, their authors have confused Boulton’s first employment of steam-powered presses with his first venture into coinage: as we’ve seen, Boulton’s 1786 venture involved the striking of coins for John Company’s Bencoolen settlement, which was done not at Soho, but in a London warehouse equipped with several manual screw presses. Boulton’s first *steam-struck* coins were the tokens he made for Roe & Company in the summer of 1789; and Boulton didn’t come up with a practicable means for steam-striking coins in restraining collars until the autumn of 1790.² Thus Dickinson (1936, p. 137) is quite right in saying that, when Boulton were not counterfeitable or at least were very costly to counterfeit,” Redish’s statement seems to imply that most commercial tokens were steam struck.

In correspondence, however, Redish claims to have understood that counterfeit-proof coins could be struck manually, though at a relatively high cost. This stance begs the question: If private firms, which received no state subsidies, could afford to strike counterfeit-proof tokens using hand presses, why couldn’t the subsidized Royal Mint have done the same?

² The myth that Boulton’s East India Co. coins were steam-struck may originate with Smiles (1866, p. 389), who appears to have been misled by an ambiguous passage in Watt’s memoirs. Nor is 1786 the earliest date that has been given for the appearance of Boulton and Watt’s steam press. Mitchiner (1998, p. 1962) actually gives the date as 1775, evidently confusing B&W’s first steam engine sale with their earliest use of a steam-powered coinage press!

Although at one point Sargent and Velde (2002, p. 45) state that the steam coining press “became available after 1787,” elsewhere (ibid. p. 61) they suggest that it was first employed in
told the Coinage Committee of the Privy Council in December, 1787 that he was prepared to coin counterfeit-proof halfpennies at no more than half of the Royal Mint’s costs, he still didn’t have a working steam press!

So all commercial coins struck before mid-1789, and all those struck in collar before the fall of 1790, were struck using hand presses. These make up more than half of all 18th-century commercial coins, for they include all of the Parys Mine Company’s Druid tokens produced at its own mints in Holywell and on Great Charles Street and the several tons worth of 1787-8 Willies struck at the same facilities. Of significance equal to their numbers is the fact that these early tokens were, by all accounts, among the highest-quality tokens of all.

The correct dating of Boulton’s first steam-struck coins alone refutes the claim that steam power was essential to the success of Britain’s commercial coinage. The refutation becomes all the more thorough, of course, if it can be shown that other commercial mints refrained from employing steam-powered presses even after Soho pioneered their use.

That this was indeed the case is suggested, first of all, by the Matthew Boulton and Boulton & Watt papers, which, according to both my own research and that of Soho Mint historian Richard Doty (2000, p. 22?), never once refer to the use of steam presses at rival mints. Although the lack of any reference to rivals’ steam presses doesn’t prove beyond all doubt that such presses were used only at Soho, no firm could have purchased Boulton &

1786. Redish (2000, p. 154) gives the 1786 date, referring specifically to Boulton’s East India Co. coins.

Doty reports two items that might be construed as referring to other mints’ employment of steam presses. The first is a 1788 reference by Boulton to the five-foot-diameter “Flys” on the presses John Gregory Hancock had installed at the Parys Mine Company’s Great Charles Street Mint, which according to Hancock could be worked “so as to strike ½ pence with ¼ of 1 turn.” The other occurs in a June 1789 letter from Watt informing Boulton that Hancock “braggs that he can coin in your way, at half the price you can” and advising him to “get Mr. P. [William Pitt] to make an act making it felony to use These new presses & methods.” But although Doty claims that “the concept of a flywheel tends to go along with the idea of automatic machinery,” a look at any contemporary dictionary of mechanics makes clear that the “Flys” referred to in the first item are merely the hand-turned circular wheels found on many conventional manual screw presses. That the dies on Hancock’s press could be closed with a ¼ rotation only of the fly meant that it had what are known as “fast” threads. Doty believes that Hancock’s presses also had automatic blank feeding and ejection devices, and that it was in this respect only that his equipment resembled Boulton’s.

Watt’s desire to have Hancock’s presses outlawed suggests, on the other hand, his doubts concerning whether Soho’s steam-driven coining equipment was in fact technically and economically superior to available alternatives.
Watt’s own presses without the fact being recorded somewhere in the company’s very complete accounts; and it seems just as unlikely that any firm could have replicated Boulton’s innovation without Boulton or Watt referring to the fact even once in their voluminous correspondence.

Next let’s look at what Birmingham’s steam engines were up to during the first commercial coinage episode.¹ In 1840 the Royal Statistical Society published a survey of all steam engines ever erected in Birmingham up to that date. Using information from it and from a number of other sources, one can locate and identify the owners and principal uses of all of Birmingham’s pre-1798 rotary steam engines. Table 9.1 lists the engines—there were only eight of them all told—along with their locations and some other information.

Two main conclusions can be drawn from the information summarized in the table: first, there is no positive evidence suggesting that steam from any of them was ever used to power presses or stamping equipment of any kind, their known uses having been metal rolling or boring, flour grinding, or grinding and sharpening tools. Second, none of the engines (which were all located along the town’s circular canal network, so as to minimize costs of coal delivery) was located within a shaft’s-length of any commercial mint. Indeed, as our “ramble” revealed, and as can be seen from Figure 9.1, only two were located in Birmingham’s toy district. These were the Water Street engines, originally owned by Joseph Pickard and Charles Twigg, whose well-documented histories give no indication of their ever having taken part in the striking of tokens or other numismatic products.

¹ As Table 9.1 indicates, one small-scale 18th-century token maker was located in Sheffield, and several were located in London. Although I haven’t attempted any comprehensive review of London’s pre-1798 steam engines, by consulting the Boulton & Watt archives I have been able to establish that none of London’s pre-1798 Boulton & Watt “rotatives” was employed in and sort of metal work.
Table 9.1: Rotary-Motion Steam Engines in Birmingham through 1797.

<table>
<thead>
<tr>
<th>Erection Date</th>
<th>Horse-power</th>
<th>Firm</th>
<th>Principal Use</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1780</td>
<td>14</td>
<td>Charles Twigg and Co.</td>
<td>Metal Rolling</td>
<td>Water Street</td>
</tr>
<tr>
<td>1783</td>
<td>25</td>
<td>Pickard’s Corn Mill</td>
<td>Flour Mill</td>
<td>Water Street-SnowHill</td>
</tr>
<tr>
<td>1787</td>
<td>18</td>
<td>Warren’s (Old) Cotton Mill</td>
<td>Cotton Spinning</td>
<td>Fazeley Street</td>
</tr>
<tr>
<td>1788</td>
<td>18</td>
<td>Phipson &amp; Sons</td>
<td>Metal Rolling</td>
<td>Fazeley Street</td>
</tr>
<tr>
<td>1791</td>
<td>12*</td>
<td>Eagle Foundry†</td>
<td>Boring Cast Iron</td>
<td>Broad Street</td>
</tr>
<tr>
<td>1792</td>
<td>16</td>
<td>New Steam Mill Co.</td>
<td>Metal Rolling</td>
<td>Fazeley Street</td>
</tr>
<tr>
<td>1796</td>
<td>24</td>
<td>Deritend Mill</td>
<td>Drawing Wire</td>
<td>Deritend</td>
</tr>
<tr>
<td>1797</td>
<td>16*</td>
<td>Old Union Mill*</td>
<td>Flour Mill</td>
<td>Holt Street</td>
</tr>
</tbody>
</table>


Although there’s no reason to think that any of Birmingham’s pre-1798 steam engines was used to power screw presses, that doesn’t mean that those engines played no part at all in commercial coin making. Both the Twigg engine and that belonging to Phipson & Sons were employed in making sheet copper, some of which may have been purchased by one or more commercial mints. Steam power may thus have played a role in commercial coining outside of Soho. But any such role was a far cry from the crucial one recent works have assigned it.⁵

By 1812 there were dozens of steam engines in Birmingham. That makes locating each of them, and determining its uses, a Herculean task. But other evidence suggests that, whatever else these engines may have been up to, they almost certainly played no role in striking 19th-century tokens.

⁵ That this indirect contribution of steam power was of limited importance is suggested by an article in the October 1886 Birmingham Weekly Mercury in which it is observed that, even at that late date, “many of the Birmingham steam mills are not supposed to be able to compete in point of excellence and precision of workmanship with some of [the] distant country mills” run by waterpower (cited in Pelham 1963, p. 90). In any event, if steam mills were capable of turning out better quality sheet copper, at a low price, there was nothing to prevent counterfeiters as well as legitimate mints from acquiring copper from them.

As noted elsewhere, Soho’s own rolling mill was water powered throughout the 18th century and remained so until the factory was shut down.
One small but nevertheless significant bit of evidence consists of a pair of dies employed by Younge and Deakin in striking Scarborough’s 1811-12 shilling tokens. The dies, which have been preserved by Scarborough’s Rotunda Museum, are perfectly round, with a slight cone-like tapering up to their faces. According to Richard Doty, such dies belong to “straight manually-operated screw press” rather than one powered by steam (private communication, January 6, 2005). If Younge and Deakin, one of the most important token producers of the period, struck its tokens by hand, other, smaller-scale token makers almost certainly did the same.

The other evidence consists of information concerning the general use of steam power by Birmingham manufacturers, and especially its use in making metal buttons and numismatic products that resembled coins. According to Eric Hopkins (1989, p. 34), in Birmingham manufacturing generally steam power “was of relatively small importance till the 1830s at the earliest.” Steam power was used to make semi-raw materials, including sheet metal, rather than final products such as buttons (Allen 1966, pp. 104-108). According to the 1833 Factory Inquiry Ledsam & Sons, Birmingham’s largest button factory (with 300 employees), used “a small portion only” of steam power, which it let from an adjoining factory’s engine. The city’s second largest button firm, Hammond, Turner and Son (which made tokens in 1812 and 1813) relied solely on human-powered equipment.

Other sources from the same era (e.g. West 1830, pp. 177-81 and Smith 1836 pt. II, pp. 9-16) supply the detailed descriptions of Edward Thomason’s factory that informed our visit there. Some years earlier Charles Pye (1825, pp. 88-9) had described Thomason’s works as “the longest established and the most extensive in town”; and Thomason was certainly Birmingham’s largest producer of numismatic products, including commercial coins, during the first decades of the 19th century. The descriptions don’t mention any steam engine or steam-powered machines. Yet they do mention Thomason’s manually operated drop hammers and screw presses. If Great Britain’s largest producer of 19th-century commercial coins was still relying on human powered equipment in 1836, it’s hardly likely that any of the city’s less important commercial mints employed steam-powered presses prior to that time.

The general situation in Birmingham, with screw presses and other machinery
being manually operated except in the heaviest trades, remained essentially unchanged until as late as the mid 19th-century. In February 1851, for instance, brass “coffin plates” were still being made using manual labor, although the stamping of such plates required great strength. A forty-ton press at one of the larger coffin hardware factories was powered by two strong men, each of whom earned 25 to 30 shillings a week (Morning Chronicle, Feb. 10, 1851). Even drop hammers, which usually took three strong men to operate and were more easily adapted to steam than a screw press, were human powered “with one or two exceptions” as late as 1866 (Timmins 1866, p. 307; also Allen 1966, pp. 106-7).

To conclude: a mass of evidence contradicts the claim that steam presses were widely employed in striking tradesman’s tokens, supporting instead one given in the most exhaustive 19th-century work on the commercial tokens: “the merit of applying steam power to the production of [commercial] coins,” Richard Samuel (1994 [3-22-1882]) observed, “was exclusively Boulton’s.”

**Was Steam Efficient?**

If Birmingham’s commercial mints were able to make high quality, counterfeit-resistant coins without steam presses, such presses cannot have played any essential role in solving Great Britain’s “big problem of small change.” Might it have been the case, though, that other private mints failed to adopt Boulton’s technology despite its superior efficiency? Boulton’s coining apparatus was, after all, highly sophisticated for its day. Perhaps other mints wanted to employ it but couldn’t do so because they weren’t able to purchase or make the necessary machines.

It’s true that Soho had more than its share of outstanding mechanics. But it was far from having had a monopoly on inventive genius. And although it took a great deal of ingenuity, and trial and error, to figure out how to deliver power to as many as eight coin presses at once from a single rotating shaft, to drive one, perhaps even two, screw presses this way would have been a relatively simple matter. As for Boulton’s patent, which he secured in 1790, it was granted not for the general idea of hooking up a coining press to a steam engine, but for his peculiar wheel-and-escapement arrangement for delivering steam power to a battery of presses. Other mints were entirely free to experiment with steam power so long as they did not make use of this peculiar arrangement, which, in any event,
was meant to handle a coinage capacity far beyond what they required.

Granted, the capital costs involved weren’t trivial. Even a small (say, five-horsepower) Newcomen engine, modified for rotary motion, could cost a couple hundred pounds, which was hardly loose change for operations that were mainly small workshops. A Watt engine might cost twice as much. Coining presses specially adapted to steam-power also cost more than conventional presses. Assuming that they could not finance purchases of such expensive equipment out of their retained earnings, could Birmingham’s commercial mints have done so otherwise?

According to experts on Birmingham’s economy many could have done so, by taking advantage of informal bonds of kinship (if their owners were among Birmingham’s many non-conformists), by applying for credit at one of Birmingham’s several banks, or, most probably, by forming partnerships, as Boulton had done when he joined forces with Fothergill, and as Matthew Wasborough did when he hooked up with Pickard and Twigg (Everseley 1964, p. 90; Duggan 1985, pp. 45-60). Compared to the overall capitalization required to set up a button-making factory, the funds needed to pay for a small steam engine were, in fact, quite modest. Thus one button manufacturing partnership formed in 1822 involved a capital investment of £5000; and initial business investments of this magnitude had in fact been fairly common in Birmingham for decades prior to that time. Indeed, by the early 19th century money could be had at competitive rates in amounts that “seemed to belie the small workshop image of the city,” with investors and lenders in many instances offering “tens of thousands of pounds in a single transaction” (ibid. pp. 59-60). It is hardly likely, therefore, that Birmingham’s commercial mints refrained from employing steam-power owing to a shortage of funds.

Needless to say, Birmingham’s eight rotary-motion steam engine owners might have entered the coinage business themselves without having to invest in any additional steam power. That none chose to do so suggests that possession of a steam engine did not constitute an important technical advantage in coin production.6

6 Recall that Twigg, the original owner of the Water Street steam mill, was also a button maker who issued his own tokens and produced some numismatic products. Twigg did not make tokens for others, however; and both his buttons and his numismatic products were manufactured, not at his Water Street facility, but at a separate toy shop on Harper’s Hill, near St. Paul’s Square (Mitchiner 1998, p. 2005).
The most persuasive evidence against the hypothesis that steam-powered presses were more efficient than manually-operated ones consists of the simple fact that mints employing manual screw presses managed to survive, and even (it seems) to thrive, despite having to compete against Soho. Although Boulton may have hoped to gain a monopoly of the token trade after Thomas Williams’s withdrawal and John Westwood Sr.’s bankruptcy, the early ’90s witnessed the entry into token-making of both Peter Kempson and William Lutwyche, whose businesses would flourish until the end of the century and (in Kempson’s case) well beyond it. During the mid ’90s another dozen small-scale mints entered the scene, each grabbing a small share of the token market from the Soho Mint, which was never close to running at full capacity until it began coining cartwheels in 1797. Unlike Boulton the other commercial coiners entertained no hopes of securing even a temporary monopoly. On the contrary, they all faced a positive probability that unauthorized commercial tokens would be suppressed once the government reformed its own copper coinage, as happened in 1672 and as would happen again in 1817. It is hard to see why any of them should have been attracted to the business unless it offered reasonable profits.

Actually, one mint did stay in business despite failing to turn a profit. That mint was none other than the Soho Mint itself. “In truth,” the mint’s historian (Doty 1998, p. 50) informs us, the “Soho Mint was not a going concern and would not become one until its master secured his first regal coining contract in 1797.” Boulton’s net loss on his mint’s output prior to its first regal coinage amounted to just under £2,500 on an investment of £7,780. This substantial loss suggests that the Soho Mint was, given the state of coinage technology as of 1797, a marginal operation that would in the competitive long run have been forced out of business by its more efficient rivals. Boulton was willing to endure losses because he was banking on something other than a competitive long run. That Boulton looked forward all along to landing an exclusive regal contract explains why he embraced a technology that wasn’t capable of holding its own in what Sargent and Velde term a “laissez-faire” coinage regime.7

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7 It is also worth remembering in this connection Eric Roll’s conclusion that Soho (1930, p. 99) generally "expanded its productive capacity far beyond the limits justified by the fluctuating nature of the demand for its products."
A comparison of Soho’s charges for its 1797 regal penny and two-penny “cartwheels” with Lutwyche’s charges, as supplied by him to cataloguer Thomas Sharp (1834, p. ?) in 1793, provides qualified support for the above conclusion. Lutwyche charged his clients about £42.13.4, exclusive of the cost of copper, to manufacture one ton of halfpenny tokens. Soho, in contrast, charged the government £41.6.8 to manufacture and deliver one of the five-hundred tons of one- and two-penny coins it produced in fulfillment of its first regal coinage contract in 1797 (Doty 1998, p. 317). Although these figures give the lie to Boulton’s claim that his equipment would cut coining costs in half, they at least appear to suggest a slight cost advantage. But even that slight advantage turns out to be illusory, for Soho was producing only 16 pennies per pound weight copper, or half as many two-penny coins. Given the actual proportions of 1d and 2d pieces produced, which strongly favored the former, this was about a third as many coins per ton of copper as Lutwyche had offered to supply for just a bit more. Had Soho really been the more efficient mint, its costs should have been substantially lower than Lutwyche’s, abstracting from differences in coin quality. That they weren’t suggests that Soho was the less efficient mint, although its higher charge per coin may also have reflected Soho’s higher profits, or its coins’ superior quality.8

Because coining by steam involved substantially higher fixed costs than coining by hand the relative efficiency of the former approach would tend to rise along the scale of the coinage being contemplated. So steam technology was most likely to be worthwhile when coining was to be done on a very large scale. But even then steam technology might not be efficient, or might be efficient only assuming the presence of an artificial constraint forcing all coining to be concentrated under one roof. Such a constraint had been part of British coining policy since 1553, when all regal minting was assigned to the Tower Mint in London (Craig, p. xvii); and Boulton had good reason for assuming that it would be relaxed as little as possible in any reform of the copper coinage. His technology choice may therefore have been perfectly rational, given his goals, despite not having been efficient in a competitive context.

8 The nature of the tokens to which Lutwyche’s figures refer isn’t known.
Counterfeit-Proof Coin

If steam power wasn’t the key to making counterfeit resistant coins, and making them efficiently, what was?

A fundamental if prosaic answer is: superior engraving. The traditional way to make counterfeit resistant coins was to employ the services of a die sinker whose original dies, like any superior work of art, were inimitable and therefore (to employ the terminology of Sargent and Velde) capable of being monopolized. “Superiority of execution alone,” Rogers Ruding (1799, pp. 36-37) opined,

Can protect our money from being...counterfeited and debased. That will immediately place it far out of the reach of many who have sufficient skill to copy the wretched workmanship of our present coins...whilst the expense of time required for finishing the work so highly, will abate so much from the profit, that a greater number must be forced into circulation before the forger can be repaid.\(^9\)

As we’ve seen, Birmingham in the 18th and 19th centuries was home to some of the world’s outstanding metal engravers. Birmingham’s commercial mints employed the best of them to make tokens that proved not only counterfeit resistant, but tremendously popular among coin collectors. Soho went to especially great lengths to employ the best available engravers, at one point employing no fewer than half a dozen of them on a full-time basis, and searching overseas as well as locally for outstanding talent.

Besides embellishing their coins with outstanding engravings commercial coiners generally marked their coins’ edges. In the 18th century they did so mainly using incuse legends indicating places where the coins could be redeemed, while in the 19th they switched to graining. Such edge markings, which were applied to blanks prior to coining, prevented what might otherwise have been an effective though inexpensive method of forgery, namely, the casting of imitation coins in molds made using authentic ones. Edge markings ruled out this easy and cheap alternative, forcing would-be counterfeiters to stamp

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\(^9\) In a clarifying footnote Ruding (ibid, p. 36n) adds: “By superiority of workmanship is not meant anything in the least resembling the late copper coinage,” meaning the regal copper coins then being made at Soho. His reasons for saying so will be considered below.
their products using hand-made dies, because there was no way to prevent molten copper from leaving a seam where observe and reverse casting molds met.

Unlike Soho the Royal Mint could not assign salaried posts to foreigners. Nor were the chief engravers responsible for most of its 18th-century coins—John Croker and (after 1740) John S. Tanner—any match for Birmingham’s best diesinkers. Besides relying upon unimpressive engravings “the old shop,” as Matthew Robinson Boulton styled the Mint in 1810, “never made the least improvement for a century past” to its coins (Powell 1993, p. 53), the only modifications being the inevitable ones reflecting the accession of new monarchs. The Mint didn’t even bother to edge mark its copper coins, so that back-alley operators were able to churn out cast imitations that, with the help of a little filing or “aqua fortis,” could not readily be identified as such. No wonder Ruding (1819, v. 4, p. 155) characterized the workmanship of the Mint’s coins as “barbarous,” while John Pinkerton (1808 [1786], v. 2, p. 186) went so far as to rank its 18th-century output “with that of the lowest times of the Roman empire.”

Something else that may have given commercial coiners an edge, so to speak, over the Royal Mint was the invention, in Sheffield during the mid-1740s, of cast or crucible steel. Such steel is free of the slag and silicon particles found in blister steel. This makes it harder and more uniform and, therefore, far better suited for making master and working dies capable of withstanding multiple blows without fracturing. For several decades crucible steel could be obtained only in very limited quantities and for a high price from its original inventor, Benjamin Huntsman. But during the 1770s Huntsman’s trade secret—which had to do with the mixture of local clays employed to make the necessary crucibles—got out, and within a decade or so Birmingham die sinkers could obtain crucible steel at a considerably lowered price from no fewer than seven Sheffield suppliers (Ashton 1951, p. 57). By that time crucible steel was being generally employed by Birmingham’s button makers, including Boulton, who started doing business with Huntsman in the 1750s (Tweedale 1995, p. 39, and MBP 238/231-2). Although Huntsman’s earliest records were destroyed in a fire, his firm’s post-1787 records and Boulton’s own papers reveal a long list of deliveries of steel and die blanks to the Soho Mint starting in 1789 (MBP 238/233; also Ashton 1951, p. 58).10

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10 Huntsman’s pre-1800 sales records are available at the Sheffield Archives, items LD 1612-24.
The use of steam presses made the right choice of steel especially crucial because such presses exerted more pressure than manual ones, causing dies of any given steel to fail more rapidly, and especially so for heavier coins. That’s why, when the first cartwheels were being struck, John Southern insisted that Huntsman supply Soho with steel and die bosses “of the strongest and best quality without regard to prices” (MBP 343/30, July 2nd 1797; see also Chard 1990, pp. 1141-3). The Royal Mint, on the other hand, seems to have remained unaware of the advantages of crucible steel until many years after it switched to steam presses: during the 1837 Mint Inquiry William Busson, the Mint’s Surveyor of money presses and coins, testified that he “took a great deal of pains some years ago to discover the best kind of steel” for making long-lasting dies. “I think now I have found it out,” Busson added (Great Britain, Privy Council 1838, questions 1142-1149, emphasis added). What Busson finally “discovered” was Huntsman’s steel, which Boulton and other Birmingham button makers had by then been using for over half a century.¹¹

Crucible steel aided the detection of counterfeit coins by making legitimate ones more uniform. Dies made with it lasted longer. They were also easier to replicate. With the aid of a large (manual) screw press,¹² a single crucible steel master die could be “hubbed” to make dozens or even hundreds of precisely identical working dies without cracking and without need for further resort to hand engraving to correct flaws caused by metal impurities. Millions of precisely identical coins could then be made using a single hand-engraved crucible-steel matrix. Hubbing, which Birmingham’s button makers had long practiced (Dickinson 1936, p. 146) but which was not a normal practice at the Royal Mint until the late 1770s (when the Mint had ceased to make small change) (Dyer and Gaspar 1992, p. 430), allowed any even slightly deviant coin to be reckoned counterfeit,

¹¹ According to Craig (1953, p. 293) the Mint’s “first scientific inquiry” into steel for its dies “was entrusted in 1823 to London’s leading chemist, William Thomas Brande,” whose “research somewhat improved the average life of dies, which had been curtailed by the steam-driven presses.” Prior to Brande’s researches the average output of the Mint’s upper- and lower guinea working dies was only 1000 coins (ibid, p. 34). The Parys Mine mint, in contrast, managed to strike 9 million Druid pennies using only 152 obverse and 250 reverse working dies, implying an average output of 48,000 pennies per die (Hawker 2000).

¹² Even the Soho Mint employed a manual press for die multiplication, because steam presses were not practical for conveying impression in high relief, in part because their higher striking pressures would destroy even a crucible steel punch in short order. Concerning this, more below.
thereby substantially lowering the costs of counterfeit detection. Although hubbing became standard practice at the Royal Mint after it switched steam power, the Mint’s failure to “discover” crucible steel until many years later meant that its master hubs often failed after only a small number of working dies had been reproduced from them, defeating attempts to avoid unwanted variations in its coins.

Just why did Birmingham’s commercial mints take such pains to render mere pennies and halfpennies inimitable? The answer is, first, that the mints’ clients couldn’t afford to settle for less, because they promised to redeem their tokens in standard money and might therefore be rendered bankrupt by counterfeits not demonstrably different from their own issues; and, second, that if any one mint failed to meet a client’s needs, the client could take his business elsewhere. The Royal Mint, in contrast, never offered to redeem its small-denomination coins during the 18th century. It therefore suffered little if at all from the successful counterfeiting of its coins. The private token regime thus supplied stronger incentives for the production of counterfeit-resistant small change than the state monopoly regimes that preceded and followed it.

Rogers Ruding (1799, p. 36n), for one, was convinced that poor incentives rather than poor machines were at the bottom of the copper counterfeiting problem:

Let but the skill of our first designers and engravers be stimulated by proper encouragement; and, with that, there can be no doubt of their producing a coinage, which, at one glance, may be distinguished from the work of inferior artists.

By electing to issue inconvertible copper coins, on government account, the Royal Mint caused most of the costs related to counterfeiting to fall on outside parties. Matters changed only when commercial coiners, including Boulton, proved that it was possible to strike counterfeit-resistant token coins. The threat of a privatized copper coinage, and the still greater threat of a privatized silver coinage (which loomed large once Soho began striking Bank dollars) induced the Royal Mint to embrace, not only steam power, but various traditional counterfeit proofing measures employed by most commercial mints.

The convertibility of tradesman’s tokens, together with their lack of even limited legal-tender status, also made it relatively easy for issuers to retrieve worn or damaged
tokens and withdraw them from circulation. Thanks to this ability, token counterfeiters had no choice but to come up with convincing imitations of genuine tokens in something close to their mint condition. In contrast, because the Royal Mint refused to take back its own copper coins, no matter how worn they had become, even in order to exchange for fresh regal copper, regal copper counterfeiters had merely to replicate the most dilapidated current regal coins which, besides containing less raw material, displayed only a shadow of their original (mediocre) engravings, if that. By failing to redeem or otherwise “cry down” worn small-denomination coins, the Royal Mint rendered nugatory what little anti-counterfeiting effort it may have invested in them when they were first produced.

The point can be made by referring to Redish’s (1990, p. 793) condition for profitable coinage, \( P + C < ME \), where \( P \) is the market price of a pound weight of copper, \( C \) is the Royal Mint’s cost of coining a pound of copper, and \( ME \) is copper’s mint equivalent. If the Royal Mint can profit by coining copper, counterfeiters might also profit, even despite adhering to the official mint equivalent (in this case, 23d/lbwt. copper), so long as their costs fall short of the sum of the Mint’s costs and its profit.\(^{13}\)

But genuine regal coins were allowed to remain current despite being badly worn. The coins’ worn state amounted to an ex post increase copper’s mint equivalent, owing to the reduced copper content of the worn coins. It also gave counterfeiters a coining-cost advantage by allowing them to use dies intentionally cut shallow and without detail, if not “plain” dies bearing no engravings at all, which had the added merit of not being incriminating.\(^{14}\) “At present,” Rogers Ruding wrote at the end of the century (1799, v. 5, pp. 35-6), referring specifically to silver coin,

\[ \text{the counterfeiter has only to procure a die (the sinking of which is within the ability of any workman in steel), with a faint outline of part of a bust upon it, and with a} \]

\(^{13}\) Some clarification is called for here: counterfeiters, being competitive coin manufacturers, were presumably not capable of earning above-normal profits in equilibrium. They sold their products at cost (roughly half their face value) to wholesale counterfeit dealers, who in turn sold them at smaller discounts to retailers known as “utterers” or “smashers” (Colquhoun 1800, pp. 16-19). Redish’s profit condition must thus be understood as measuring potential gains for the counterfeiting industry taken as a whole, and not specifically those of counterfeit manufacturers.
reverse totally plain: With this mean instrument he may secure a profit of nearly thirty per cent. by coining shillings, even of standard silver.

Legitimate silver sixpence were in even worse shape than shillings; and the regal copper coins were no better, many of them having been issued during the reign of George II (Oman 1967, p. 364). “Worn” imitations of these coins could not be distinguished from genuine ones except perhaps by an expert medallist (Pinkerton v. 2, p. 226).

Evidently, no new coin production technology is likely to prevent official coins from being counterfeited if older official coins, and badly worn ones especially, remain current. That is one reason why the Coin Committee was obliged, in March of 1807, to admit to the Treasury that, despite Soho’s having issued over 110 million new halfpennies, “counterfeit halfpence are now nearly as abundant in the circulation of London as they have been at any former time” (Wager p. 47; Doty 1998, p. 320 and 330). The systematic withdrawal of old Tower copper didn’t start until a few years later, and didn’t end until the last day of 1817 (Craig 1953, pp. 266-7).

Why the long delay? The cost of a comprehensive recoinage, which had to be borne either by persons bringing worn coin to the Mint or by the public at large, was the main hurdle, and one that grew greater with every year’s delay. Already in 1755, when large numbers of William III halfpennies made from cast flans (and hence easily counterfeited) were still in circulation, Mint officials estimated that a proposed recoinage would involve a loss of 9d per pound weight of recoined copper, or £222,400 for supplying an estimated 1800 tons (avoirdupois) of new copper coin. The Treasury balked, and the

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14 Some procedures for mimicking old coin, including the common practice of frying counterfeits in brimstone to give them an appropriate patina, added to the costs of counterfeiting, but such costs were presumably small compared to savings on copper and die sinking charges.

15 In 1789 Mint authorities claimed that there were perhaps 1200 tons of legitimate regal halfpennies, and no less than 3000 tons of counterfeits, in circulation (MBP 249/234). Using the Mint’s 1785 estimate, which (after allowing for an error in the Mint’s calculation) placed the nominal value of authentic regal coppers at £306,000 (Craig 1953, pp. 231-2), and rounding it down to allow for coins lost between 1785 and 1789, one arrives at a de facto mint equivalent of 55 halfpennies per pound copper, as opposed to the de jure equivalent of 46 per pound.
proposal was abandoned (Snelling 1775, p. 45). Aggravating the problem was the fact that the Mint couldn’t avoid redeeming convincing counterfeits along with its own worn-out products, unless it did so by refusing many of the latter. Successful counterfeiting thus played into a vicious cycle: the greater the quantity of (convincing) counterfeit money in circulation, the higher were the expected costs of, and the greater the official resistance to, a recoinage. Putting off recoinage only served, however, to allow the coin stock to go on deteriorating, directly adding to the costs of a recoinage while further reducing the cost and increasing the volume of counterfeiting.

Britain’s commercial coin issuers avoided a similar vicious cycle by insisting upon token designs that were difficult to copy in the first place, and by offering to convert their tokens into gold guineas or banknotes on demand, which made it easy for them to routinely retire and replace worn tokens.

There was one aspect of Royal Mint procedures that made life easier for the average 18th-century counterfeiter no matter whose coins he chose to imitate. This was the Mint’s system, or rather its lack of any system, for getting coins where they were needed (Mathias 1979, p.192-5; Craig 1953, p. 252). As we’ve seen, the Mint, despite selling its copper coins at face value, made them available only at the Tower, instead of offering to bear the costs of shipping them to distant towns and factories. Then, because regal coins were inconvertible, once they were spent by their initial recipients they made their way to retailers and publicans who, being legally obliged to receive them in small payments, had to watch them accumulate helplessly unless some manufacturer offered to purchase them. While London coin surpluses gave the Mint an excuse for not issuing any new coins, provincial shortages aided counterfeiters, by tempting manufacturers to do business with them and by forcing workers and retailers in affected areas to accept even the most transparent fakes, for want of anything better. In light of this, to treat the counterfeiting problem as having been primarily let alone entirely a problem of inadequate coin making technology makes little sense. The problem was to a large extent institutional rather than

16 Recall that, when the government elected to recall and recoin light (gold) guineas starting in 1773, the recoinage ended up costing close to £200,000, much of which went to line the pockets of the Mint’s officers. The huge expense of the recoinage prompted Edmund Burke to introduce a bill that would have abolished the Mint and transferred responsibility for coinage to the Bank of England.
technological; and the solution lay not so much in improved equipment as in improved policies.

Did Steam-Striking Suffice?

If steam striking wasn’t essential for making counterfeit-resistant coins, was it at least a substitute for traditional anti-counterfeiting methods?

Boulton, of course, claimed that it was: coins made his way, he insisted, could not be imitated except by someone equipped with similar machines. But taking Boulton’s claims at face value is risky. “Like a showman,” Dyer and Gaspar (1992, p. 446) write, Matthew Boulton “made extravagant claims” concerning what his equipment could do, in part because he believed he could make good on the claims, but also because he was determined to obtain a lucrative regal coinage contract. He also hoped to sell his machinery to various national mints, including the Royal Mint.

One of Boulton’s extravagant claims consisted of his assertion, during his 1787 testimony to the Coin Committee, that coins made using his method would be “perfectly uniform,” whereas those made by “Men will vary as their strength respectively does...the effect of which will appear in the difference of Diameter and Thickness of the pieces of Coin” (quoted in Redish 2000, p. 145). In fact, steam striking could make only a trivial contribution to the uniform thickness and diameter of coins, which depend mainly on the uniformity of the sheet metal used to make coin blanks, on the accuracy of blank-cutting tools, and on whether blanks have been run through an edge marking or “milling” device prior to being struck. Although it is true that Boulton’s coins had especially round and smooth edges, this was so, not because they were struck using steam presses, but because they were struck using a restraining “collar.” But coins could also be collar-struck by

17 The early 1780s saw many improvements in metal rolling, including a method for hardening copper by graduated cold rolling patented by John Westwood, Sr., one of Birmingham’s commercial coiners (Dykes 1999, p. 181). The Royal Mint’s own horse-powered rolling mill, though adequate for rolling gold and silver, couldn’t handle copper ingots (Craig 1953, p. 175).

18 A coin struck without a collar will generally be of slightly greater diameter than the blank from which it is struck, and might not be perfectly round, depending on the coin’s design and, significantly, the operating pressure of the press (concerning which, more below). Late George III halfpennies, for example, were slightly wider than they were high. In this respect at least, most counterfeits were faithful to the originals (Smith 1995, p. 37).
hand; in Paris the practice dated back to 1555, and the Royal Mint itself had been doing it, albeit on a very limited basis, since the reign of Charles II (Sargent and Velde 2002, p. 54; Oman 1967, p. 330). Among commercial coiners the Parys Mine Company, Peter Kemspoon, John Gregory Hancock, and William Lutwyche all employed collars in striking some of their commercial coins, while most private mints employed them in trial strikings and in making “private” (display) tokens. Indeed, at the time of Boulton’s testimony he was still more than three years away from perfecting a collar and coin-ejection mechanism compatible with his presses’ high operating speeds. The Parys Mine Company would, in the meantime, issue about nine million collar-struck pennies.

Nor could anyone say, concerning steam-struck versus “milled” (that is, manually struck) coins, what all numismatists acknowledge concerning milled versus hammered coins, namely, that the difference is such as to be “obvious, upon a bare comparison of the products” (Pinkerton 1808, v. 2, p. 174). The collar-struck Parys Mine pennies were, according to Richard Doty (private communication August 6, 2002), “every bit as good as [Boulton’s] products, even though they were struck on hand presses,” and were struck on a scale comparable to that of Boulton’s 1797 regal coinage. Soho could of course strike coins on a still vaster scale. But that didn’t stop small-scale counterfeiters from profitably imitating its coins.

One thing Boulton didn’t tell the Privy Council was that the rapid thrust of Soho’s presses, when they were run at excessively rapid rates, tended to shatter dies, high-relief ones especially, even when they were made from the best crucible steel. Sixty coins per minute was about as fast as Boulton’s original presses could safely be run, even for farthings and other small coins. The vacuum-type presses were, if anything, slightly slower. As Sargent and Velde (2002, p. 55) themselves note, manual screw presses modified to

As for variations in thickness, although it is true that counterfeits of Soho’s steam-struck coins could often be identified using a steel thickness gage, this reflected, not the inferior accuracy of screw presses, but the fact that many counterfeiters were inclined deliberately to make their coins slightly thinner and lighter than the originals, so as to enhance their profits. Had mere inaccuracy been to blame, there should have some “heavy” counterfeits. So far as records indicate, there weren’t.

The principal collar-struck commercial coins, apart from Soho’s, were the Parys Mine pennies, at least nine tons of Hancock’s “Willeys,” and just under five tons worth of Kempson and Lutwyche issues, including most of Kempson’s Scottish commissions. For details see Pye (1801).
provide for automatic feeding of blanks and ejection of finished coins, like those designed by Droz for the Paris Mint, were just as fast.\textsuperscript{a} The steam striking of larger coins, like the tuppence cartwheels, required still slower speeds and striking pressure to avoid damaging the presses (Doty 1998, pp. 46-7 and 55-6).

Furthermore, because steam-powered presses, unlike manually powered ones, did not lend themselves to “multiple” strikings—the traditional means for avoiding die breakage when making high relief coins and medals—Boulton had to stick to shallower dies which, according to some numismatists, were easier to engrave—and to copy (Pinkerton 1808, v. 2, pp. 186-7).\textsuperscript{a} Because shallow engravings also tend to wear out rapidly, Boulton tried surrounding his with the thick raised rims that earned the cartwheels their nickname. The thick rims had to be given up, however, because they “broke dies right and left” (Doty, private communication August 7, 2002) and because they caused the designs they surrounded to become caked with grime (Samuel 3-12-1882, p. 307c.2).

In short, although Boulton’s presses allowed him to strike coins in collar faster than was possible by manual means, they didn’t allow him to produce coins that could not also be produced manually. The cartwheels’ unusual design contributed to the myth that they could only be made using Boulton’s presses. However, as Ruding (1819, v. 4, p. 378n) indicates, “all the [cartwheels’] boasted improvements are to be found on the patterns of Queen Anne’s Money: except, perhaps, their complete circularity” (ibid, p. 81n). In fact it was, as Richard Doty observes (personal communication, August 7, 2002), “much easier to create the ‘Boulton look’ (i.e., the raised ribbon/incuse lettering)...with a normal screw press, with or without a collar,” because a normal press wasn’t so rough on dies. In fact the

\textsuperscript{a} In 1818 Pistrucci discovered to his dismay that the Mint’s steam-powered presses were too weak to fully strike in a single blow both sides of the high-relief crowns he had designed toward the end of George III’s reign. In consequence the crowns designed by Mint’s Italian engraver had to be run through the presses twice, slowing their output to a snail’s pace of 50 per hour (Doty 1998, 164n19). Even the most indolent manual screw press team could do better than that.

\textsuperscript{a} Pinkerton, writing in December 1797 (1808, v. 2, pp. 186-7), faulted the Royal Mint both for the artistic shortcomings of its coins (“the pattern shilling of 1778...is perfection itself—in the bathos of art; if the shilling and six-pence do not exceed it” etc.) and for their low-relief designs, which, requiring less talent to make, were also easier to copy. He recommended, per contra, the use of high-relief dies “so as to rival the ancient in this grand criterion of good coin,” while criticizing the alternative proposal of “a noble lord” (Boulton) who proposed to reform Britain’s coin by making it “in still less relief than now—with a circle to protect that relief.”
look was imitated by Kempson and several other commercial coiners during the 1812-17 commercial coinage episode.

Indeed, steam presses were generally less versatile than manual ones. Thus, when he was asked, during the 1837 Mint inquiry (Great Britain Privy Council, 1838, questions 1156-1163), to state the advantages of the Royal Mint’s coining “plan” to that of the Paris Mint (which, having experimented with steam technology, rejected it in favor of continuing to strike all of its coins “by hand”) William Busson, the Royal Mint’s Surveyor of money presses and coins, replied simply but evasively that the Royal Mint plan allowed it “to coin more rapidly.” Busson’s Privy Council interrogator was far from satisfied:

PC: “My question went not to the quickness of execution, but as to making the coin as perfect as possible; do you think, according to the French mode...that they can coin better?

Busson: “I think the French mode of coining is very much like the mode adopted here in casting medals, or in coining proof-pieces, which we coin by hand, and we can then coax the press according to circumstances.”

PC: “Is not that a much superior mode?”

Busson: “Much superior.”

That the Royal Mint was still striking its proof pieces manually in 1837 is especially revealing, as these pieces were supposed to be more impressive but otherwise faithful renderings of coins being proposed for mass production.

One might suppose that the Royal Mint was at least coining more economically than the Paris Mint and other mints equipped with manual presses only. Boulton had, after all, claimed as far back as December, 1789 that “although my Machinery is more expensive at the outset it can manufacture Coin cheaper than the cheapest Method now used” (MBP 249/225). Later on, when Soho had all eight of its coining presses in running order, Boulton supplemented this claim with the more specific one that, using his equipment, steam from 1 bushel of coal could do the work of 55 men working 11 old-style presses (Doty 1998, p. 150). If Boulton was being truthful, then steam power might indirectly have helped to make British coins more counterfeit resistant by freeing up resources that could then be invested in better (albeit shallow) engravings.

But Busson’s further testimony during the 1837 Inquiry suggests that steam power
did not even supply this more indirect advantage.

**PC:** “Is it not the case, from the scale upon which the machinery of the English Mint is constituted, it is a very expensive process to put into operation?”

**Busson:** “Very.”

**PC:** “It is not worth while to do so for anything but a considerable coinage?”

**Busson:** “No.”

The trouble, according to Senior Moneyer Jaspar Atkinson, was that it cost the same amount to run the Mint’s steam engine when only one of its coining presses was operating as it cost when all eight were at work. The same observation applied to the Mint’s cutting out presses, twelve in all, which were powered by a separate engine. For anything except a major recoinage, Atkinson testified (ibid, questions 1894 and 1915-16), manual pressing was more economical.

It was owing to the limited market for new coin that the Paris Mint decided to strike coins by hand even after it had acquired a steam engine for the purpose:

**Atkinson:** “I asked the (Paris Mint) contractor why [the steam engine] was not set to work; he said it was so expensive he could not afford it; and six years ago, when I was there, it had been some time in a quiet state, and has so been ever since.”

**PC:** “Do your observations apply to the increased expense incurred by you in smaller coinages?”

**Atkinson:** “Yes; and the Committee will observe in looking at the accounts, our expenses now, as compared to what they were in the period of 1770 to 1781, are more than doubled; whether it was a small coinage or a large one, they are more than doubled.”

Atkinson’s last statement suggests, intriguingly, that steam-powered coining presses may not have been efficient even for large coinages: the decision to install them in the new Little Tower Hill mint, which was made, not by mint officials themselves, but by the Privy Council’s Coin Committee, appears to have been due more to Boulton’s relentless and ultimately successful lobbying of the Committee and Lord Liverpool than to any well-established advantages, economic or otherwise, possessed by his equipment.

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22 The Paris Mint did eventually switch to steam-powered presses, in 1845. Elsewhere as well coins continued to be struck manually decades after Boulton’s first employment of steam power.
Finally, as we’ve seen, Soho’s official coins, starting with the cartwheels, were counterfeited despite the extra legal protection such coins enjoyed compared to commercial tokens. According to Ruding (1799, p. 36n; see also idem, 1819, v. 4, p. 377n) Boulton’s “boasting was found to be vain almost as soon as the coins were issued; for, the workmanship of the dies being not beyond the skill of many other Birmingham artists, their ingenuity readily suggested expedients to supply the want of the so much vaunted power of the machine.” In deciding to dispense with edge markings on his first regal coins Boulton neglected the advice he’d given in his original proposals to the Coin Committee, reverting instead to the Royal Mint’s bad practice, and thereby encouraging the making of plausible cast cartwheels. [Artistry. Motives.] Soho’s Bank dollars proved still more vulnerable to counterfeiting, with copies good enough to fool even the bank’s clerks appearing within days of the first originals. This was a classic instance of counterfeiters successfully undermining part of what Sargent and Velde term the “standard formula” for a successful token coinage.

I remind readers of these occurrences, not in order to deny that Boulton’s coins were harder to counterfeit than earlier regal coins had been, but simply to show that steam-striking alone was, Boulton’s claims notwithstanding, no guarantee against counterfeiting.

Britain’s Yellow Brick Road

In truth the counterfeiting of regal coin continued to be a problem well into the Victorian era. Britain nonetheless managed to contain the problem enough to abandon official bimetallism in favor of a token-coin-supplemented gold standard in 1816. If the steam presses at Little Tower Hill didn’t make this move possible, what did?

A strengthening of legal penalties against counterfeiting, undertaken in response to recommendations made by London Police Magistrate Patrick Colquhoun (1800), may have helped somewhat. Perhaps the most important reform along these lines was an 1803 statute making simple possession without lawful excuse of as few as six pieces of counterfeit copper a crime punishable by a fine of from 10 to 40 shillings for each fraudulent coin

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23 Mayhew (1967 [1851], v. 4 p. 377), however, reports on the revival by 1851 of silver-coin counterfeiting, claiming that the forging of coins in London was then “as prevalent as ever.”
(Ruding 1819, v. 4, p. 85). But it seems unlikely that this reform alone could have had any great effect unless the quality of legitimate coins was also improved.

Other reforms (which, like the switch to steam power, had been urged by Lord Liverpool) effected such an improvement, and thus made counterfeiting more difficult, by eliminating local coin shortages and by replacing old Tower halfpence with fresh coins. Starting with Boulton’s 1797 cartwheel coinage the Treasury at last began to allow £4 per ton to cover the costs of shipping regal copper coins where they were needed. This reform, coupled with Soho’s large copper coin issues and, especially, the much larger silver coin issues of 1817, radically changed the nature of the counterfeiting trade. Because they were no longer “exploiting a need,” John Powell (1993, p. 55) writes,

counterfeiters had to change their methods. They could no longer deal in bulk but needed to slip their coins into circulation. Before 1810 a counterfeiter did not need to make an exact copy since shortages would have made his money acceptable, but after 1816 the counterfeiter had to possess the best of disguising skills.

Steam power did, of course, increase the Royal Mint’s ability to produce large quantities of new coin within a relatively short period of time, and under one roof. But this indirect contribution was hardly essential: given enough space and manual screw presses the Mint might have produced coins just as rapidly, though perhaps at a higher unit cost, without steam. It was, moreover, the Mint’s prior mismanagement of the coinage and not its prior reliance upon human-powered presses that made such enormous issues of new coin necessary in the first place: in a well-designed coinage system, only a small part of the coin stock becomes excessively worn, and in need of replacement, each year.

Eventually the government arranged, at long last, to recall and recoin all of its old and decrepit small change. In February, 1817 the Mint’s old silver was recalled and recoinied; and in December all pre-1797 regal coppers were retired. Also, in January 1817, most unauthorized coins (including evasives and commercial tokens) were legally suppressed. Thus by late 1817 counterfeiters were forced to replicate relatively recent Soho and Royal Mint products. Although these measures followed Britain’s official abandonment of
bimetallism, all were understood to be necessary complements of that measure. Some years later, in 1846, a new policy of continuous withdrawal, at the Mint’s expense, of worn sixpences and shillings was inaugurated. Continuous withdrawal of half-crowns began in 1871 (Craig, p. 311). These policies mimicked the private market’s solution of making small change redeemable on demand, though for silver coins only; copper coin remained subject to discrete renewals only.

The remaining and crucial challenge was that of making Britain’s new coins as difficult to counterfeit as the earlier commercial coinage had been. As we have seen, this challenge could not be met simply by switching to steam powered presses. It could be met only by designing better coins. In fact the new regal subsidiary coins were, by all accounts, far better than earlier ones had been. They were better not because they were struck using steam but because Soho continued to employ several of the world’s best engravers (including Kütchler, who designed the new regal copper coins), and also because the Royal Mint, having put old Pingo out to pasture, drew on Birmingham talent to re-staff its own die shop and engraving department, hiring (among others) Soho’s George Rennie and James Lawson and a battery of Wyons.24 Recall that it was young Thomas Wyon Jr. who, in his capacity as the Mint’s Chief Engraver, executed the dies for its new silver half crown, shilling, and six pence coins which, according to one respected Victorian authority, were “the finest that had ever been issued in Europe” (Humphreys 1848, p. 111).25

Also, starting with Soho’s cartwheels regal coins were struck in collar to discourage the making of low-cost counterfeits. Regal coins were also given smaller diameters with reliefs as high as (and, at least in the case of Pistrucci’s crowns, higher than) their steam presses could readily handle. Besides making official coins more difficult to copy, these steps also reduced the rate at which they deteriorated, that rate being proportional to a coin’s surface area. Finally, by the mid-1830s the Royal Mint had perfected its die-making procedures, as Soho had already done by 1791 (Vice 1998, p. 53), in part by switching to

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24 As part of his comprehensive 1815 Royal Mint reorganization mint master William Wellesley Pole also announced that the Mint, instead of relying on its own staff only as it had done in the past, would select its new coin designs from entries submitted by all the best artists of the realm.

25 The same writer recalls having witnessed “the agreeable impression” Wyon’s coins produced when they were first issued, and especially “the extraordinary beauty the coins appeared to possess, after the flat, bent, and battered bits of silver...that had been so long made to pass current as coin of the realm.”
crucible steel and in part by drawing on the expertise of several former Boulton employees whom it had lured away.

Despite all of these improvements to its small change Britain never did implement a fully convertible token coinage during the 19th century, settling instead for limited convertibility only, starting in 1834 with the Treasury’s (reluctant) offer to receive unwanted silver from the Bank of England (Redish 2000, p. 152-3) and concluding with the extension of the continuous withdrawal policy to silver half-crowns in 1871. In this respect, at least, contrary to what Sargent and Velde (2002, p. 268) suggest, the commercial mints’ solution to Britain’s small change problem, though certainly “tentative,” was also more rather than less “complete” than the official solution that supplanted it (cf. Cannon 1935, pp. 41-2).

... and its Ruby Slippers

There was no shortage of skilled die engravers prior to the 19th century. Nor was there any lack of means for edge marking coins, distributing them effectively, and arranging for their regular redemption and replacement. Even crucible steel and advanced hubbing techniques had been around for several decades before the British government finally got around to modernizing its coinage system.

Why, then, did reform not come sooner? If the absence of steam technology didn’t stand in the way, what did? According to Sargent and Velde (2002, p. xviii), if the problem wasn’t inadequate technology, it must have been poor theory. Yet Sargent and Velde (2002, p. 268) themselves recognize that the necessary theory, or key elements of it at least, had been set-forth by at least one Englishman—Sir Henry Slingsby—as early as 1661. By the 1780s many persons—Matthew Boulton and Samuel Garbett among them—had outlined the basic requirements for a sound small change system explicitly and thoroughly, while others, including practically everyone involved in making or issuing commercial coins, can at least be said to have understood them implicitly.

The fundamental problem with Sargent and Velde’s perspective is that, by starting with the question, “Was it poor economic theory or inadequate technology?” that stood in the way of a solution to the small change problem (ibid., p. xviii), it altogether rules out the possibility that national mint authorities simply weren’t inclined to do their jobs properly. Mint authorities or “policy experts,” as portrayed by Sargent and Velde, “struggled” and
“groped” their way toward a solution to the small change problem, but had to “strain against constraints” posed by flawed theories and equipment (ibid., xviii and 23). It is as if the ethos of a medieval mint (and the Royal Mint remained an essentially medieval institution at least until Wellesley Pole’s time26) were no different from that of a modern think tank—and a disinterested think tank at that. Not a word is said about mint officials living off generous sinecures without ever having to set foot in a mint, about senior engravers retaining their posts after going senile, or about moneyers who would rather persecute inventors than embrace their inventions.27

Yet history is chock full of instances of resistance—including violent resistance—to progressive inventions and ideas. Medieval craft guilds were particularly notorious in this respect. Instead of embracing new and superior methods, guilds “defended the interests of their members against outsiders [including] inventors who, with their new equipment and techniques, threatened to disturb their members’ economic status” (Kellenbenz 1974, p. 243). At bottom, guilds’ ability to resist desirable change rested upon monopoly rights granted to them and enforced by the government. The monopoly rights enjoyed by the Royal Mint’s Company of Moneyers differed from those of other English guilds in three important respects only: they extended throughout Great Britain, were enforced with especially great zeal, and lasted a lot longer.28 These differences made it especially easy for the Mint to resist change. That economists, who led the fight against monopoly in most commercial arenas, refrained (and still refrain) from questioning national mints’ monopoly rights also helped.

To conclude, having a sound theory of small change, as well as the equipment needed to put the theory into practice, wasn’t enough to guarantee a solution to the “big problem of small change.” Institutions also mattered. If economists are right in viewing monopoly rights as the fundamental source of resistance to desirable innovations, then the

26 In the most recent official history of the Royal Mint Dyer and Gaspar (p. 411) refer to “the antiquated medieval system by which the Mint was governed” throughout the 18th century.

27 Sargent and Velde (2002, p. 56, 60, and 268) say nothing about the Royal Mint’s vicious treatment of Mestrell, Briot, and Blondeau, while accepting Mint officials’ critical assessments of their innovations at face value.
real key to the reform of Great Britain’s coinage consisted, not in Boulton’s having equipped the Royal Mint with steam-powered presses, but in his having successfully defied its monopoly. By chipping away at the “old shop’s” long-standing privileges, Boulton forced it to mend its medieval ways. To be sure, steam presses helped Boulton to achieve this result. But they did so, not by actually making better or cheaper coins, but by appearing to be capable of doing so. As Jenny Uglow (2002, pp. 210-11) observes, in reference to both Boulton and Josiah Wedgewood, “it is easy to overstate the role of machines. It was skilled hands that made the difference in the toy trades and in pottery. But machines were new and intriguing and helped make their factories into showpieces.” Besides having captivated and misled all those who beheld them, Boulton’s steam-powered presses allowed him to coin money on a vast scale, making his boast—that he alone could meet not only Great Britain’s but all of Europe’s coin requirements—fully credible.

To parry Boulton’s assault upon its privileged status the Royal Mint adopted both desirable and dubious aspects of his coining technique. By doing so, by recalling its old coin, and by beginning to shed its medieval make-up, it was able at last to meet the monetary needs of an industrial economy. This was, to be sure, a great accomplishment. Still it shouldn’t be allowed to overshadow the brilliant achievements of Great Britain’s commercial coiners, both famous and obscure, whose ephemeral enterprises pointed the way.

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