Crucible steel as an enlightened material

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ABSTRACT: Crucible steel is usually seen as a product of Sheffield. It is defined as a key element of Britain's Industrial Revolution; in turn, it defines the Industrial Revolution as something essentially provincial and vernacular. This paper proposes a shift in perspective. It examines the alternative genealogy of crucible steel to be found in Henry Horne's Essays concerning iron and Steel (1773). Horne presented crucible steel as something metropolitan and enlightened: it was a product of London and its scientific community. It is a suggestion that runs counter to the accepted history of crucible steel as a process and a product, but there is something to be gained by taking Horne's view seriously.

Steel with Sheffield

The *Essays concerning iron and steel*, published in 1773 by a London cutler named Henry Horne, have not been much noticed by historians, perhaps because the story told therein is so at odds with our common understanding of one of the key episodes in Britain's Industrial Revolution: the invention of crucible steel. Crucible steel, in the conventional narrative, is Huntsman steel. It is a product of Yorkshire. It speaks of dogged provincial endeavour; its social origins are modest, clothed in Quaker plainness. Benjamin Huntsman, the only true begetter of crucible steel, occupies an honoured place in the pantheon of sturdy, unpretentious innovators – Arkwright, Darby *et al* – who feature so prominently in the traditional telling of British industrialisation.

Henry Horne tells a different story, offering a narrative that departs sharply from the one familiar to modern readers. Crucible steel originated not in the sooty vernacular of Sheffield, but amongst learned and distinguished figures in London. The method, Horne revealed, had been discovered by 'a gentleman (as I have been informed) residing in the Temple, an acquaintance of the late Lord Macclesfield' (Horne 1773, 165). Here, clearly, was a figure with social *cachet* and formidable intellectual credentials: he was a denizen of one of the capital's great seats of legal learning and a client of George Parker (*c* 1697–1764), second Earl of Macclesfield, an eminent astronomer and president of the Royal Society from 1752 to his death. Horne could not positively identify this gentleman-who-could-not-be-named; 'nor could I ever gain the least information of the means by which he became possessed of so valuable a secret'. But Horne was willing to relate how crucible steel became a sought-after commodity in London.

The gentleman-who-could-not-be-named had shown no desire to profit from his breakthrough. He waited for a worldlier individual, one who could exploit the technique effectively, to show himself. That individual turned out to be 'one who had been employed in flatting of gold and silver wire for the use of the lace-men' (Horne 1773, 166). There was nothing implausible in this; the employment of cast-steel rollers in preparing metal leaf was one of the earliest attested uses of Benjamin Huntsman's steel. Nor was there anything suspect in Horne's next suggestion: that the metal-leaf roller who had been entrusted with the secret of making crucible steel by the gentleman-who-could-not-be-named should apply himself to the making of razors.

> 'The razors, made from this sort of steel, wearing, whatever was their intrinsic merit, a much finer face than common, procured him a pretty large number of customers at the west end of the town, where [the metal-leaf roller] became a considerable hawker'.
>
> This is quite in keeping with what we know of the market for Huntsman steel. Its most enthusiastic users were not engineers, but the makers of prestige goods, entranced by its capacity for taking a high, unblemished polish. The French traveller Gabriel Jars went so far as to assert that it was 'only used for those items requiring a fine polish' (Barraclough 1984, 214).

At this point Henry Horne himself enters the story. London's cutlers were not a little alarmed by the success of the metal-leaf roller in selling razors, so some of the leading figures in the trade approached Horne, begging that he produce a steel equal to that used by the mysterious metal-leaf roller. Working at his 'steel manufactory in White-Cross-Alley in Middle Moorfields', Horne did just that:

> 'it was not long, before I was enabled… to furnish my solicitous customers with a commodity, vastly superior to what the person, who had risen up in their way, had sufficient skill to procure for his own use'.

Only now does Sheffield feature in the narrative. The unnamed metal-leaf roller, finding himself thwarted in London, sought out provincial patrons:

> 'For this purpose he went into the North, to dispose of his secret to the best advantage; first to Birmingham; and not finding sufficient encouragement there, to Sheffield; and, as I have been informed, offered his secret to several considerable manufacturers, at so extravagant a price, that few or none cared to be purchasers. However, he met at last with some keen friends, who wormed the secret out of him, supplied him with a little money, and sent him back to town; and they, being better skilled in the nature of steel than he was, soon outdid their master' (Horne 1773, 172–3).

Sheffield's steel refiners soon outdid Henry Horne as well, supplying crucible steel at a cut-price rate to his faithless London clientele. 'Many new customers', he complained, 'now finding they could purchase melted steel from Sheffield at eight or ten-pence a pound, dispatched their orders thither, without any regard (which is too common a case) to the trouble and expense, which at their own request I had been at, to serve them under their difficulties.' Thus the advantage belatedly passed to Sheffield. The discovery of crucible steel by the gentleman-who-could-not-be-named had, after many twists and turns, 'turned out of great service to that large and populous seat of manufacturers; which wears', so Horne loftily declared, '… a very different aspect from what it did not many years ago' (Horne 1773, 173).

Crucible Steel with Huntsman

This is history told backwards, with Sheffield as the destination, not the point of departure for crucible steel. It is a tale that runs counter to everything that we know about crucible steel's early history and subsequent development. There is unimpeachable evidence that Benjamin Huntsman was casting steel by the end of the 1740s and that the technique was taken up by others—although not by many—in the three decades that followed. And there can be no doubt that Sheffield stood out as the world centre of crucible steel production in the early 19th century. Henry Horne's alternative narrative, in which the principal actors are anonymous and dates are maddeningly absent, must surely be impudent or fanciful—or both.

Yet there is reason enough to take Horne seriously. 'White-Cross Alley', where Horne had his 'steel manufactory', was in Moorfields, where London's elite tool makers were concentrated. It was precisely the location where high-quality steel would be prized and new methods sought out. White Cross Lane was, for example, home to White, the capital's leading saw maker, whose products commanded an international market (Barley 2008, 86; Gaynor and Hagedorn 1993, 84; Rees and Rees 1997, 45). When the Swedish traveller Samuel Schröder visited his workshop in 1749 he found that White subjected shear steel ('here called Newcastle Steel as it comes from that place and from Crowlis [Crowleys'] works') to a number of further refining processes. The saw maker's smiths told Schröder that shear steel was 'melted all to one lump' before being forged and cut into the appropriate shapes (Schröder vol. II, 24 July 1749). Melted 'all to one lump': what can be read into this ambiguous remark? White's intention was clear enough: it was to render the steel as uniform as possible in structure. Was he doing so by reducing it to a liquid state after the fashion of Benjamin Huntsman?

That Horne himself was making crucible steel in Moorfields is attested to by William Blakey, the Parisian toymaker. His *Réflexions sur le progrès de la fabrique du fer et de l'acier dans la Grande Bretagne* of 1783 included a riposte to the French cutler Jean-Jacques

Perret who had questioned the value, indeed the reality, of crucible steel. Blakey put himself forward as an eye-witness: 'But to leave you in no doubt of the existence of English cast steel, I will tell you that I have seen it made in London, *chez* Mr Horn, the famous manufacturer of watch springs and pendulums' (Blakey 1783, 27-8). There are also signs of the shadowy roller 'of gold and silver wire for the use of the lace-men' who, so Horne asserted, had first melted steel on a commercial basis. Consider the claim made by a Londoner named John Waller in 1755:

> 'to make Mills, for the flatting of Gold and Silver Wire, for the making of Lace.
> divers Parts of my Work, as a Gold and Silver Wire-Drawer; I then at leasure Times applied myself to study in various Things in Metal, particularly in refining About twenty Years ago, I got a violent Sprain of my right Leg, which took me off of Steel'.

After much trouble in finding 'Matter to make my own Bricks and Potts off; for I could get none to stand my exceeding Strong Furnace', Waller succeeded in producing a steel of 'greater Condensity and Toughness' (Waller 1755, 6, 7). In a petition to the Treasury in 1752 Waller elaborated. Not only had he 'by Great Labour and Study in Philosophy and Chemistry, compleat[ed] the Refining of Steel'; he was 'the Inventor of the refined Steel Razors, which have been vended in most parts of *Europe* with general Satisfaction' (TNA: PRO, T 1/352/77). This accords closely with Henry Horne's version of events, and Waller even supplies a date for his breakthrough in making crucible steel: 1737 (Waller 1755, 6).

None of this means that Benjamin Huntsman's laurels must necessarily pass to John Waller. But it does mean that Huntsman is best seen as one of many actors working within an evolving metallurgical environment in Hanoverian England and not as a lone innovator. After all, Huntsman could hardly have been alone in his exasperation with shear steel. That the solution he hit upon, the liquefaction of steel, also occurred to others is not at all improbable. Huntsman claimed to have been inspired by brass founding, a trade with which he, as a clock maker, was well acquainted. There was no reason why a metallurgist in London, which was amply supplied with brass foundries, should not have been similarly inspired. It would not be the last time in the history of metallurgy that innovators who were not known to one another arrived at a common conceptual response to a shared difficulty. A century later, the key feature of Henry Bessemer's steel converter, the blowing of air through a vessel of molten iron, was anticipated by an American, William Kelly, working in isolation in Kentucky. The difference between the two was that Bessemer turned the thought into a working prototype, then into a commercially viable operation; Kelly did not (Gordon 1996, 221-25; Evans 2003).

At the very least, John Waller's claims make it plain that Benjamin Huntsman did not burst upon a technologically stale metalworking scene. Indeed, Hanoverian England was alive with new products, like the *ersatz* precious metal 'pinchbeck', and new processes, such as that for making 'Sheffield plate'. Empirical improvement, involving the use of more consistent materials or the deployment of better equipment (crucible design looms large in this respect), was a visibly attainable goal. Moreover, Huntsman, Waller and those others who experimented with the melting of steel did not labour in an intellectual vacuum. The properties of heat and the nature of chemical substances had been matters of debate across the smudged borderlands that separated natural philosophy, alchemy, and empirical medicine in the 17th century. It was suggested to Bengt Ferrner, the Swedish *savant* who toured England in 1759–60, that Huntsman had been inspired by *Medicina practica*, the compilation of alchemical and metaphysical writings published by William Salmon (Salmon 1692). Ferrner's guide in the Midlands showed him a copy of the work, 'in which many secrets are hidden and from which he thought that Huntsman had found his way of making cast steel' (Lindberg 1956). The possibility that steel might be melted in a crucible was certainly current late in the 17th century. In 1675 the natural philosopher Robert Hooke noted that 'steel was made by being calcined or baked with Dust of charcoal'—a clear description of the cementation technique—'and that by bringing it up soe as to melt made [into] the best steel' (Smith and Forbes 1957, 37). A few years later a German visitor to London inspected some small steel articles at the workshop of the clockmaker and medallist John Pingo (1668–1733), which, it was said, were the outcome of a casting process: 'The metal or steel that [Pingo] uses is nothing but old sword-blades which he melts down' (Quarrell and Mare 1934, 113). Whatever the truth of this claim, there was certainly a widespread awareness that steels from the east (Damascus steel, wootz steel) were made by a crucible process and had been so for many centuries (Bronson, 1986; Craddock 2003). 'Damascus-steel' was held in high regard, so Joseph Moxon reported in his *Mechanick exercises*, although it circulated almost entirely in the form of 'Turkish-Cymeters'. Such scimitars were, Moxon added, 'by many Workmen, thought to be cast-Steel' (Moxon 1703, 59).

Enlightened Steel

Henry Horne's *Essays concerning Iron and Steel* located crucible steel (and Horne's own endeavours) within an intellectual tradition that stretched back a century or more. But it was an intellectual tradition with which Horne was dissatisfied. The metallurgical literature at his disposal seemed dated, out of step with the scientific culture of the 1770s. It was a deficiency Horne proposed to rectify by giving a systematic account, 'both historical and physical', of crucible steel (Horne 1773, 38). In doing so, Horne launched an assault on the corpus of technical literature that had emerged in Britain since the start of the 18th century. Reference works and scientific primers poured from the press after the easing of state restrictions on publishing in 1695. They described processes and products for a lay readership, offering 'useful knowledge' to an intellectually curious public. Such knowledge was ably marshalled by editors like John Harris (*c* 1666–1719) who combined learning with entrepreneurial flair. Some of these publisher-activists were members of the august Royal Society, and some belonged to the established professions: John Harris fell into both camps as a Fellow of the Royal Society and an Anglican clergyman. But for the most part they were not gentlemanly practitioners of science; they were commercially driven knowledge-impresarios, turning Newtonian science to profitable account (Stewart 1992).

The purveyors of 'useful knowledge' did not meet the exacting scientific standards of Henry Horne, however. Ephraim Chambers, the compiler of *Cyclopaedia; or, An Universal Dictionary of Arts and Sciences* (1728), the inspiration for Diderot and D'Alembert's *Encyclopedié*, was the first to be arraigned.

> 'Mr Chambers, in his Dictionary, hath very arbitrarily assigned names and characters to different sorts of iron, according to the different countries where they are produced; this he has done in such a manner, (though without any real judgement), as to give the world a very high opinion of the iron of one country, to the great disparagement of that produced in another' (Horne 1773, 46–47).

Chambers' taxonomy was flawed from the outset, or so Horne argued. It was based upon geographical singularity, not the method of production. Horne argued instead for a form of classification in which the affinity of method rather than geographical provenance was paramount. Functional characteristics that were readily measurable were to take precedence over less tangible qualities like the 'genius of the place'.

Horne went on to address the besetting sin of 'useful knowledge' as it circulated in 18th-century Britain: its derivative nature. John Harris' *Lexicon Technicum; or, An Universal Dictionary of Arts and Sciences* (1708), for example, rested on insecure empirical foundations. The 'precise method' of smelting iron, Horne observed, as described by 'Dr Harris, in his Lexicon Technicum', was transcribed from 'the Philosophical Transactions, No 137, or from the end of a little treatise, entitled Mr Ray's Collection of Old English Words', by which Horne meant John Ray's book of 1674: *A Collection of English Words not Generally Used…and an Account of the Preparing and Refining such Metals and Minerals as are gotten in England* (Horne 1773, 52–53). On another occasion, Horne was tempted to quote from Peter Shaw (1694–1763), editor of the English edition of Herman Boerhaave's *A New Method of Chemistry* (1727). Alas, the 'very ingenious and inquisitive Dr Shaw, in his notes upon Boerhaave's Chemistry, p 95, seems to have copied from Dr Harris, or perhaps from the Philosophical Transactions, No 137, from whence, as before observed, Dr Harris took his hints' (Horne 1773, 66). Shaw, it might be added, was an associate of the already suspect Ephraim Chambers. 'Useful knowledge' was all too likely to be the same small stock of knowledge, endlessly recycled.

Having unmasked Ephraim Chambers and John Harris, the only two writers in English who had 'offered any thing upon this matter worthy of notice', as no more than plagiarisers of the few late 17th-century authorities upon whom reliance could be put, Henry Horne looked elsewhere for an authoritative account of steel making. He found it in the work of René Antoine Ferchault de Réaumur (1683–1757), whose *L'art de convertir le fer forgé en acier* of 1722 was the first attempt 'to reduce the affair of converting iron into steel to a regular intelligible science'. Not that Horne was entirely satisfied with Réaumur. He lost no time, for example, in reprimanding the Frenchman's views on the tempering of steel, which had just been translated into English (Réaumur 1771). Indeed, Henry Horne doubted the practical utility of Réaumur's great tome: 'it ought to be observed that Mr Reaumur wrote his treatise in a great measure to be an amusement for gentlemen, and the appearance of his book entitles it to a place in the genteelest library ... [but] I do not remember to have met with a single instance, where an artist in the steel-way has ever professed to have received any benefit from his writings' (Horne 1773, 193–4).

This was not to say that untutored artisanal lore should be preferred to science. On the contrary, Horne's complaint was that Réaumur's science was out of date:

> 'It is now fifty years since his elaborate treatise made its appearance, during which time, such have been the improvements in science, particularly in magnetism, electricity, &c.... that gentlemen of education and science are now not so easily brought to sit down satisfied with mere theoretic, and plausible hypotheses; but require such evidence as will stand the test of the strictest experimental scrutiny' (Horne 1773, 194–5).

Réaumur was a product of the age of Newton. The world had moved on and progressive-minded men now looked for an enlightened science that could accommodate dynamic and disruptive phenomena such as 'magnetism, electricity, &c'. For that reason, Henry Horne advertised his acquaintance with some of the luminaries of the contemporary scientific world. Indeed, he was an incorrigible name-dropper. He boasted of 'my ingenious friend Mr John Bird', the freshly appointed resident instrument maker at the new Radcliffe Observatory at Oxford. He spoke cordially of Gowin Knight, whose method of magnetizing steel bars had won the Royal Society's Copley medal in 1747; and he digressed lengthily on the polished mirrors he had supplied to 'the very ingenious Dr Ingenhoust (Jan Ingen-Housz, the Dutch natural philosopher), while he was last in England' (Horne 1773, 168, 178).

Couture Steel

Henry Horne provides a set of co-ordinates for crucible steel quite different from those to which we are accustomed. If our traditional view of the crucible process focuses on Benjamin Huntsman and emphasises the *provincial* and the *vernacular*, Horne stresses the *metropolitan* and the *enlightened*. As it happens, Horne's account complements the radically revised view of the Huntsman firm that is emerging from French archives, where Liliane Pérez has unearthed a remarkable series of letters between the Parisian toy maker William Blakey and Benjamin Huntsman (and William, the inventor's son). The correspondence that passed between Paris and Sheffield in the 1760s reveals that there was far more to the business of Messrs Huntsman and Asline than the making of crucible steel (see Pérez, this volume, pp 00-00). A number of features stand out. First, although Benjamin Huntsman wrote with pride about 'my Steel', he also supplied blister steel to Blakey. Indeed, he offered to ship as much as '4 Ton of barr Steel per Month' to Paris if Blakey would only pay promptly (*Factures Huntsman & Asline*, letter accompanying an invoice dated 30 May 1767). Crucible steel accounted for only 29% by weight of the steel that Huntsman shipped to Paris in 1766–69. Second, unwrought steel formed but a minor part of the Huntsmans' sales to Blakey. Manufactured items were far more important. Some of these goods, like razors and cutlery, were made from crucible steel, but others were fashioned from common steel. And some were Sheffield-made plated goods, like coffee pots, with no steel content whatsoever (*Factures Huntsman & Asline*, invoice of 25 September 1769, listing barbers' basins, tumblers, coffee pots, and other plated goods). Tools made up 45% by value of what Messrs Huntsman and Asline sent to the Blakeys; toywares accounted for another 42%. Steel and other materials made up just 13%. Third, as the foregoing suggests, the Huntsmans are best seen as traders or brokers rather than specialised steel makers. Not only did they supply Blakey with goods made by other Sheffield manufacturers, such as the filesmith James Creswick, they also dealt in articles from far beyond Sheffield (*Dossier Sheffield*, William Huntsman to Mrs Blakey [date obscured but in a context of December 1766 to January 1767]). Indeed, the most important category of goods that the Huntsmans provided to Blakey were 'Lancashire tools': highly specialised implements (Fig 1), designed for use by clock and watch makers, that were made in just a few towns and villages in south-west Lancashire (Bailey and Barker 1969). Benjamin Huntsman acted as the intermediary between Blakey and Daniel Mather of Toxteth, one of the most eminent 'Lancashire tool' makers of the day (*Dossier Sheffield*, Benjamin Huntsman to William Blakey, 16 December 1765).

That an icon of Yorkshire industry should be a dealer in Lancashire tools is an affront to Yorkshire patriots, no doubt; but the pattern of commercial activity disclosed in the Blakey papers, as Liliane Pérez makes clear, calls for a re-evaluation of crucible steel along the lines laid out by Henry Horne. Steel was not simply more abundant in the 18th century, or present in a purer form than of old. It has to be seen as a key material ingredient in new social practices. It was, as we are increasingly aware, a decorative substance, to be used in acts of social display and self-presentation. Steel was already regularly deployed for ornamental purposes in the 17th century, being used to 'garnish' prestige articles like tooth-pick cases, often in conjunction with semi-precious materials like 'Prince's Mettle' (*OBPO*, January 1687, trial of Claudius Bertin [t16880113–22]). Soon it would be used in the highly polished watch chains that appeared early in the 18th century. In October 1728, for example, a pick-pocket named Ann Williams was brought to trial at the Old Bailey. She was accused of 'stealing a silver Watch, and a steel Chain, from the Person of

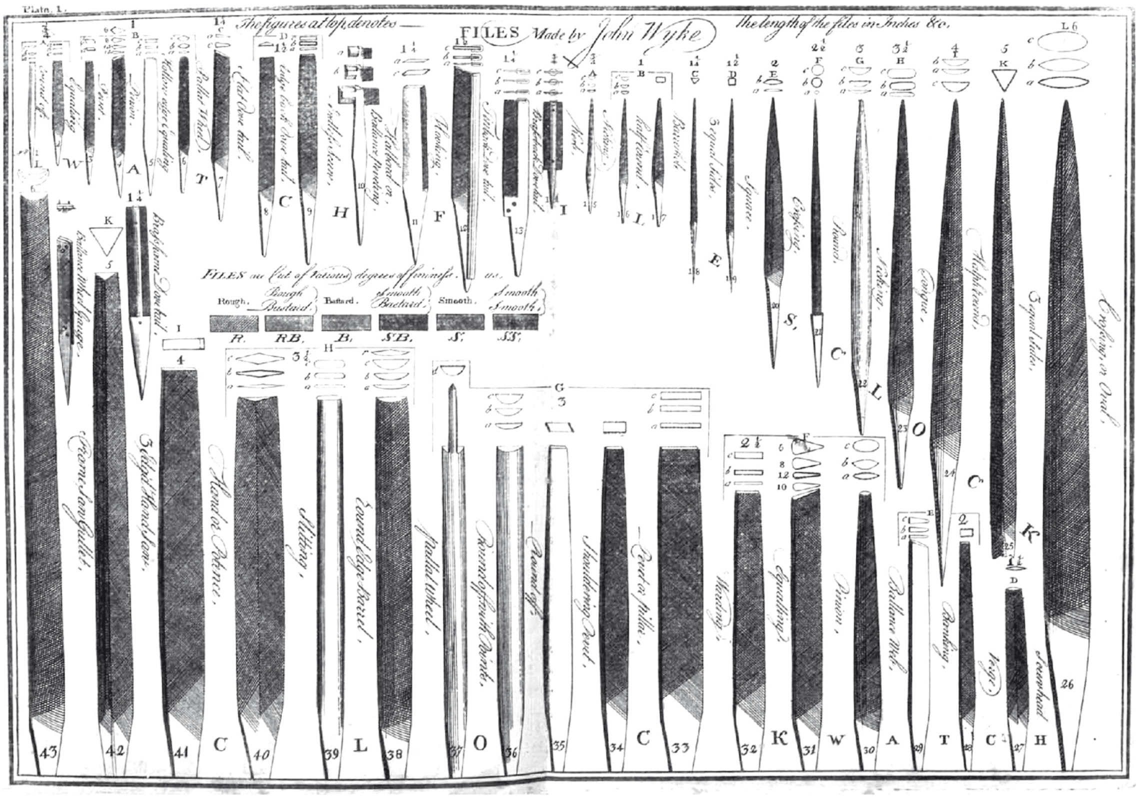

Figure 1: Watch and clock files from the catalogue of John Wyke, c1760. The files shown here were made by a contemporary of Daniel Mather, the Lancashire tool manufacturer who supplied the Huntsmans. The catalogue shows the range of tools made; 43 different files are illustrated in this plate alone. The delicacy of some of the files is also made clear. The original illustrations were to scale, revealing that the smallest items were no bigger than toothpicks.

William Baxter'. Ann Williams, so it was alleged, had been 'so lewd as to ask the Prosecutor to go with her to a Brandy-Shop, and he was so silly, as to comply'. As he took his dram Baxter was deprived of his watch and chain (*OBPO*, October 1728, trial of Ann Williams: t17281016–9). For us, it is the silver watch that is the eye-catching element in this criminal transaction; the chain ranks only as a utilitarian accessory. In the 1720s, however, a steel watch chain was a newly minted article of fashion that enjoyed prestige in its own right. It would certainly not have been cheap. A Philadelphia merchant who visited Wolverhampton, one of the principal centres of their manufacture, much admired the chains that he saw: 'very neat', he scribbled in his journal, 'some of them sold for 10 G[uinea]s Ea[ch]' (Fisher journal). To be sure, by the 1760s steel toys and jewellery enjoyed a tremendous vogue. Crucible steel, which had been cleansed of unsightly slag inclusions, was ideally suited for the purpose, hence the patronage that Matthew Boulton of Birmingham, the toy-maker supreme, bestowed on Benjamin Huntsman.

The impact of burnished steel could be considerable.

'What beauteous works from ORES refin'd arise,
To grace the HEAD and NECK, and charm the eyes;
To grace the HANDS, and FEET, the COAT, and VEST,
And ornament our Belles and Beaux, full drest;
The orient PEARLS, and blazing DIAMONDS, feel
Their lustre, oft, outvied by polish'd STEEL' (Bisset 1800, 37).

That, at least, was the judgement of a Birmingham poet who sang the praises of locally-made wares. His verdict was effusive, but not necessarily exaggerated. As Helen Clifford has shown, in the second half of the 18th century dazzlingly cut-and-polished steel jewellery of English manufacture enjoyed a European-wide vogue (Clifford forthcoming; Craddock and Lang 2004). Lord Grantham, Britain's ambassador in Madrid in the diplomatically troubled 1770s, used cut-steel beads, buttons and chains to charm the Spanish court. Madrid's grandees were not alone in their enthusiasm for steel trifles; the Wolverhampton buckle maker, John Worralow, received commissions from Versailles and St Petersburg, as well as Madrid. Steel jewels were items of sufficient importance for the Swedish metallurgist Sven Rinman to include an entry for 'stål-brillanter' in his *Bergswerks lexicon*: 'small buttons or beads of fine and rather strongly tempered cast steel' (Rinman II, 871). The tarnished survivals that are left to us today

Figure 2: Steel Buttons – Coup de Bouton, 1777. This print mocks the rage for ostentatiously large and reflective steel buttons of the 1770s. Crucible steel was essential for making such articles.

give little impression of their original radiance, but the coruscating effect of steel buckles and buttons was sufficiently noteworthy to attract caricaturists. The 1777 print 'Steel Buttons/Coup de Bouton', which showed a lady of fashion overwhelmed by the effulgence of her companion's costume, was one outcome (Fig 2).

Steel in the closing decades of the 18th century was seen as a decorative substance of sufficient standing to be combined with other modish materials. Matthew Boulton proposed 'an alliance betwixt the Pottery and Metal branches', so Josiah Wedgwood told his business partner; 'Viz., that we shall make such things as will be suitable for mounting, & not have a Pott look, & he will furnish them with mounts' (Dolan 2004, 230). Examples survive of blue jasper medallions from the famous Etruria works that were edged with cut steel in Matthew Boulton's Soho factory. (See Uglow 2002, plate 26, for examples of belt buckles made in this style). Indeed, insofar as swords were items of fashionable accoutrement rather than functioning weapons, there is a case to be made for steel being a significant element in the dress of the *beau monde*. We might go further and assert that steel played an increasing role in governing the appearance and deportment of those who aspired to enlightened civility. The key role of razor manufacturers as early users of crucible steel has already been noted. They prized its glitter, of course; but also its density and homogeneity. Razors made from crucible steel were to be preferred:

> 'they being much better united in their Substance, much less disfigured with foulness and drossy Veins, and always (when wrought with that extraordinary Care that this Steel particularly requires) free from those visible Pores, which cannot fail to affect the Delicacy of the Edge' (Savigny 1780?, 5–6).

But the keenness of a razor was more than just a technical question. To be bearded, according to the cultural and artistic conventions of the time, was to be socially marginal. It was a signifier of extreme old age, of someone on the verge of exiting society, or the mark of a hermit, of someone who had wilfully rejected society. A close and even shave was an essential indicator of man's social nature.

Shaving was very often a social act, of course, undertaken publicly. For a few pennies a man could avail himself of the professional services of a barber. One's wig could be dressed while one's jowls were soaped, and there was usually the opportunity to engage in or listen to gossip and drollery, or to browse the public prints. But the Enlightenment also put a premium on privacy, domestic comfort and personal convenience. That is why acquiring individual expertise in the use of a razor was seen as a desirable goal: it allowed mastery over one's own body. Autonomy in one's ablutions became an issue of public discussion in the closing decades of the 18th century. Jean-Jacques Perret's *La Pogonotomie* ('Or the art of shaving oneself') was published in Paris in 1770 (Hilaire-Pérez and Thébaud-Sorger 2006); English authors followed in his wake. The date of the first edition of John Horatio Savigny's *Treatise on the use and management of a razor* is not certain—probably around 1780—but it had reached a fourth edition by 1786. The author dwelt upon the preparation of the skin, the angle at which a razor should be applied, and the speed and force of its strokes. Savigny also gave due consideration to the precise qualities that were needed in the steel from which the razor was formed. He was well equipped to do so, for he had already published excerpts from Réaumur's *L'art de convertir le fer forgé en acier* in 1771 (Réaumur 1771). But it was not just the quality of the product that left the maker's workshop that was at issue; it was its upkeep. In an age before razors were disposable, a close knowledge of how to maintain steel instruments was requisite. A rival to Savigny's manual, Benjamin Kingsbury's *A treatise on razors*, published in 1797, promised special consideration of the 'means of keeping [a razor] in order' (Kingsbury 1797). Kingsbury was particularly interested in establishing the value of the various razor strops that were so energetically and inventively marketed by contemporary entrepreneurs. So, it was not merely the fact that steel that was circulating in greater volume in the later decades of the 18th century; it was that public knowledge of steel and its properties came to be seen as increasingly necessary.

The interface between metallurgy and *toilette* that Savigny and Kingsbury patrolled bears investigation. If a smoothly shorn chin was essential, so too was a closely-cropped scalp in an age when the wearing of a wig was a key signifier of genteel politeness. Even Rousseau, the self-proclaimed enemy of social artifice, wore a wig. When turning his back on the fashionable world in the 1750s he simplified his dress in a radical manner: 'I gave up my gold trimmings and white stockings .... I laid aside my sword, I sold my watch' (Kwass 2006, 631). But Rousseau did not forego the wig; he merely traded-in the extravagant hairpiece he had been accustomed to wear for a more modest type. Any consideration of bodily protocol in the Enlightenment must include the increasingly elaborate apparatus required to manufacture and maintain the wig. This included not just human hair 'ready curled by the best approved Hands in London', and the choicest ribbons and silk threads, but a considerable supply of metallic paraphernalia:

> 'Frame Sticks and Screws, fine polished Steel and Iron Cards, and Brushes, and drawing Cards, pinching Tongs, and Topee Irons, Wig Springs, hollow Blocks... Block-pins, Curling-pipes, Vices, Scissars, Razors, Hones, and Straps'(*Virginia Gazette*, 25 July 1751).

Barbers and wig-makers, the practitioners of trades that are now much diminished in extent or greatly altered in their nature, loomed large in 18th-century society. They and others were devoted to controlling the human body in culturally approved ways. The barber was primarily concerned with curbing the unruliness of the hirsute body, but barbering as an historic craft aimed at a rather more wide-ranging management of the human frame. The barbers of the 18th century were not yet completely distinct from the ancestral figure of the barber-surgeon. The barber-surgeon, with his predilection for bleeding his clients, operated according to a humoural theory of the body and its disorders. This had an antique flavour in the Age of Enlightenment, but those who made or wielded razors retained a para-medical outlook.

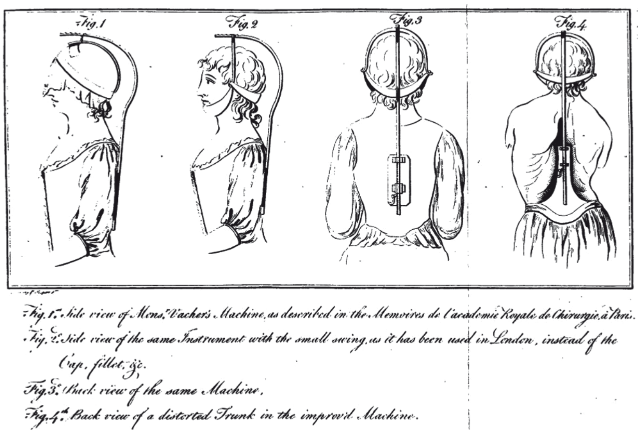

Figure 3: From left to right: (1) the 'machine' of the French inventor Vacher; (2) 'Side view of the same instrument with the small swing as it has been used in London, instead of the Cap, fillet, &c'; (3) 'Back view of the same Machine'; (4) 'Back view of a distorted Trunk in the improved Machine'. From Sheldrake (1790).

J H Savigny, it should be remembered, was both a razor maker and a manufacturer of surgical instruments. The title page of the first edition of his *Treatise on the Use and Management of a Razor* described him as 'Instrument-Maker to ST GEORGE'S HOSPITAL'. Indeed, Savigny is credited with issuing in 1798 the first illustrated catalogue of surgical and dental instruments in Britain (Naqvi 2004).

The springiness of steel had numerous medical applications. Liliane Pérez (this vol, below, pp 00) has explored William Blakey's use of 'steel bandages' in the treatment of hernias. Mention might also be made of the use of steel in correcting deformity. The orthopaedic potential of steel was widely recognised. Timothy Sheldrake junior, another of those who bridged the worlds of medicine and mechanics, was the author of *An Essay on the various causes and effects of the distorted spine* (1790). In it he critiqued 'the improper methods' usually employed to correct spinal malformation. Percivall Pott, the recently deceased chief surgeon at St Bartholomew's Hospital in London, was the first to be censured. Next, Sheldrake exposed the sprung-steel apparatus 'made by a Mr Jones, who calls himself the inventor of them', as nothing more than a copy of a 'machine' described in the *Memoires de l'Academie Royale de Chirugie à Paris*; there it was 'ascribed to a Mons. Vacher, and it has been made public for near thirty years' (Sheldrake 1790, 20). Finally, Sheldrake unveiled his own version of the Vacher apparatus, one in which the steel arm that supported the sufferer's head rose from a solid framework that rested on the pelvis rather than a whalebone corset (Fig 3).

Conclusion

Henry Horne spoke of crucible steel as an enlightened substance. That is to say, Horne defined steel as a material that merited close scientific scrutiny within an evolving system of publicly accessible knowledge. Moreover, the genealogy that Horne constructed for crucible steel made much of the intellectual context within which it emerged. He peppered his narrative with the names of scientific authorities. Moreover, he presented crucible steel as an important material element in the elaboration of enlightened subjectivity. Steel—and crucible steel above all—assisted in the process of self-presentation that was central to enlightened etiquette; it allowed men and women to demonstrate their understanding of the demeanour appropriate to people of education and social standing.

Given their haughty tone, it is tempting to dismiss Henry Horne's *Essays* of 1773 as tendentious self-promotion. But the approach he adopted can have positive consequences for our understanding of steel's place in enlightened culture. By specifying the niche markets that it served, Horne compels us to think again about the chronology of crucible steel. The 18th century, for too long seen as a mere prelude to more significant developments after 1800, stands forth as a period with its own distinct characteristics. The use of steel as a decorative substance need no longer be seen as an aberration, one that withered once the true role of crucible steel as an engineering material became apparent. More importantly, perhaps, greater attention must be paid to the wider material culture within which steel featured. New articles such as steel-edged sugar nippers had little meaning other than in combination with porcelain and silver cutlery, as part of a system for serving tea. And the basic functionality of sugar-nippers can only be judged in the context of freshly devised cultural regulations for the handling and consumption of novel or exotic foodstuffs.

It is particularly important to consider steel in conjunction with other metals, for the reflex of many who deal with historic aspects of ferrous metallurgy is to focus on primary production methods and the *isolation* of metallic elements, and to give less attention to manufacturing systems that rely on the *intermixing* of metals. Yet some of the most innovative uses of steel involved its incorporation into composite mechanisms. Scientific instruments are especially noteworthy in this respect in that they involved the use of steel, in the form of needles, wire or springs, in conjunction with brass (Low-Morrison (2007) makes it clear that many instrument makers also manufactured steel toys, buttons and fancy goods). Musical instruments might also be considered in this respect. Note how from the 1750s the leading London flute makers began to exploit the elasticity of steel springs to add levered keys to their instruments. By the end of the 18th century the so-called German flute was no longer a wooden article whose acoustic was modulated by the direct application of the finger tips; it was a more complex mechanism featuring steel springs, brass axles and pewter plugs (Powell 2002, 111–12).

Looked at in this way, steel in the Age of Enlightenment is no longer just a prosaic engineering input. It becomes a multivalent material. In its use, questions of functionality, aesthetics and scientific knowledge intrude upon one another. New histories of steel can be incorporated fruitfully into the new histories of 18th-century enlightened culture that are now being written. It would be to the benefit of both.

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