INTRODUCTION: SHEFFIELD AND THE GENESIS OF THE AMERICAN TRADE

> Nothing can account for the sustained prosperity of Sheffield, and the very large increase of its population from 1821 to 1831 ... except the American demand.
> A. Gatty, *Sheffield: Past and Present* (Sheffield, 1873), p. 213.

In England the name 'Sheffield' has long been synonymous with fine-quality steel, no more so than in the early nineteenth century when the town, though seeming to possess few advantages for the manufacture of steel, virtually monopolised the industry in Europe. In contrast, the United States before 1860 was still in the age of wood and iron, relying almost exclusively on England for supplies of cast steel. No better example illustrates the Anglo-American relationship termed the Atlantic economy.[1]

Sheffield's technical mastery of steel manufacture involved the crucible or cast steel process – an invention generally attributed to Benjamin Huntsman (1704–76), the Quaker clockmaker from Doncaster, who, in 1742, hit upon the idea of melting pieces of carburised bar iron in a clay pot. Until Huntsman's discovery the only type of steel commercially available was 'blister' or 'cemented' steel, produced by baking or 'converting' wrought iron in charcoal until it absorbed the necessary carbon. The uniformity of blister steel (so called because of the appearance of numerous swellings on the surface of the bars) could be improved greatly by forging, making it into 'shear' steel, the material of choice for Sheffield's famous cutlery; but it was far from ideal for other uses. By melting blister steel, however, Huntsman not only thoroughly diffused the carbon, so improving the steel's working properties – which could be enhanced by the addition of various 'physics' – but he also had the chance to pour the molten metal into a mould. So was produced Europe's first steel ingot.[2] Huntsman's commercial exploitation of his process began in the 1750s and by 1830, Sheffield, the town where he began manufacture, had firmly estab-

lished itself as the world's steelmaking capital – a town 'as completely the metropolis of steel as Manchester is of cotton or Leeds of woollens'.[3]

Not only was Sheffield the world leader in steelmaking (it has been estimated that by 1850 the town was producing 90 percent of all British steel and 50 percent of all European), it was also a major European centre for cutlery and edge tool, saw, and file manufacture. Also, while Huntsman was revolutionising steelmaking, Thomas Boulsover had discovered a type of imitation silver ('Sheffield Plate') by fusing copper and silver. Shortly afterwards, another Sheffield metalworker, James Vickers, began producing Britannia metal, from tin, copper, and antimony, which rapidly superseded pewter as the poor man's silver. In 1830 there seemed to be nothing associated with steel manufacture that Sheffielders could not do better than anyone else. No other British industrial town – not even Manchester or Birmingham – could match Sheffield's inventiveness and diversity in metal manufactures.[4]

This diversity reflected the high degree of specialisation that had created minute divisions amongst the local trades, each with its own trade society, its own piece-rates and its own traditions, and each producing innumerable patterns and qualities. In about 1830 this was seen as the great strength of the Sheffield trades. One visitor discovered that 'the perfection of the Sheffield manufactures arises from the judicious division of labour. I saw knives, razors ... produced in a few minutes from the raw material. I saw dinner knives made from the steel bar, and all the process of hammering it into form, welding the tang of the handle to the steel of the blade, hardening the metal by cooling it in water, and tempering it by decarbonizing it in the fire, with a rapidity and facility that were astonishing.'[5] In short, it was mass-production by traditional methods. Manual skill was the main industrial factor and consequently most firms remained fairly small, since the idea of a self-contained factory where each operation was subject to the control of a single guiding hand was alien to the Sheffield trades. Mechanisation had yet made little impact, as much for social as technological reasons. The trade unions dominated the local specialised crafts, ensuring by various sanctions, often involving violence or 'trade outrages', that the skills of the craftsmen were never supplanted by machinery.[6]

Nearly all of the Sheffield trades involved hardship. Burns and gruesome injuries were suffered by the steelmakers; the file cutters risked lead poisoning from their cutting blocks and often ended their days permanently bow-legged and stooped; and the grinders faced the twin hazards of shattering grindstones and 'grinders' disease', a debilitating condition caused by the inhalation of sandstone and steel particles which ensured

that they rarely reached the age of forty. In compensation, wages for these crafts were relatively high, a fact frequently mentioned by contemporaries, though it was also noted that the higher earnings were almost invariably spent on the Sheffield workman's favourite pastime – drinking. Such pursuits were not only an escape from working but also living conditions, which for the majority were cramped and insanitary. Sheffield in the early nineteenth century had yet to come to terms with a massive increase in population from 31,000 to nearly 135,000 between 1800 and 1850.

Nevertheless, other industrialising nations regarded Sheffield as an example to be emulated. Foreign visitors toured its crucible steel furnaces hoping to learn the secrets of the processes as they watched the melters tip the gleaming metal into the moulds. Later in the century Americans would be critical of Sheffield's archaic methods and its drunken workmen, but in the 1820s and 1830s, when Sheffield manufacturing techniques represented the state of the art, they too had nothing but praise for its industries.[7] Zachariah Allen, the famous Rhode Island textile manufacturer, visited the town at about this time, and recorded his awed impressions of a visit to the showrooms of Joseph Rodgers (the only such establishment in the world), where he saw displayed scissors large enough to walk beneath and knives with over two thousand blades 'like the horrid quills on a porcupine's back'.[8] Such firms had little to fear from US competition at this time and the emerging American cutlery and edge tool industry was scarcely given a second thought by Sheffield manufacturers.[9] America in 1830 was the town's biggest customer, not its rival.

Sheffield's American connection was an old one that had first flourished with the eighteenth-century trade in cutlery and edge tools.[10] In the words of one Sheffield worthy:

> The [American] settler needed his axe to fell the primeval forest, his spade to break the hitherto untilled ground, his saw, and chisel, and file, and scythe, and shears for constant use in building and agriculture, as well as the necessary domestic utensils in setting up a new home. These and the like were the very things which Sheffield could at once supply, and it did so to a very large extent – insomuch that some few houses of business in Sheffield had established their agents at New York before the commencement of the present century, and the result was that its prosperity became most closely linked with the fortunes of America.[11]

The beginnings of the town's American trade cannot be dated precisely. But it was the cutlery and edge tool trade with the US which was largely responsible for the burst of activity and the 'immense earnings' of Sheffield manufacturers, noted by Arthur Young on his tour through the district in about 1769.[12] A little later the trade was of such importance that the American War of Independence 'created much alarm in the town,

particularly amongst the several merchants and factors who during the last fifteen years had opened a trade to Philadelphia, Boston, and other places'.[13] The growth of the trade was reflected in the American preference for Sheffield planes, saws and files by makers such as Spear, Greaves, Butcher and Ibbotson,[14] whilst the cutlery marks of Joseph Rodgers and George Wostenholm became as prestigious in the US as they were in England.

Shortly after 1800 it was estimated that a third of Sheffield's working population of 18,000 was engaged in the American trade, which consumed a third of the town's manufactured goods. Moreover, eighteen 'export houses' dealt with the American market (compared with nine to other foreign countries), and firms such as Naylor Sanderson sent almost the whole of their goods to the US.[15] Though the accuracy of some of these figures may be disputed, it is clear that about this time the transatlantic trade was beginning to rival Sheffield's Continental trade. The movement gathered pace enormously after 1815, when:

> From seven to ten Sheffield firms at once embarked largely in direct trade with America; some of these sent vast quantities of goods on sale, some took orders on very long terms of credit: 'there was', says an active witness of the period, 'a mad rush for goods'; the *cornu copia* was freely poured into the lap of the ready customer, and then came a glut, dismay, and disaster. 'Many American houses suffered, some so seriously as to disappear from among us. Few emerged from this crisis without heavy losses, all arising from a financial collapse in America growing out of the transition from war to peace.' Some few houses of high character had remained comparatively unscathed during this season of trial, and the competition being lessened by the adversities of those who had suffered, it was not difficult to establish a new basis of commercial engagements, – that of cutting down long credits to the American dealers, to terms almost equivalent to cash payments on the delivery of the goods. This has been considered the first great cause of all the fortunes subsequently made in the American trade.[16]

By the late 1820s the demand was so great that Sheffield had difficulty in meeting orders. William Cobbett, observing that in the scythe trade America was 'still a part of old England', waxed complacent about edge tool manufacture: 'No fear of rivalship in this trade. The Americans may lay on their tariff, and double it and triple it; but as long as they continue to cut their victuals, from Sheffield they must have the things to *cut* it with.'[17] Though Cobbett's optimism was misplaced – the tool trade peaked in the 1830s and 1840s – the increasing self-sufficiency of Americans simply meant, in the absence of domestic cast steelmakers, a greater demand for Sheffield steel, ensuring that from 1820 to 1850 the 'rise of fresh applicants for American orders continued unceasing'.[18] So closely did Sheffield and America become tied that it seemed to one observer as 'if

the fortunes of the town rose and fell with the temperature of the American demands'.[19]

Other factors contributed to Sheffield's success. The opening of the canal in 1819 and the Sheffield–Rotherham railway in 1838 gave better access to both American and Baltic markets.[20] Sheffield was an entrepôt in the Atlantic economy, converting Swedish iron into steel for subsequent shipment to the US and also monopolising the sale of Swedish bar iron in America through its own agents.[21] Nevertheless, it seems to have been the American market which fuelled Sheffield's growth. By the 1820s and 1830s several crucible steel firms such as Sanderson Bros, William Greaves, William & Samuel Butcher, and Jessop's had outgrown their 'back-yard' and small-scale origins.[22] All these enterprises traded chiefly with America. By 1850 the number of men who had made large fortunes in the American trade included all the great captains of Sheffield steel: William Butcher, Charles Cammell, Mark Firth, Thomas Jessop, Frederick T. Mappin, Edward Sanderson and Edward Vickers.[23] Such men, alongside many less famous Sheffielders, gained much of their early business experience in America. These were the 'good old days' of the US trade when firms such as Jessop's were 'heaping up their riches in as easy and quiet a way as ever wealth was put together';[24] and when the American trade enabled Greaves to erect the famous Sheaf Works in 1823 at a total cost of £50,000.

Probably very little Sheffield crucible steel was exported to America before 1800, since at that time the American industries that were to become the town's biggest customers were either in their infancy or non-existent. The expense of cast steel (about a third as much again as shear steel) precluded its widespread use, and the needs of colonial craftsmen could be met, to a certain extent, by imports of Sheffield shear steel or domestic blister steel.[25] Crucible steel, however, competed successfully with blister steel and iron: it was free from inclusions of slag, making it far more homogeneous and reliable; it could take and hold a hard cutting edge; it was resistant to the percussion and abrasion endured by sledge-hammers, files, and axes; and its toughness and durability made it ideal for the wearing parts of machines and engines. Above all, the plasticity of the material under heat allowed it to be worked and manipulated to cut other metals.[26] These factors ensured that crucible carbon steel gradually replaced iron and low-grade steel in America in the first half of the nineteenth century.

Sheffield crucible steel, shipped through the town's resident agents in Boston, New York, and Philadelphia, improved the American economy's cutting edge in the drive to exploit the country's huge resources of wood.

By 1860, an American using a high-quality domestic axe, saw, chisel, or plane, invariably wielded a piece of Sheffield steel. In the 1820s and 1830s the imported product became the basis for several New England and Pennsylvanian attempts to overcome the prejudice against home-produced woodworking tools.[27] In New York, Richard Hoe & Co pioneered the production of circular saws with steel from Sanderson Bros of Sheffield.[28] Henry Disston, of Philadelphia, relied upon English steel in founding what was to become the world's largest saw manufactory.[29] Other American sawmakers – Charles Griffiths, Abel Simonds, and Josiah Bakewell – also had the same source of supply.

Sheffield steel likewise became indispensable for American axemakers. In 1825 Daniel Simmons, founder of the Weed & Becker Manufacturing Co, in Cohoes, New York, began using it after a way was found of welding thin strips to the head of the traditional iron axe.[30] Cast steel came into general use for axes sometime after 1830, the composite axe eventually being superseded by one with a completely steel blade.[31] The Douglas Axe Co, of East Douglas, Massachusetts, was another committed user of English steel.[32] The Collins Co, a Connecticut axemaking firm that was to acquire a world-wide reputation, built its early success on Sheffield steel from Naylor & Sanderson, later transferring its business to Sanderson's. In 1842, the superintendent of Collins, Elisha K. Root, was sent to Sheffield to 'pick up information' so that the firm could begin manufacture itself. But shortly afterwards, recorded Samuel Collins, a member of Firth's of Sheffield visited Collinsville and 'made such representations and named terms that induced us to give them our business and we used their steel exclusively for about twenty years'.[33]

American makers had also begun to supply the domestic market with wood-finishing tools. In 1800, New York, for example, had almost no mass-produced tools; but by 1860 the reverse was true, and a wide variety of American woodworking tools were available, typically with a well-advertised edge of 'superior English cast steel'.[34] Throughout the nineteenth century, American planemakers imported Sheffield cast steel for cutting irons from firms such as Butcher, Newbould, Sorby, and Ibbotson.[35]

As American population expanded westwards, steel found new uses. In the 1820s and 1830s the American Fur Co, in Mackinac, Michigan, imported crucible steel for the steel traps and flint steel of the trapper and fur trader.[36] Heavy-duty hacking and hunting knives were also in demand, supplied by cutlery makers in the East, using English steel.[37]

More significantly, the expansion and mechanisation of American agriculture opened up a vast new market.[38] At the time of the American Rev-

olution, most farm tools differed little from the ones which had been used for two thousand years. Grain was cut almost universally with a sickle, and it was not until about the time of the Revolution that the scythe came into use. Several inventors experimented with the plough, but the early designs by Charles Newbold and Jethro Wood were constructed of cast iron, which did not cope well with the sticky soils of the prairies. In 1833, John Lane, an Illinois blacksmith, began experimenting with steel-bladed ploughs, an idea fully developed by John Deere in 1837, who utilised strips of Sheffield steel from discarded saw plates. Deere's success eventually brought him into contact with Naylor & Co's agency in New York, and soon the American was importing regular shipments of Sheffield steel at $300 per ton.[39]

The mechanical reaper also appeared on the scene between 1830 and 1860, the work of Obed Hussey and Cyrus H. McCormick. By the 1820s a corn cultivator and a hay and grain rake were available to farmers. In 1837 John and Hiram A. Pitts patented a commercially successful mechanical thresher. Other machines marketed before the Civil War included mowers, grain drills, corn shellers, hay bailing presses and cultivators of various types. Most of these machines were constructed of cast iron and wood: however, the critical cutting, ploughing, and reaping sections offered a market for cast steel.

Sheffield steel was involved in an area that many historians have identified as the cradle of the so-called 'American System of Manufactures' – armsmaking and toolmaking enterprises in the Connecticut Valley. These included Eli Whitney's New Haven factory, the Collins Axe Co, the Springfield Armory, the Works of Robbins and Lawrence in Windsor, Vermont, and the Ames Co in Chicopee, Massachusetts. In the early nineteenth century the dependence of these factories on imported steel was almost total, a reflection of the poor quality of the small amounts of domestic steel. Most of the steel used, however, was of the blister or shear variety imported chiefly from England and, to a lesser extent, Germany, for sword and bayonet blades. Cast steel had not been generally adopted for rifle barrels, and the armories relied upon local bar iron. The Salisbury District in northwestern Connecticut was the principal source of iron of the requisite quality, and Salisbury iron became the standard material used in the Connecticut Valley manufactories.[40] By the 1840s, however, contemporaries began to complain, it now seems with some justification, of a decline in the quality of Salisbury iron.[41] Firms such as Ames and Colt instead turned their attention to cast steel because of its durability, elasticity and lower failure rate.[42] The material was apparently first considered for barrel manufacture on a large scale in 1845, when the Navy

forced a reluctant Nathan Ames to try the new material. Ames' misgivings, however, were offset by the advocacy of men such as Eli Whitney Jr, who in 1848 convinced an Ordnance Board of the superiority of steel barrels.[43] By 1845 cast steel, usually imported from England, was driving out iron as a material for rifle barrels, though iron still held a share of the market.[44] The armories boosted the custom that Sheffield already enjoyed from American cutlery firms in the Connecticut Valley, located in New Haven, Meriden and New Britain.[45]

Carefully heated and then quenched, carbon steel could be used in the shaping of softer metals, especially in the cutting of wheels, gears and axles. As America's engineering works came into existence after 1825, Sheffield began to build a reputation that would make its name synonymous with tool steel in the latter half of the nineteenth century.[46] The blacksmiths who prepared tools for the engineer also benefited from the introduction of cast steel. In 1847 Mark Fisher began welding cast steel to anvils to increase their wearing qualities and manufacture began under his patents.[47] Blacksmiths' tools in the pre-1850 period were also made increasingly from cast steel.[48]

Sheffield steel was imported by wiremaking firms such as Washburn & Moen, for the speciality manufactures of pianos and scientific devices.[49] This foreshadowed the later demand for Sheffield-made wire for steel ribs in umbrellas and crinoline wire for skirts. Sheffield steel could also be found in a myriad of other uses: clock springs and clockmakers' tools;[50] surgical instruments; pen nibs;[51] mint dies; engraving plates;[52] magnets; textile machine parts;[53] skates; and whaling lances and cutting spades.[54] The small amount of crucible steel used in these industries should neither obscure its tremendous impact on the American economy nor its great importance for Sheffield.

In 1850, four hundred American cutlery and edge tool establishments, well over a thousand for the manufacture of agricultural implements, as well as numerous machine shops and blacksmiths' concerns, offered an enormous potential market.[55] The Sheffield crucible steel industry expanded accordingly, and by 1854 growth hit a peak, with new furnaces appearing at the rate of one every two weeks.[56] Sheffield's American steel trade now reached a climax as exports to the US reached 21,998 tons in 1860 – about a third or more of the town's total output! This was a period when Greaves' Sheaf Works styled themselves as 'American Merchants' and when Biggin's 'America Works', Brookes & Crookes' 'Atlantic Works', Alfred Beckett's 'Brooklyn Works', Butcher's 'Philadelphia Works', and Wostenholm's 'Washington Works' proudly proclaimed the town's chief trading interest. Across the Atlantic, Sheffield merchants

dominated the selling of hardware in areas such as New York's lower Manhattan district, so that some makers 'became a stranger in their own land and infinitely better known in Broadway [than in Sheffield]'.[57]

Sheffield had the American market completely at its mercy, since competition in the US was virtually non-existent before 1860. Despite optimistic pronouncements to the contrary, the earliest American attempts at crucible steel manufacture were largely unsuccessful and short-lived ventures. The outlook did not appear very promising. Though the US had abundant supplies of natural ores, they were an unknown quantity compared with the well-tested uniformity of Swedish irons. Nor was it known whether another pre-requisite of the crucible steelmaker, the clay for the pots, could measure up to its English equivalent. In the late 1850s, producing only a few hundred tons of cast steel each year, and relying on annual imports valued at over £650,000, America was remarkably dependent on Sheffield. Concluded the *Scientific American*: 'This is a subject to which our people should direct their attention.'[58]

For Americans eager to compete with Sheffield manufactures, though, the prospects were not entirely unfavourable. The 1850s had seen the heyday of the Atlantic economy, fostered not only by the remarkable economic expansion of the US, but also by the relatively low level of American tariffs. But there were some ominous portents. In a situation in which Sheffield was 'indebted to the United States for the greater part of the activity that prevails in the trade of the town',[59] economic and political events left the Sheffielders vulnerable. In 1857 an American banking and financial panic once more plunged the steelmakers into crisis,[60] and, though trade swiftly recovered, worse was to follow with the outbreak of the American Civil War. Heavy orders for steel rifle barrels and tools for fortifications could not prevent severe disruption in the cutlery and tool firms, which began seeking orders elsewhere in China, India and South America.[61] This trend was strengthened when, in 1861, the US Congress passed the Morrill Act, one of the most important of a long series of tariffs levying progressively higher taxes on steel and hardware imports.

Even more disturbing for Sheffield manufacturers were reports of increasing American proficiency in the town's traditional crafts. The heavy edge tool trade to the US had been largely lost by the early 1850s, since the American artisan was 'ever willing to adapt his handicrafts to the exact wants of his customers'.[62] In New York American table knives were 'about the *same price* and *better finished* than the Sheffield article',[63] so that the English, who were also unable to match American delivery times, were reduced to trading in the more common lines. Yet Sheffield houses were said to be 'content with the business they are quietly doing, and only

laugh at what seems to them a good joke, knowing full well that their name and influence are known and felt throughout the whole civilised world, and some of these firms will not even stoop to decorate their goods by "labels, inscriptions and devices", for the purpose of "tickling the vanity of even Brother Jonathan"'.[64]

Moreover, in crucible steel manufacture the upsurge in demand had not been without its effect in America, where, by the 1850s, pioneer attempts had been made to cast steel in New York State, often with the help of Sheffield managers.[65] In Pittsburgh capital had also been invested in crucible steel ventures, steps had been taken to attract skilled labour, and efforts had been made to overcome native deficiencies in natural resources. The admonishment of the *Scientific American* elicited pointed rebukes from Pittsburgh entrepreneurs.[66] Disquietingly for English makers, one Sheffielder in Pennsylvania forecast in 1856 that America would be 'setting down, a year from hence, at the door of Sheffield manufacturers, a steel superior to any now manufactured in Sheffield, at a considerably less price'.[67]

Thus the 1850s, that golden age of Sheffield–American commerce, had ended by posing a number of questions: could the US succeed in manufacturing satisfactory crucible steel?; could Sheffield's cutlery and edge toolmakers recapture lost ground in the American market against domestic (and German) producers?; could the town modify its alleged complacency and conservatism and adapt to new technologies and products? To find the answer to these questions we must turn to the history of the American crucible steel industry and examine the involvement of Sheffielders with the US market.