

At the cutting edge: edge tool production in southern and south-west England, 1740 to 1960^{*}

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Abstract

The transition of edge tool making from a workshop to a factory industry is normally associated with the great metallurgical centres of Sheffield and the west midlands. It is assumed rather than proven that in southern England the old industry disappeared during the eighteenth and early nineteenth centuries, snuffed out by northern and midland competition. The paper proposes a different sequence of events. It contends, first, that in the early Industrial Revolution the pace was set, technologically, not in the great historic centres, but in south-west England, where water-powered hammers were first applied in the 1740s to the forging of large-surfaced items, such as scythes, spades and plantation hoes. And second that, whereas elsewhere in England – apart from Sheffield – hand-forging was in decline and by 1880 had largely ceased, in Kent and Sussex it underwent a revival. Located in country blacksmiths' shops, the last edge tool forge closed about 1970, about the same time as the last water-powered forge, in the Black Country.

For the purposes of this paper edge tools are defined as hand tools made from wrought iron with a cutting edge of welded steel. They changed little in their configuration and mode of construction from Roman times to the mid-nineteenth century, when traditional welded types began to be superseded with all-steel tools.¹ The tools found on Romano-British sites strongly resemble those featured in early twentieth-century trade catalogues, or stocked by hardware

^{*} This is an expanded version of an earlier paper read at the S. R. Epstein Memorial Conference, 'Technology and human capital formation in the east and the west', held at the London School of Economics on 21 June 2008, and published subsequently on the School's website. In turn it draws on my paper on edge tool patterns, 'Agricultural hand tools in the Industrial Revolution', in N. Harte and R. Quinault (eds), *Land and society in Britain, 1700–1914* (1997), pp. 57–77.

¹ See R. Burgess, 'History', billhooks.co.uk. This is an over-simplification. Important differences existed between Britain and mainland Europe. Steel being far more expensive than iron, in Britain edge tools were made from two metals – low-carbon wrought iron and high-carbon blister, cementation or crucible steel – in ratios of 6–10 to 1. Much of Europe on the other hand, used just one metal, a low-grade steel, known as German or natural steel, which was made by decarburizing cast-iron in a furnace. 'Patent' scythes with cast steel blades and riveted iron backs were made in Sheffield from the 1790s. Bessemer hot-blast and Siemen's open-hearth steels, so-called mild steels, came into general use from the 1860s, and laminated iron and steel plate from the 1890s. Unlike true steel, carburized iron would not hold an edge, and required frequent sharpening, or in the case of scythes, hammering on an anvil. Mild steel could be pressed and stamped but was difficult to weld.

stores and garden centres today.² In earlier times, and for many tasks even now, edge tools were indispensable, and for that that reason, edge tool manufacturing would have ranked as a strategic industry. The tools were essential for a wide range of agricultural and related tasks, and their manufacture a locally important rural trade. Yet, neither edge tools nor the edge tool trades rate more than a passing mention in the standard histories. Moreover, the specialist literature, while extensive, is concerned primarily with Sheffield and the west midlands, the historic centres of the hardware industries, to the neglect of other regions, and the crucial early and middle stages of the Industrial Revolution. This paper will hopefully go part way towards making good the gaps.

Edge tool making was a recognized artisan trade, and edge tool smiths a separate class of metalworker, distinct from whitesmiths and blacksmiths with whom they are often confused. The received wisdom as to its progress during the Industrial Revolution rests on two assumptions, neither as yet properly tested. The first is that by the early nineteenth century edge tool making in southern England had effectively ceased, destroyed by northern and midland competition. And second, that the technical innovations which transformed edge tool making from a workshop into a factory industry, were pioneered in Sheffield and the west midlands. The two most important findings to have emerged from this research, both contrarian, are first, that a technological revolution took place in south-west England, beginning in the mid-eighteenth century, whose principle feature was the application of water power to the plating and steeling of tool blades and bodies, crucial operations hitherto performed by hand. And second, in south-east England in the nineteenth century, there was a revival of hand-forging, at a time when elsewhere in Britain, apart from Sheffield, traditional tool making was in terminal decline or had entirely ceased.

The timing and direction of industrial change in south-west and south-east England differed from the prescribed pattern modelled on the experience of the textile and iron industries.³ Technologically the pace was set not by Sheffield, Birmingham, or the Black Country, but by a region with no prior tradition, still less a national reputation, in tool making. The water-powered hammer was responsible for a breakthrough in output and productivity, especially in the production of large-surfaced tools, such as spades and plantation hoes, in which south-western manufacturers enjoyed a competitive advantage over their northern and midland rivals until the 1820s.

² See K. D. White, *Agricultural implements of the Roman world* (1967); Collins, 'Agricultural hand tools', pp. 57–8. Here we will be concerned with those classes of tool used in agriculture, forestry, mining, and general labouring. They included agricultural tools (scythes, sickles, reaping and fagging hooks, weeding, thinning and digging hoes, dock and thistle spuds, mattocks, digging forks, manure forks, hay forks, hay rakes, hay knives, sheep shears); forestry and woodmen's tools (axes, hatchets, adzes, billhooks, shaves, pruning, trimming, gorse, hedging and slashing hooks, thatching

hooks, log splitters); mining and general labouring tools (spades, shovels, pickaxes) and plantation tools (cane knives, machetes, digging hoes). Artisan and tradesmen's tools lie outside the scope of the present study, although many of these were made by the same firms as agricultural and woodmen's tools.

³ Maxine Berg, *The age of manufactures, 1700–1820* (1985), part 2, 'Pathways to the Industrial Revolution', esp. ch. 11; and Maxine Berg *et al.* (eds), *Manufactures in town and country* (1983), should be read in conjunction with this discussion.

The following discussion is in four parts. Section I begins by examining the history of edge tool making in the subregions: south-west, south-central, and south-east England, before reviewing the evidence of occupations contained in the 1841 census. It then turns to edge tool production in other areas of the British Isles. Industrial progress in south-west England is compared with that in Sheffield and the west midlands in Section II. Section III takes a closer look at the tilt hammer, the dominating element in this first stage in the mechanization of edge tool production in the early Industrial Revolution. Here we seek to explain why the tilt hammer was first adopted in the mid-eighteenth century, and in the south west rather than in the two old established centres. Finally section IV addresses the broader issue of the coexistence in the early twentieth century of different types and sizes of firm and levels of technique. A conclusion (Section V) draws the paper to a close.

I

In this section we consider the regional distribution of edge tool making throughout Britain and Ireland tracing the history of edge tool making in each region.

(a) *South-west England*

We begin in south-west England where the research has identified 27 water-powered 'hammer mills,' eight in Gloucestershire, 12 in Somerset, six in Devon, and one in Cornwall. The majority of these were specialist edge tool manufacturers, although large-surfaced tools such as spades and digging hoes were sometimes made in ironworks and foundries as sidelines.⁴ Figure 1 and Table 1 shows the location and dates of establishment and closure of both water-powered forges and hand forges in south-west and south-central England. So far, the first recorded use of water-powered hammers for forging edge tools was at Coaley in Gloucestershire and Mells in Somerset, both in 1744.

Gloucestershire possessed at least six, and possibly eight, hydraulically powered forges, all dating from before 1801 (Table 1).⁵ In 1744, the Coaley Iron Works, a former corn and fulling mill on the River Cam near Dursley, was converted by its new owner, Nathaniel Underwood, to an edge tool mill by the addition of hammers. A sale notice of 1855 described it as consisting of five workshops, 19 forges, a grinding mill with three grindstones, and pair of large mechanical shears, together with five waterwheels, four plating hammers with cast steel blocks and heads, plus a further three large hammers and several sets of bellows.⁶ A separate hammer in the field

⁴ T. S. Ashton, *Iron and steel in the Industrial Revolution* (fourth edn, 1968). According to Ashton (p. 242), in the early eighteenth century, as much as one-half of the domestic output of manufactured iron goods was produced by works with communications with the River Severn. Inexplicably, both Ashton and Harris, *The British Iron Industry, 1700-1850* (1988), appear to have overlooked the large Gloucestershire Severn-side ironworks identified here.

⁵ I am grateful to David Grace for kindly supplying me with much of the Gloucestershire information,

notably for Cirencester. The Mills Archive at Reading lists in its database 16 water-powered 'forge mills' in Gloucestershire, only three of which feature in my Table 1. The majority though were iron mills or foundries, one a 'tilting mill' (making steel), and another a tinplate works, several of which may also have made edge tools.

⁶ R. Wilson, 'Coaley Mill: corn, cloth and iron-works', *Gloucestershire Soc. for Industrial Arch. J.* (1966), pp. 44-5.

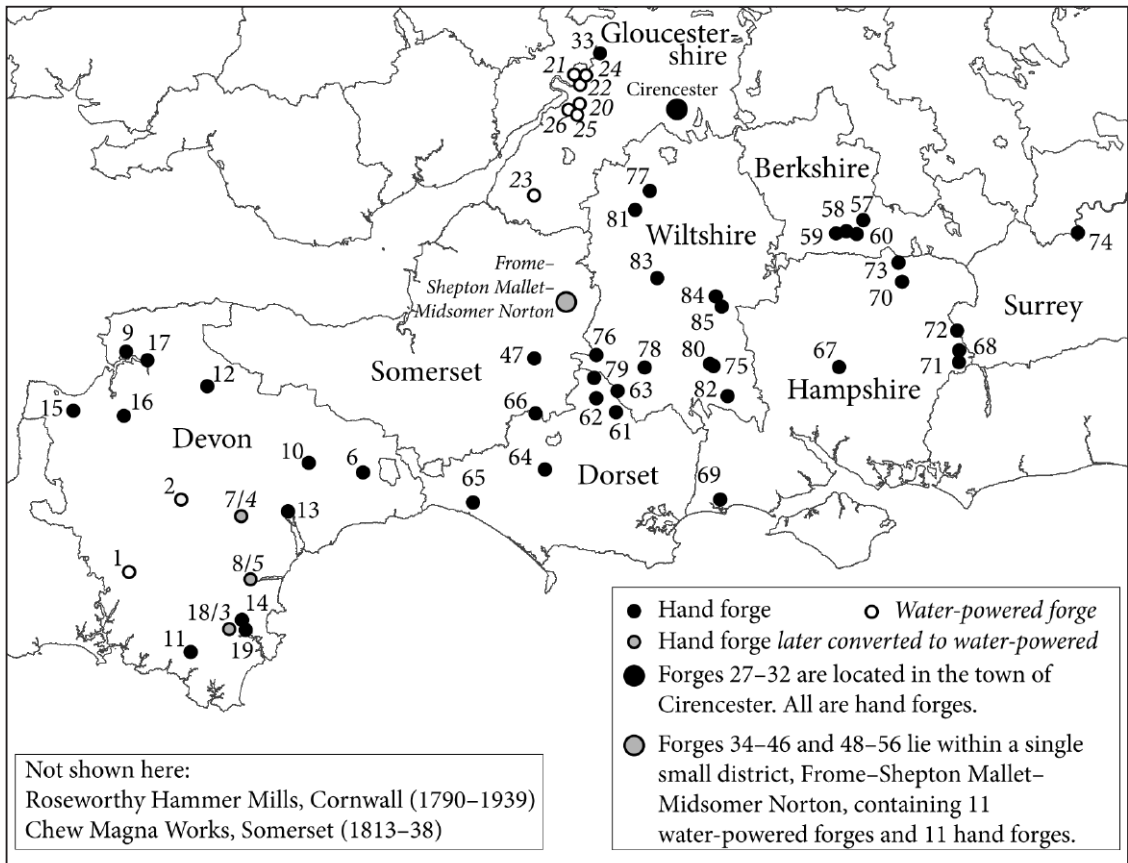


FIGURE 1: Location of water-powered and hand-operated forges in south-west and south-central England, c.1740–1960. Numbers refer to Table 1.

Source data for county boundaries: A. E. M. Satchell, L. Shaw-Taylor and E. A. Wrigley, 1831 *England and Wales ancient counties GIS* (2016). This dataset was created with funding from the ESRC (RES-000-23-1579), the Leverhulme Trust and the British Academy. A description of the dataset can be found in A. E. M. Satchell, *England and Wales ancient counties 1831 documentation* (2016) available at: www.geog.cam.ac.uk/research/projects/occupations/datasets/documentation.html.

adjoining the main mill is shown on the 1881 1:2500 inch Ordnance Survey map. By c.1900, power was supplied by three waterwheels, two turbines, an oil engine and a steam engine (later replaced by a turbine).⁷

With a five-acre pond, 16½-ft fall, and power rating of 20–30 kW (32–48 hp) in 1850, Coaley was among the south west's largest manufacturers. In 1850 it was said to have employed about 40 men and boys. A 1914 catalogue advertised 36 patterns of shovel (a Coaley speciality),

⁷ See also Wilson, 'Coaley Mill', pp. 42–50; 'Industrial Gloucestershire, 1904', www.coaley.net/indglos_1904/; Illustrated Catalogue, issued by Leonard Thomas & Co., Coaley, c.1900–20 (copy in Ryder Collection, Gloucester City Library). I am indebted to Professor Tann, Dr Ray Wilson, David Grace, and Osman Goring (the present owner), for this and other information about the Coaley Works.

TABLE 1: Dates of establishment and closure of forges in southern England, c.1730–1970, shown in Figure 1 (From first reference or date of establishment To last reference or date of closure.)

<i>No</i>	<i>Location</i>	<i>From</i>	<i>To</i>	<i>No</i>	<i>Location</i>	<i>From</i>	<i>To</i>
Berkshire				63	Shaftesbury	1824	
<i>Hand forges</i>				64	Cerne Abbas	1816–17	1824
57	Bucklebury	<1736	1913	65	Bridport	1824	
58	Thatcham	<1768	1823	66	Sherborne	1824	
59	Newbury	1791	1820	79	Gillingham	1747	
60	Thatcham	1900	1925	Gloucestershire			
Devon				<i>Water-powered forges</i>			
<i>Water-powered forges</i>				20	Coaley	1744	1944
1	Tavistock	1800	1850	21	Framilode	<1786	1809
2	Sticklepath	1814–15	c.1950	22	Frampton-on-Severn	1786	
3	Harberton	1820	1954	23	Frenchay-in-Winterbourne	later 18th century	1879–85
4	Dunsford	1826	Still working	24	Moreton Valence	1761	1879–85
5	Holbeam	1830s	1942	25	Cam	<1816	–
<i>Hand forges</i>				26	Cam	<1821	1831
6	Honiton	1762		<i>Hand forges</i>			
7	Dunsford (see 4)	mid-18th century	1826	Cirencester			
8	Holbeam (see 5)	late 18th century	1830s	name of maker			
9	Barnstaple	1815–16	1856–57	27	Lane	<1772	1886
10	Bradninch	1816–17		28	Cox	1784	1791
11	Modbury	1816–17		29	Wilkins	1772	1784
12	Molton	1816–17		30	Deighton	1784	1861
13	Exeter	1824		31	Hunt	1820	
14	Totnes	1824		32	Jackson	1894	1911
15	Woolfardisworthy	1856		City of Gloucester			
16	Torrington	1856		33	Cox/Cox-Buchanan	1784	1830s
17	Barnstaple	1856	1930	Hampshire			
18	Harberton	1857		<i>Hand forges</i>			
19	Ashprington	1857		67	Winchester	<1761	1808
Dorset				68	Conford	1800	1915
<i>Hand forges</i>				69	Christchurch	1816–17	
61	Fontmell	1714		70	Basingstoke	1824	
62	Orchardleigh	1803		71	Griggs Green	1861	1895
				72	Dockenfield	1891	1895
				73	Bramley	c. 1920	c.1970

<i>No</i>	<i>Location</i>	<i>From</i>	<i>To</i>	<i>No</i>	<i>Location</i>	<i>From</i>	<i>To</i>
Somerset				53	Chilcompton 1*	1840	
<i>Water-powered forges</i>				54	Stratton-on-Fosse*	<1840	1939
34	Mells (Upper Works)	1744	1891–5	55	Doultong*	1861	1914
35	Nunney (see 46)	1760	<1895	56	Chilcompton 3	<1840	1935
36	Great Elm	1792	<1895	Surrey			
37	Mells (Lower Works)	<1791	<1895	<i>Hand forge</i>			
38	Nunney	1838	<1895	74	East Molesey	1859	
39	Chantry	<1806	<1895	Wiltshire			
40	Railford	<1830	<1895	<i>Hand forges</i>			
41	Gurney Slade	1831	1934	75	Salisbury	15c	1855
42	Stoke Lane	<1817	<1886	76	Mere	<1683	1889
43	Stratton-on-Fosse	<1840	1939	77	Christian Malford	<1704	1783
44	Chilcompton 2	c.1840	1920	78	Tisbury	<1744	
<i>Hand forges</i>				80	Fisherton Anger	1769	
45	Mells	1698	1744	81	Chippenham	1793–98	
46	Nunney	1717	1760	82	Downton	1793–98	
47	Castle Cary	1719		83	Great Cheverell	1812	1815
49	Stoke Lane	<1744	<1886	84	Netheravon	1849	1906
50	Ashwick	1818	1831	85	Figheledean	1889	1915
51	Gurney Slade	1818	1831 (see 41)				
52	Picton	1833	1833				

14 types of fork, and a variety of weeding, digging, woodcutting, gardening and drainage tools.⁸ In the 1920s, spades and shovels were made from mild steel, plated under the hammer, then shaped in a hydraulic press to give the correct curvature. Following its sale to A. & F. Parkes, a leading Birmingham manufacturer, spades and shovels stamped 'LT' or 'Leonard Thomas' (after the previous owner), continued to be produced there until its closure in 1944, due to shortages of labour and materials. At that time, one waterwheel and two tilt hammers were still in operation.⁹

Two water-powered works, Upper and Middle Mills, leased to Nathaniel and Robert Underwood (co-partners at Coaley), were situated further down-river at Cambridge. The former was converted to an ironworks and edge tool mill in 1791,¹⁰ while the latter, 'a former fulling mill now an iron mill', was described in the *Universal British Directory* as 'a very extensive manufactory of edge tools'.¹¹ A further four works stood on the River Frome. The Lower Iron Works at Winterbourne was built in 1761, and the Upper Iron Works, a grist mill,

⁸ Wilson, 'Coaley Mill', p. 46.

⁹ *Ibid.*, pp. 46–8.

¹⁰ Pers. comm. Prof. Jennifer Tann.

¹¹ *Universal British Directory* (1791), p. 854.

converted to edge tools in 1798.¹² Amalgamated in 1810, the combined enterprise conducted a large business in spades, shovels and hoes with other parts of Britain and the Colonies.¹³ Little is known about the Moreton Valence works, erected probably in the 1780s, or about the Frenchay Iron Company of similar date, beyond the fact, of enormous significance for the development of the edge tool trades in the west midlands, that during the Napoleonic Wars, a dozen men from these two villages were recruited by John Gilpin to work at his new water-powered mill at Churchbridge near Cannock, in Staffordshire.¹⁴ Framilode Mill in Eastington parish near the River Severn, referred to in a lease of 1786 as 'those stack of iron mills' is believed to have also made edge tools in addition.¹⁵ Their manufacture at Fromebridge Mill at Frampton on Severn, is better attested. A former flour, grist and slitting mill, acquired in 1767 by John and William Purnell, it was claimed in 1789 to be 'one of the largest and compleatest works in the Kingdom for making iron and steel wire'.¹⁶ In 1790 the plant consisted of an edge tool, rolling block, and tilting mill, all 'under one roof'.¹⁷ When the business was advertised for sale in 1830, it was described as fitted out for the different branches of the iron trade, including edge tools. With a two-mile-long dam and a steam engine installed in 1824, the power available was stated to be 'very great'.¹⁸

For a short while in the third quarter of the eighteenth century, Gloucestershire was a leading producer of both hand- and machine-forged tools. The Cotswold town of Cirencester enjoyed an 'unrivalled reputation for 'heavy edge tools' and curriers' knives, all made by hand, which Birmingham manufacturers are said to have tried to replicate without success.¹⁹ The 1768 Cirencester Poll Book lists 15 makers, working mainly at the commercial end of the town, four miles distant from the nearest grinding mills at Bagendon on the River Churn.²⁰ The combined workforce of smiths, strikers, journeymen, and apprentices, may have numbered as many as 60, large by eighteenth-century standards, and possibly the historic peak. Competition from the newly opened water-powered works in the Cam and Frome valleys would have been a major factor in the industry's decline after 1780.

References to hand-forging in the standard archival and literary sources are disappointingly few. In the City of Gloucester, an old cutlery centre, the last edge tool makers, Cox Buchanan

¹² C. H. B. Elliot, *Winterbourne, Gloucestershire* (new edn, 1999), p. 64; J. Fisher and D. Fisher, *Bygone Bristol, Frenchay and Stapleton on old postcards* (nd), illus. 34, 35, 49–51. This and other information was kindly supplied by Frenchay Village Museum.

¹³ Elliot, *Winterbourne*, p. 64.

¹⁴ Fisher and Fisher, *Bygone Bristol*, p. 64; E. J. Homeshaw, 'Edge tools', *VCH Staffordshire*, II (1967), pp. 259–62.

¹⁵ Pers. comm., Prof. Jennifer Tann, who supplied me with copies of the following archival sources: London Metropolitan Archives, Sun Insurance Registers, 488,383, 1784.F, no. 251,943; 17 Dec 1767, Gloucestershire Archives (hereafter GA), D149/175; D2957/137 *passim* (deeds and other manuscripts formerly Gloucester City Library, Box 27, bdle 17; Box 33, bdles 3–40, bdles 4, 27,

17). See also her *Gloucestershire woollen mills* (1967), pp. 138–41.

¹⁶ S. Mills, 'Fromebridge Mill, Frampton on Severn', *Gloucestershire Soc. for Industrial Arch. J.*, 1998, pp. 6–22; S. Rudder, *A new history of Gloucestershire* (1779), pp. 63, 452.

¹⁷ GA, D2957/137, formerly Gloucester Library Box 33, bdle 4.

¹⁸ *Birmingham Gazette*, 29 Aug. 1830; Science Museum Library, London, The Simmons Collection of records relating to British Windmills and Watermills, vol. A–H, Gloucester Watermills.

¹⁹ Rudder, *New History*, pp. 63, 345, 452; ex. inf. David Grace.

²⁰ Cirencester Poll Books, Gloucester Library Collections.

(also lessees of the Coaley Iron Works), disappeared from the City lists soon after 1830.²¹ The 1871 census returned just three makers (of curriers' knives) in Cirencester, the town's last practitioner retiring in the late 1920s.²² In 1890, the number of water-powered firms in the county had been reduced to just two, killed off by west midland competition.

The 12 water-powered works in Somerset were mostly established between 1800 and 1840 in the east Mendips, in the Frome–Radstock–Shepton Mallet triangle, in and around the small market town of Mells, the hub of the famous Fussell empire, dubbed the 'Iron Burgh' (see Table 1). In 1744, James Fussell, an edge tool maker of Stoke Lane, leased a plot of land on the Mells stream in the Warbury Valley on which he erected a waterwheel, a tilt hammer, and blade mill for 'grinding edge tools and forging iron plates'.²³ The business prospered, and by 1830 comprised six works – at Mells (est. 1744, 1791), Nunney (1760), Great Elm (1791), Chantry (1806), and Railford (1830) – each specializing in a different aspect of the trade. In 1804, the Mells plant consisted of 24 hearths and anvils, 140 grindstones, and 10 or more tilt hammers, driven by nine waterwheels. With sales throughout the West Country, southern England, south Wales, Ireland, and overseas, and renowned for its superior skills in hardening edge tools and the quality of its scythes (said to equal to those of the Black Country), the firm must then have ranked as the largest in the country.²⁴ As business expanded, ever larger volumes of water were needed to drive still more wheels, and ensure supplies during times of shortage. Delays in upgrading the plant enabled west midland firms to catch up, and eventually overtake it. In a letter to his landlord of December 1829, John Fussell stressed the urgent need to spend thousands of pounds on steam engines and improved plating and stamping machinery to keep pace with the recent rapid improvements made by 'our competitors in the north'.²⁵ A round of new investment, including a small steelworks, temporarily restored the firm's fortunes, but not its ranking. To counter falling profits, at the onset of the Great Depression the individual businesses were incorporated into a single holding company, but to no effect, as by 1881 the business was bankrupt, with debts of £60,000.²⁶ It staggered on, to close finally in 1894. The goodwill was acquired by the Worcestershire firm of Isaac Nash, which continued making Fussell patterns, stamped with the original trademarks, for sale throughout south-west and south-central England, all former Fussell territory.²⁷

Fussell's size and reputation appears to have encouraged rather than stifled imitation. In addition to two new Fussell works at Railford and Chantry, at least seven hand- and three water-

²¹ *Bailey's Directory* (1784); *Gell and Bradshaw's Gloucester Directory* (1820); Pigot & Co, *National Commercial Directory* (1830), p. 143; *Gloucester Incorporated Chamber of Commerce, Supplement to 56th Report 1897*, copy in Gloucester City Library.

²² Pers. comm., David Grace.

²³ Somerset RO, DD/X/HNR 484 N20. On the history of the firm see R. Thornes, *Men of iron, Fussell of Mells* (2010), and Burgess's review of it in *Tools and Trade Hist. Soc. Newsletter*, Winter 2010; K. Griffiths and R. Gallop, *Fussell Ironworks, Mells* (1964); R. Athill, *Old Mendip* (1964), pp. 69–73, and *Mendip: a new study* (1974), pp. 167–8; *Fussell of Mells: a reproduction*

of the late nineteenth century catalogue (Tools and Trades Hist. Soc., 2001); V. Littlewood, 'The Fussells of Mells', *Tools and Trades Hist. Soc. Newsletter*, 69 (2000), pp. 24–9; E. Tylee, 'An old Somerset industry', *The Somerset Yearbook*, 1934, p. 62ff.; C. Wood, 'History of the Fussell family', *Somerset Standard*, 7 June 2001.

²⁴ J. Collinson, *The history and antiquities of Somerset* (1791).

²⁵ Athill, *Old Mendip*, p. 64.

²⁶ *Martineau and Smith's Hardware Trades J.*, 31 Mar. 1882.

²⁷ Pers. comm. Bob Burgess, Tilshead, Wilts, Aug. 2005 and R. Athill, Oakhill, Bath, Aug. 1985.

powered works were established in east Mendip during the first half of the nineteenth century. The Gurney Slade works in Binegar parish, founded by James Fussell Steeds (a prestigious appellation), was fitted with two wheels, one driving the grindstones, the other the 'Great Hammer': it was demolished in 1931 to make way for a water treatment works.²⁸ A single wheel, tilt hammer, and grindstones were installed about 1840 at Chilcompton Mill, probably the last new water-powered works in the south-west region. Although it closed in the 1920s, edge tool making continued at a hand forge in the upper village away from the river, the grindstones being driven by electricity.²⁹ The 1840 tithe map shows a cluster of small forges at Stratton-on-Fosse, fed by a stream running along the hillside, with sufficient flow to power a blade mill.³⁰ Kelly's 1861 Directory lists an edge tool maker at Doultong on the River Steppe: an 1886 map depicts a small works alongside a weir and engine house. An 'iron works', power source unknown, at Stoke Lane below Mells, in the occupation of Messrs Fussell and Wise, is mentioned in 1871, but shown on an 1884 map as disused.³¹ Burgess notes a water-powered forge making edge tools and shovels at Chew Magna, near Wells, between 1813 and 1838. Interestingly, a number of edge tool makers, formerly of Chew Magna, were returned in the 1841 census as residing at Coaley, having probably been re-employed by the Coaley Iron Works.³² The hand forges at Chilcompton and Stratton-on-Fosse were still working in the mid-1920s, the latter until 1939.

Devon stands out insofar as the first water-powered edge tool mills were established in the early nineteenth century, much later than in either Gloucestershire or Somerset, but they endured longer, with four of the five original works still operational in 1940. The earliest, the Tavistock Iron Works, was established in 1800 by a partnership headed by John Gill, a local banker with extensive mining interests, for the manufacture of scythes, reaping hooks, and shovels.³³ A sizeable enterprise, it was described in 1815 as an edge tool works, anchor smithy and foundry, with nine waterwheels and eight hammers. Its early history is unclear. One account claims that the works was sold in 1815 and the hammers disposed of: another that it underwent merely a change of ownership, and with Gill still at the helm, continued making edge tools until about 1850, when it became a foundry. Plans to add a steelworks never materialized, and in 1867 the business was bought by Messrs Nicholls and Mather, 'manufacturers of engines, waterwheels, shovels and 'hammered iron'; the business closing in 1897.

Four mills were erected on fast-flowing Dartmoor rivers. Hill Mill at Harberton, a run-down fulling mill, was converted to an 'edge tool factory' in 1824 by the addition of tilts driven by a large waterwheel fed by a leet from the River Harbourn.³⁴ In 1850, the plant consisted of two wheels, four hammers, two grindstones, a polishing wheel and an iron splitter. A steam engine

²⁸ Ex. inf. Mrs Barbara Thorner, Gurney Slade, 17 July 1985. See also *Binegar: a short history* (1974); and Dom Hubert Van Zeller, *Willingly to school* (1952).

²⁹ Ex. inf. George Gorringer and David Strawbridge, Bowden Hill, 17 July 1985.

³⁰ Pers. comm. R. Athill, Oakhill, Bath, 5 Aug. 1985.

³¹ Ibid.

³² R. Burgess, www.billhooks.co.uk/edge-tool-makers-of-somerset.

³³ G. Woodcock, *Tavistock's yesterdays*, X (1994),

passim. See *Devon Archaeological Soc. Proc.*, 67, 2009, for a report on the works. However, Martin Watts (pers. comm.), millwright and mills historian, expresses doubts about the interpretation offered there.

³⁴ Mrs Nora Peters of East Hanham, Devon (daughter of the last works manager) kindly supplied me with an excellent first-hand account with floor plan of this West Country works as it was in the early 1930s (see Figure 5). I am grateful to Stanley Oldfield for his comments and corrections.

was installed later, and two of the hammers retired in the early 1920s. From 18–20 in 1890, the workforce had shrunk to eight by the late 1930s, and at closure in 1952, to four. Holbeam Mill on the River Lemon, a hand forge, formerly making knives and fish hooks for the Newfoundland Fisheries, installed a pair of hammers about 1830. Sold in 1910 to the Birmingham spade maker, A. & F. Parkes, the business closed in 1942 and the hammers afterwards removed to the Science Museum, where they became part of the permanent display.³⁵ Dunsford Mill on the River Teign was a hand forge until 1821 when its new owner enlarged the premises and erected a tilt hammer, later replaced by two trip hammers. At least five smiths plus several apprentices and other employees worked there in 1851. Of the south-west region's original 27 water-powered works, only Dunsford survives, making all-steel tools forged by electrically driven hammers installed in 1937.³⁶

The Finch Foundry at Sticklepath on the River Taw is one of Britain's best-preserved edge tool mills.³⁷ According to the official history, in 1815 its founder, William Finch, a whitesmith formerly employed at the Tavistock Iron Works, erected two tilt hammers purchased from his one-time employer in a disused woollen mill. Another account places their acquisition much later, about 1850, but these may have been replacements for the original set. In 1851, all five of the founder's sons and a grandson were employed there. In 1900, the plant comprised three wheels, two hammers, a power shears worked off the main shaft, a bellows, a pair of grindstones, and a foundry, making spades, shovels and the usual range of agricultural tools. A waterwheel, supplemented by a steam engine added about 1860, was the main energy source throughout. By the 1920s, iron and steel laminate and rolled bar steel had mostly replaced wrought iron and welded steel. Following closure in 1952, the site was redeveloped as a working industrial museum, subsequently gifted to the National Trust.

The dates of origination and closure, where known, of the south west's 27 water-powered forges are analysed at approximately 50-year intervals in Table 2. Of these, 13 date from the eighteenth century, the two earliest from 1744 in Gloucestershire, four in Somerset, and one each in Devon and Cornwall. All six Devon and seven of the 11 Somerset forges were founded between 1801 and 1840. Cornwall yielded only one forge, which, in view of its abundant water supplies and extensive mining industry, seems an implausibly small number. It may be that large-surfaced tools, particularly spades and shovels, were made in iron foundries, as a sideline. In 1900, 10 of the original 27 works were still working: one in Cornwall, two in Gloucestershire, three in Somerset and four in Devon. Edge tool mills tended to be long-lived: 14 of our sample for more than a hundred years, the Coaley Works for exactly 200, and the remainder typically for 60–80 years

³⁵ J. Chard, *Along the Lemon* (rev. edn, 1980), pp. 23–34.

³⁶ Ex inf., Alec Morris, Dunsford, 20 July 1985; and C. A. Jewell, former Keeper of the MERL, who recorded the Dunsford works in the 1960s. See also W. M. Williams, *The country craftsman* (1958), p. 69.

³⁷ The Sticklepath Foundry has been extensively researched and recorded. R. A. Barron, *The Finch Foundry Trust* (nd), is the definitive historical account.

I am grateful to Mr Barron, a Finch descendent, for sharing with me his unique knowledge of the business and production techniques. See also D. Gordon, 'Industry in a Devon village', *Country Life*, 14 June 1944, pp. 62–4, which contains excellent photographs; J. K. Major, *Finch Brothers Foundry, Sticklepath, Okehampton, Devon* (nd); K. S. Woods, *Rural crafts of England* (1949), pp. 39–43.

TABLE 2: Numbers and dates of operation of water-powered hammer forges in south and south-west England, 1744–1960

	<i>Gloucestershire</i>	<i>Somerset</i>	<i>Devon</i>	<i>Cornwall</i>	<i>Total</i>
Numbers of forges	8	12	6	1	27
Number of forges founded in:					
1744–1800	7	4	1	1	13
1801–20	1	3	3	0	7
1821–40	0	5	2	0	7
Post-1840	0	0	0	0	0
Numbers of forges active in:					
1750	1	1	0	0	2
1800	7	4	1	1	13
1850	4	11	4	1	20
1900	2	3	4	1	10
1940	1	0	4	0	5
1960	0	0	1	0	1

The majority of works ranked as large- or medium-sized by early nineteenth-century standards. Nine were in multiple ownerships – the Underwoods with three, all in the Cam Valley, the Fussell family six in east Mendip, and the Purnells two. The 1880s saw the first acquisition of a south-western firm by a midland manufacturer. During the course of the following half-century, three were bought as going concerns, while the patterns and goodwill were purchased at closure in two. The discovery at Dunston Forge of a box containing the metal stamps of some 20 or so mostly midland firms, implies that subcontracting may have been common practice between the wars, contributing to the survival of local firms, and the curious fact that many of the ‘traditional’ iron and steel welded tools bearing the marks of midland manufacturers were made in south-west England.³⁸

(b) South-central England

The Cotswolds formed a natural boundary between the two historic branches of the industry. From Cirencester eastwards hand-forging was the rule, with the grindstones driven mostly by animals, usually donkeys, or by human muscle, rather than by waterwheels. After 1900, oil engines, water turbines and electric generators supplied power for lighting and machinery. In the new century, rolled mild steel plate and steel scrap became the standard materials, eliminating the need for welding, and enabling ordinary blacksmiths to make simple forged or riveted tools, such as weeding hoes. The evidence for the distribution of hand forges is shown in Table 3, from which both the early disappearance of hand-forging in the West Country, and its protracted survival in south-east England, is all too evident.

³⁸ The stamps were seen by the author on his visit to the firm in 1987.

TABLE 3: Regional distribution of hand forges in south and south-west England at various dates, 1800–1950

	South West	Central South	South East	Total
Operational in:				
1800	25	20	<15	60
1850	12	9	c.25	46
1900	5	9	c.55	69
1930–36	5	1	12	18
1950		<3	<3	<6

Cirencester and Salisbury were the last strongholds of traditional tool making in southern England, the latter the last town in the region with a still functioning cutlers' guild in the mid-eighteenth century.³⁹ In 1754, the Swedish traveller, Reinhold Angerstein, reported seeing half a dozen scissor and knife smiths at work in the city itself, and on the outskirts, other smiths making scythes from Swedish iron and cementation steel supplied by the Crowley Ironworks near Newcastle.⁴⁰ By 1855 this once thriving industry had been reduced to a single practitioner.⁴¹

The Down family had operated an edge tool forge at Mere on the Wiltshire–Somerset border from the late seventeenth to the mid-nineteenth century.⁴² An 1683 inventory of the contents of Michael Down's 'Shoppe', testifies to a sizeable business comprising a forge, waterwheel and three grindstones, plus a stock of three tons of iron (sufficient for making 1200–1500 billhooks), three hundredweight of steel, 20 dozen reaping hooks, and 10 dozen 'spad' (spade) moulds. Three edge tool smiths of that surname featured in the 1851 and 1861 censuses, in 1881 just one.

The Wiltshire Directory for 1885 lists three edge tool makers – at Salisbury, Netherton, and Mere – and the 1915 volume only Nias Sheppard of Figcheldean, shoeing smith and hoe maker.⁴³ The Shepherd family are said to have taken over a number of village smithies in the Salisbury plain district in the late nineteenth century, and Netherton Forge, famous for 'Buckland hoes', to have once employed up to ten workmen.⁴⁴

Further east, edge tools and plane irons (a local speciality) were made at Newbury, Thatcham, Winchester and Basingstoke.⁴⁵ A forge and waterwheel had stood in the village of Bucklebury (west Berkshire), on the diminutive River Pang, since the early eighteenth century. Its stove-type cupola furnace has since been acquired by the Museum of Iron at Coalbrookdale.

³⁹ R. Haskins, *The ancient trade guilds and companies of Salisbury* (1912), pp. 370–8.

⁴⁰ R. R. Angerstein, *Illustrated travel diary, 1753–55*, trans. T. P. Berg (2001), pp. 17–18.

⁴¹ *Kelly's Directory, Wiltshire* (1855 edn).

⁴² M. Tighe, 'Edge tool making and the Down family', *Mere Papers* 4 (1997), pp. 68–72. I am grateful to Mr Tighe for this and other information about the Down family and their forge.

⁴³ *Kelly's Directory, Wiltshire* (1855, 1875, 1880, 1889, 1903, 1911, 1915 edns); *J. G. Harrod and Co's Directory* (1865).

⁴⁴ R. Burgess: 'British edge tool makers: A to G', www.billhooks.co.uk.

⁴⁵ J. and M. Rees, 'Plane making in Thatcham and Winchester', *Tools and Trades History Society Newsletter*, 67 (1999), pp. 33–40.

A photograph of c.1900, shows a signboard above the entrance to the shop reading 'edge tool maker', probably a conceit, as no tools bearing the firm's mark have been found in the district.⁴⁶ Berkshire's last-recorded maker, George Pyke of Thatcham, made shaves, drawknives, and billhooks from old files and rasps for use in the local turneries and coppices.⁴⁷

The Moss family of Cornard, near Bramshott on the Hampshire–Surrey border, was a rare example of an industrial dynasty. Established in the early nineteenth century they became the main suppliers of agricultural and forestry tools in the Guildford and Farnham districts, with a reputation as far away as London for the temper of their axes. Between 1800 and 1920, some 48 members of the Moss family worked as blacksmiths, and 15 as edge tool smiths, based at three forges. At one time, it was claimed, a Moss shoeing forge stood at almost every major staging post on the main roads between London and the coast, serving as outlets for Moss tools. Production methods were strictly traditional – steel strips and wedges hand-forged onto wrought-iron backs. The main business ceased in 1915 due to labour shortages. The patterns and rights to the axe-tempering process using silver sand were afterwards acquired by the Black Country firm of Elwell, which featured Moss axes in its catalogues up to the 1950s.⁴⁸

Alfred Willis of Bramley in north Hampshire described himself as the last edge tool maker in southern England. The son of a blacksmith, he showed an early aptitude for fashioning hooks from old blacksmith's rasps. Combining tool making with shoeing and general ironwork, he made as many as 300–350 tools in a good year. Willis's hooks were exhibited at major agricultural shows, including the 'Royal' and are still keenly sought after by collectors.⁴⁹ Around 1900, three Surrey blacksmiths – at Farnham, Guildford and Milford, and possibly elsewhere – made farm and garden hoes from commercially supplied steel blanks. John Windsor at East Molesley was possibly a descendant of the two makers of that name working at Salisbury and Basingstoke in the early nineteenth century.⁵⁰

By 1880, traditional tool making in England had largely ceased, apart from Sheffield, where most sickles and reaping hooks were still hand-forged, and in Kent and Sussex where the ancient craft had recently undergone a resurgence. Here there were two distinct types of maker: specialist firms based mainly in market towns, employing two or three smiths plus journeymen, apprentices and assistants, and making a wide range of agricultural, woodmen's, and tradesmen's tools, for sale over a wide area, often across the county boundary. And

⁴⁶ Felicity Palmer, *The blacksmith's ledgers of the Hedges family of Bucklebury Forge, 1736–73* (Research Paper 2, Institute of Agricultural History, University of Reading, 1970), makes no mention of tool manufacture. The forge was also a foundry. The purpose of the waterwheel is unclear. The photograph of the forge and signboard is now part of the Dann Lewis Collection, Museum of English Rural Life, University of Reading (hereafter MERL).

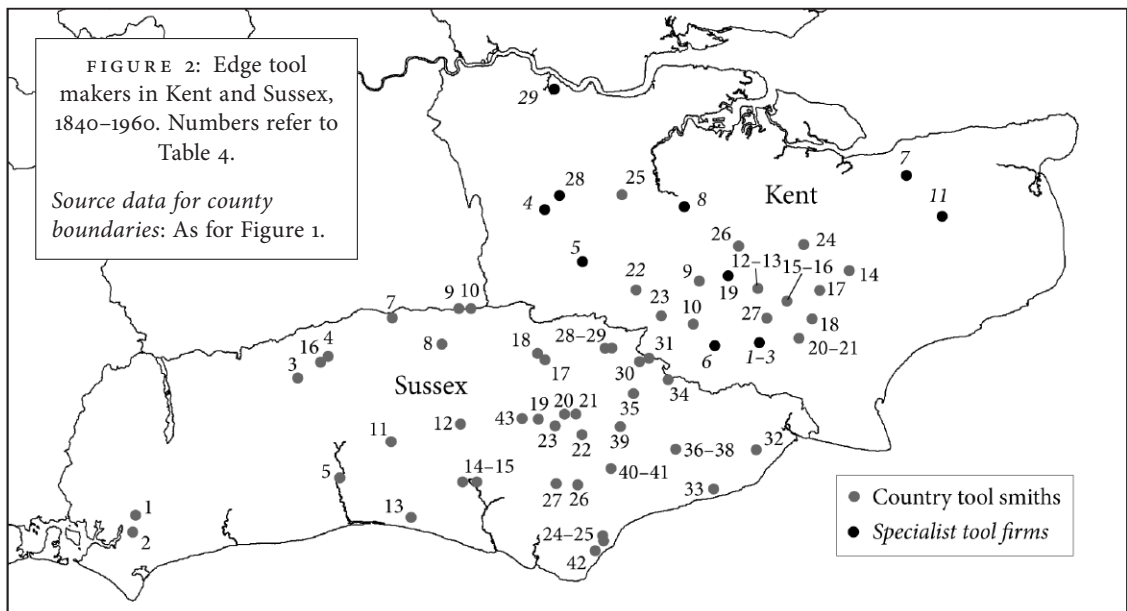
⁴⁷ Ex. inf. Robert ('Bobby') Brown, owner/manager of one of the two last Thatcham turnery works, 3 Aug. 1985. *Kelly's Directory, Berkshire* (1915). The MERL has several stamped examples of both Pyke and Willis tools.

⁴⁸ Ex. inf. R. Burgess, Tilshead, Wilts, 25 Apr. 2008;

C. Dunning, Woking, Surrey, 24 July 2003; L. C. Giles and L. C. Moss (descendants), both of Liphook, Hants, 3 Oct. 1984. Clive Dunning's history, *Genealogy of the Moss family and of the forges occupied* (ts, nd), is especially informative. See also G. Bourne, *Memoirs of a Surrey labourer* (1903), p. 183; G. Sturt, *The wheelwright's shop* (1923), pp. 161–5.

⁴⁹ Ex. inf. Alfred Willis, Bramley, Hants, July 1985.

⁵⁰ Blacksmith-made hoes held their own in the market. Surrey farmers bought them to sell to their labourers, 'veritable connoisseurs' of hoes. George Bourne, *Lucy Bettesworth* (1918 impr.), pp. 192–4. *Kelly's Directory, Surrey*, 1891, 1907, 1913.



Kent

1–3	Tenterden	9	Staplehurst	17	Great Chart	24	Charing
4	Sevenoaks	10	Cranbrook	18	Shadoxhurst	25	Offham
5	Tonbridge	11	Bridge	19	Headcorn	26	Ulcombe
6	Benenden	12–13	Smarden	20–21	Woodchurch	27	High Halden
7	Blean	14	Kennington	22	Brenchley	28	Seal
8	Maidstone	15–16	Bethersden	23	Goudhurst	29	Dartford

Sussex

1	Chichester	11	Hurstpierpoint	21	Heathfield	33	Hastings
2	Donnington	12	Chailey	22	Vine's Cross	34	Hurst Green
3	Barnes Green	13	Brighton	23	Waldron	35	Burwash
4	Horsham	14–15	Lewes	24–25	Lions Green	36–38	Battle
5	Upper Beeding	16	Boar's Head	26	Hailsham	39	Dallington
6	Burchfield	17	Jarvis Brook	27	The Dicker	40–1	Gardner Street
7	Three Bridges	18	Crowborough	28–29	Wadhurst	42	Eastbourne
8	West Hoathly	19	Framfield (Blackboys)	30	Ticehurst	43	Framfield
9	East Grinstead			31	Ticehurst Green		
10	Holtze Common	20	Cross-in-Hand	32	Icklesham		

Sources: Trade Directories, c.1800–1940, *passim*. Makers' marks and other evidence supplied by A. Bayfield, Eastbourne; R. Filmer, Ashford and F. Hams, Challock, Kent.

part-time smiths, working alongside country blacksmiths, supplying the surrounding villages.⁵¹ The locations of the two types of maker are plotted and listed in Figure 2 and Table 4.

(c) *South-east England*

One would suppose that there ought to be demonstrable links between edge tool making in the nineteenth century and the former charcoal iron industry and cutlery and blade-making centres of Tonbridge and Dartford.⁵² But in fact, there is little evidence for this. In the later middle ages, bloomery iron from the eastern Weald was made into 'semi-finished' product wares in the western Weald, and finished in London. Except for Chingley Forge, Cleere and Crossley found few signs of manufacturing activity, still less tool making, on the Weald, possibly because Wealden iron was brittle and difficult to forge.⁵³ The tradition that edge tool making was introduced into mid-Kent about 1800 by migrant smiths from Ashdown Forest finds little support. The firm of Shoebridge at Seal near Sevenoaks, in existence from the early eighteenth to the mid-to-late nineteenth century, was the sole survivor of the old industry.⁵⁴ By the 1830s, Tenterden was now a leading regional centre. A family of French toolmakers, the Bottles, is said to have settled there, probably in the Napoleonic Wars, followed about 1820 by Jasper Beale, a highly regarded tool smith, who popularized the Tenterden billhook.⁵⁵ Five edge toolmakers were listed in the town in 1855, and another at Benenden close by. The 1870 directory records five: two at Tenterden, and one each at Tonbridge, Seal, and Blean near Canterbury.⁵⁶ By 1900 only two survived: Milstead and Sons, an old Tenterden firm, which had amalgamated with Beales in 1884, and closed in the 1920s; and W. S. Swift, Shoebridge's successor at Seal, which in 1903 relocated to Cannock in Staffordshire, where it continued making Kent patterns.⁵⁷

Far out-numbering the town-based firms were the part-time country tool smiths.⁵⁸ Most of the latter were described in censuses and trade directories as 'blacksmiths' or 'smiths', their

⁵¹ Intermediate types of maker included William Tuppenny of Blackboys, near Framfield, E. Sussex. Described in 1891 in *Kelly's Directory* as a blacksmith, he was in fact a full-time edge tool smith, with an apprentice, producing many types of tools, including axes, his speciality. Gaius Carley [Tuppenny's apprentice], *The memoirs of Gaius Carley, a Sussex blacksmith* (1964), p. 20.

⁵² C. W. Chalkin, *Seventeenth-century Kent* (1965), pp. 138–9. In fact, out of c.500 tradesmen's and craftsmen's probate inventories examined for the period 1640–1710, only two were for edge tool smiths, both sickle makers, pp. 269–70.

⁵³ H. Cleere and D. Crossley, *The iron industry of the Weald* (1985), pp. 83, 89, 91, 103.

⁵⁴ M. Gattell, *The people of the parish of Seal, 1820–80* (Seal and Kensing History Publications, 2, nd), pp. 18–19. Swift's tools 'were famed in the woodlands of Kent, Sussex and Essex'. J. Fox *et al.*, *Seal: The history of the parish* (2007), p. 131; R. Tabor, 'Kentish billhooks', pt 1, *Trades and Tools History Society Newsletter*, 34 (1991),

pp. 20–5; pt 2, 35 (1991), pp. 29–31.

⁵⁵ Ex. inf. R. Filmer, Kennington, Ashford, Kent; F. Hams, Challock, Kent.

⁵⁶ *Post Office Trades Directory for Kent, 1870*, p. 155.

⁵⁷ Gattell, *People*, p. 19; Tabor, 'Kentish billhooks', pts. 1 and 2.

⁵⁸ The discussion which follows is largely based on information generously supplied by the following tool collectors and tool historians: Robert Burgess, Tilshead, Wilts.; R. Tabor, Essex Naturalist's Trust; Richard Filmer, Kennington, Ashford, Kent; Fred Hams, Challock, Kent; Tony Bayfield, Eastbourne, Sussex. I am grateful to all the above for sharing with me the fruits of their research. Tony Bayfield deserves special mention for his pioneering research on makers' marks and their interpretation. What I term the 'Bayfield Archive', is a body of original material consisting of photographs, tracings, and line drawings of edge tools and marks, plus biographical and family details and in addition, copies of OS maps showing the names and locations of 41 makers in East and West Sussex active between

TABLE 5: Estimated numbers of edge tool makers in Sussex, c.1840–1960

Pre-1860	5	1903	7
1862	10	1915	10
1878	10	1924	16
1887	11	1936	4
1891	23	1960	1
1899	11		

Source: Pigot's Post Office Directory, Kelly's Directories, Bayfield Archive.

true occupation concealed. However, tool collectors have succeeded in identifying them from their trademarks, usually consisting of the makers' names or initials, inscribed on the face of the blade. Trademark evidence has allowed at least 20 otherwise unrecorded tool smiths working in Kent in 1890 to be revealed, where the directories list only four. According to Anthony Bayfield, a tool historian, at least 70 were active at one time or another in Kent and Sussex between 1840 and 1960. In 1891, the village of Betherston, near Ashford, for example, with a population of 1030, had two 'blacksmiths', both making edge tools, and elsewhere in the village, another smith, listed as a farrier.

Country toolmakers were more numerous and widespread in Sussex than in Kent. In 1910, five were listed in the county directory, where artefactual evidence suggests at least 23, described as 'blacksmiths'. Altogether, Bayfield has located 14 in West Sussex and 46 in East Sussex, inferring that one in every 20 smithies made edge tools, and in some districts one in 10, with up to 25–30 at work at any one time, based mainly in the hop growing and coppice districts (see Table 4 and Figure 2). From a peak in the mid-1890s, numbers fluctuated, and following a secondary peak in the mid-1920s appear suddenly to have collapsed, the last forge, at Boars Head, closing in the early 1970s (Tables 3 and 5).⁵⁹

The typical country edge-tool forge employed no more than two to four workmen, a smith, a striker, possibly an assistant, and an occasional apprentice. As edge tools involved special skills beyond the capabilities of the ordinary blacksmith, new entrants would normally have served an apprenticeship. Their output can only be guessed at. A team of three might have averaged 6–8 billhooks or three or four axes per day, or 300 tools per half year working part-time, and 600 or so full-time. A skilled craftsman made good money, as 'blacksmith-made' tools normally sold at a premium to the branded tools stocked by local ironmongers, and several times the price of mass-produced mild-steel tools sold in the markets. When business was slack, and in the hunting and ploughing seasons when equine demands were most pressing, the toolmakers would switch to shoeing and general ironwork. Full-time smiths, on the other

Note 58 *continued*

1862 and 1928. The Archive will be deposited in due course with the MERL. A selection of Bayfield's lists and drawings can be viewed at R. Burgess, 'The edge tool makers of Kent and Sussex', www.billhooks.co.uk.

⁵⁹ See Table 6 for Bayfield's estimates of numbers of tool smiths in Sussex, mid-nineteenth to mid-twentieth century.

⁶⁰ R. Burgess, 'Edge tool makers', www.billhooks.co.uk.

TABLE 6: Regional distribution of edge tool makers by trade and type of tool, 1841

	<i>Edge tool makers</i>	<i>Tool makers (unspecified)</i>	<i>Sickle makers/ grinders</i>	<i>Scythe makers</i>	<i>Spade makers</i>	<i>Shovel makers</i>	<i>Shear makers</i>	<i>Total</i>
North	1112	0	21	86	70	63	173	1525
North West	3	2	5	0	0	0		10
South West	171	4	0	2	13	0	0	190
West Midlands	357	0	0	127	357	36	0	877
Central South	20						6	26
South East	2							2
Total	1665	6	26	215	440	99	179	2630

Source: Occupational abstract, 1841 census (1844).

hand, divided their time between tool making and marketing, visiting customers, attending fairs and markets, and selling door to door.

The scale and persistence of hand-forging in the extreme south east prompts the question as to whether this was a purely regional phenomenon, or was more widespread. The fact that outside of the Sheffield and Birmingham regions, the overwhelming majority of edge tool makers featuring in Burgess's master list are located in south, south-central and south-west England, and are otherwise thin on the ground, suggests not.⁶⁰

(d) The evidence of the 1841 census

The 1841 occupational census is the first opportunity to measure the numbers and regional distribution of edge tool makers.⁶¹ The printed returns show Yorkshire and north Derbyshire as the largest region with 58 per cent of the workforce, comfortably ahead of the west midlands with 33 per cent, with the south west a distant third with seven per cent (Table 6).

However, a comparison with the corresponding data for 1851 and 1861 suggests that the 1841 return very considerably understates the numbers in south-west and south-east England, the former returning only six, and the latter just two.⁶² Likewise spade makers, the south west returning only 13 when it is known from other sources that spades were one of the region's staple products, indeed, a speciality in many firms. From 1861, workers were no longer classified by trade, but subsumed under the general head of tool maker/dealer. Size of workforce, though, is of limited value as a measure of output and productivity. In the early nineteenth century, output per worker would have been much higher in Gloucestershire and Somerset than in Sheffield, on account of the more intensive use of water power in the former, and large numbers of hand-workers in the latter.

Hand-forging followed a different path. Its decline after 1780 in Cirencester and Salisbury set in motion a general retreat in south-west and south-central England, which accelerated

⁶¹ *GB Census 1841, Occupational Abstract* (1844).

⁶² *GB Census* (Occupational Abstract), BPP 1852–3, 1863.

after 1850 and was effectively complete by 1914. The revival in Kent and Sussex from the 1830s was vigorous and enduring. Surviving two agricultural depressions, the last workshop closed about 1970.

(e) *Edge tool making in the British Isles generally*

Edge tool making elsewhere in Britain deserves mention. Three regions – the north west, the north east around Newcastle, and Ulster – boasted thriving edge tool industries in the eighteenth and early nineteenth centuries. Some 20 or so spade and edge tool mills have been identified in the Lake Counties, the majority established between 1780 and 1820, with two still working in 1907. By the 1820s, Kirkstall Forge near Leeds, a former iron-refining forge, was making spades and shovels. William Park began as a spade maker in 1823 in a former slitting mill in Wigan, which was later to become an important secondary centre of the heavy tool manufacture.⁶³ Tomlin & Co, a Northampton firm, showed an impressive selection of sickles and shears at the 1851 Exhibition.⁶⁴

The Crowley Iron Works near Newcastle was the largest edge tool manufacturer in Britain, if not in Europe, in the first half of the eighteenth century.⁶⁵ When Angerstein visited the firm in 1755, it comprised a slitting mill, steel mill, and three edge tool mills, producing mainly large-surfaced tools, the annual output of plantation hoes alone being of the order of 100,000. At Crowley's death in 1727, 23,000 hoes were stored in his London warehouse awaiting shipment.⁶⁶ T. S. Ashton described the works as a mixture of the domestic system and factory production. While water-powered hammers were employed in the steelworks, plantation hoes, on the other hand, were hand-forged by teams of three workmen – a 'master' and two 'hammermen'.⁶⁷

Spade making was an important rural industry in Ulster. Of the 67 water-powered mills uncovered by Gailey, five dated from before 1800, the rest mostly from 1800 to 1835, with several still working in the 1930s.⁶⁸ In both Ireland and Cumbria, there are instances of mills erected on the sites of former charcoal iron furnaces, a rare example of continuity.

⁶³ J. D. Marshall and D. S. Shiel, *Industrial archaeology of the Lake counties* (1969), pp. 238, 251, 263. A map on p. 100 shows c.25 edge tool mills in the region, mainly on the west coast, south of Whitehaven, and around Ulverston, mostly unnamed and undocumented alas. This suggests that the Lake Counties were a major regional producer, important enough to have checked Sheffield's north-westward advance. For William Park's business records, see Wigan RO, D/D/Dy Dw B1/1. Bulldog Tools at Chillington Forge, Wigan, was in 1987 Britain's only full-time maker of spades and forks.

⁶⁴ *Great Exhibition of the works of industry of all nations, 1851: the official descriptive and illustrated catalogue* (3 vols, 1851), II, p. 592.

⁶⁵ On the Crowley Works, M. W. Flinn, *Men of iron. The Crowleys in the early iron industry* (1962); C. Evans, 'The plantation hoe: the rise and fall of an Atlantic

commodity, 1650–1850', *William and Mary Q.*, third ser., 69 (2012), pp. 581–610.

⁶⁶ Angerstein, *Travel diary*, pp. 17–18.

⁶⁷ Ashton, *Iron and steel*, p. 194.

⁶⁸ A. Gailey, *Spade making in Ireland* (1982); H. D. Gribbon, *The history of water power in Ulster* (1969), pp. 76–9.

⁶⁹ For a detailed account of the Sheffield edge tool industry in the modern period, see D. H. Blackwell, 'The growth of the Scythe/Sickle (Shear) trade in Hallamshire' (PhD thesis, University of Sheffield, 1973). For the earlier period, D. Hey, 'The origins and early growth of the Hallamshire cutlery and allied trades', in J. Chartres and D. Hey (eds), *English rural society 1500–1800, Essays in honour of Joan Thirsk* (1993), pp. 343–67; A. McPhee, 'The growth of the cutlery and allied trades up to 1914' (ts, 1939, in Sheffield Public Libraries).

II

It was inevitable that the south west would soon become enjoined in direct competition with Sheffield and the west midlands: it is to those two regions that we now turn. Sheffield's debt to its abundant water supplies is so ingrained in the folk memory as to be axiomatic.⁶⁹ In 1740, two-thirds of its 90 or more waterwheels were used for blade grinding. Tilt hammers were probably first used for forging edge tools, initially scythes, in the 1780s. In 1793, the diarist William Bagshawe informs us that Skelton Mills in Norton parish possessed one of the earliest species of tilt hammer, enabling the proprietors to raise their production of scythes to 12–15 dozen per day.⁷⁰ In 1785, tilts were added at the Abbeydale Works and Attercliffe Forge, also scythe works.⁷¹ Other early adopters included the Little London Works (1789), the Upper Slack Wheel, advertised for sale in 1785 with 18 grinding troughs and a new tilt and plating hammer, and the Clough Wheels, where a scythe works was erected between 1800 and 1810.⁷² The numbers of water-powered works making edge tools in the Sheffield region in 1800 are uncertain, but are unlikely to have much exceeded half a dozen, the majority, if not all, making scythes. There may be more to be discovered, but mill leases and inventories, informative in many other respects, did not normally state the nature of the business carried on there.

Crossley's survey of Sheffield waterwheels lists only 28 tilt hammers, five dating from before 1750, 13 from 1750–99, mostly post-1780, and 17 after 1800.⁷³ Of these, relatively few, and possibly none before 1780, made edge tools. Only one of the nine wheels on the River Moss was for powering tilt hammers, most of which were sited on the more powerful Don and Loxley rivers.⁷⁴ The 1814–15 *Commercial Directory* listed just 17.⁷⁵ By 1830, water power had lost its strategic importance, new works being almost entirely steam-powered.⁷⁶ Indeed, barely any new watermill sites were constructed after 1800: in 1865 wheels were 60 per cent fewer than at their peak in 1800.⁷⁷ Thus water-powered hammers were adopted not only much later here than in the south west, but on a more limited scale, and for a relatively short time,

⁷⁰ William Bagshawe, *Chantry land* (1910, repr. 1981), pp. 77–8.

⁷¹ D. Crossley et al. (eds), *Water power on Sheffield Rivers* (1989), p. 98.

⁷² J. Pearman, *Abbeydale Industrial Hamlet* (sec. edn, 1985), pp. 3–5, 26; Crossley et al. (eds), *Water Power*, p. 105 ff and *passim*.

⁷³ *Ibid.*

⁷⁴ T. L. Platts, *The waterways of Ridgeway and Hackenthorpe* (nd).

⁷⁵ Wardle & Bentham's *Commercial Directory*, 1814–15.

⁷⁶ Blackwell, 'Scythe/Sickle trades', I, pp. 164–5. The first steam engine, erected in 1789 at Proctor's Works on the River Sheaf, was for driving blade mills.

⁷⁷ S. Pollard, *A history of labour in Sheffield* (1959), pp. 53–4, *passim*. Water power enjoyed a modest revival in the 1860s in conjunction with restoration work in the Loxley Valley following the bursting of a reservoir.

Crossley et al. (eds), *Water power*, p. ix.

⁷⁸ *Ibid.*, pp. 53–4.

⁷⁹ Blackwell, 'Scythe/Sickle trades', I, pp. 173–4.

⁸⁰ G. Tweedale, *Steel City. Entrepreneurship, strategy and technology in Sheffield, 1743–1993* (1995), p. 171.

⁸¹ *GB Census*, 1841, Abstract of Occupations (1844).

⁸² Surprisingly, in view of their importance, there is no unified history of the west midland edge tool trades in the early and middle stages of the Industrial Revolution. So far, much of the research effort is centred on the pre-industrial period for which see W. H. B. Court, *The rise of the Midland industries, 1600–1838* (1938); D. Dilworth, *The Tame mills of Staffordshire* (1976); P. M. Frost, 'The growth and localisation of rural industry in south Staffordshire, 1560–1720' (PhD thesis, University of Birmingham, 1973, pp. 453–502); R. S. Roper, *Early north Worcestershire scythesmiths* (1967); M. B. Rowlands, *Masters and men* (1975); Z. Roscoria, *Mills and their changing roles, 1680–1750*

30–40 years.⁷⁸ Compared with other regions, the Sheffield edge tool trades, apart from scythe making, were slow to mechanize.⁷⁹ As late as 1870, most of the smaller tools – notably sickles – were hand-made.⁸⁰ Only 70 spade and shovel makers were returned for Yorkshire in the 1851 occupational census, compared with 357 in the west midlands.⁸¹

In the west midlands likewise, water power was employed initially mainly for grinding. Blade mills lined the banks of the Rea and Cole and other Birmingham rivers, and along the Tame and Stour and their tributaries in the scythe-making districts of north Worcestershire and south Staffordshire.⁸² A ‘tilt-mill’ and steam engine installed by William Hunt and Sons at the Brades Works at Oldbury in the late 1790s was probably used for steel refining or in the adjoining coal mine for pumping water.⁸³ Twenty years later, some tools were still being made by hand.⁸⁴ In Staffordshire, William Gilpin of Wedges Mills, near Cannock, having no access to proper grinding facilities when he began there in 1790, had to send his tools to be edged six miles away at Bentley.⁸⁵ In 1806, a tilt hammer was installed at his new works at Churchbridge in Great Wyreley township on a tributary of the River Penk. Local skill shortages led to the recruitment of a dozen workmen experienced in the use of water power from the edge tool making villages of Moreton Valence and Frenchay in Gloucestershire.⁸⁶ Edward Elwell, another pioneer, installed tilt hammers on taking up a lease at Wednesbury Forge in 1817, at the same time switching from hand-made saws and gunbarrels to edge tools.⁸⁷ Tilts were probably first introduced into north Worcestershire in the 1790s, when an overshot wheel and drop hammer

Note 82 *continued*

(1988), ch. 3. And for the later period: S. Timmins (ed.), *The resources, products, and industrial history of the Midland hardware district* (1866) (the Timmins family were leading tool manufacturers); Homeshaw, ‘Edge tools’, *VCH Staffordshire*, II: G. C. Allen, *The industrial development of Birmingham and the Black Country, 1860–1927* (1929). The series of small handbooks by F. W. Hackwood on Black Country towns, 1889–1908, listed in Dilworth, *Tame Mills*, p. 199, remain useful sources.

⁸³ R. A. Pelham, ‘The water power crisis in Birmingham in the eighteenth century’, *University of Birmingham Historical J.* 9 (1963), pp. 64–9. Dilworth, ‘Tame Mills’, pp. 186–8 mentions a ‘plating’ mill at Wednesbury Forge in the early eighteenth century, possibly for forging bundles of steel rods for making shear steel.

⁸⁴ H. W. Dickinson (ed.), ‘Diary of John George Bodner’, *Newcomen Soc.*, 15 (1929–30), p. 107.

⁸⁵ Homeshaw, ‘Edge tools’, pp. 259–62; Dickinson (ed.), ‘Diary’, p. 107.

⁸⁶ Homeshaw, ‘Edge tools’, pp. 259–62; B. L. L. Johnson, ‘Iron and steel since 1750’, *VCH Staffordshire*, II, pp. 123–33; C. R. Peate, *Cutting roads to glory with edge tools* (nd, copy in Birmingham Public Library, Local Collection).

⁸⁷ *The mid-Victorian Elwell catalogue of edge tools*, with an introduction by R. Filmer (2000). Edmund

Marlow (a former employee), *Reminiscences*, mss c.1929, was in the firm’s archive when seen by the author in 1985. The firm having since closed (its manufacturing plant sold to China), its present whereabouts is unknown.

⁸⁸ *Farmers Weekly*, 16 Dec 1938, pp. 28–9; Historic England, Heritage List, historicengland.org.uk/listing/the-list/list-entry/1100650. See also a typescript history of Churchill Forge, printed and distributed by the present owners.

⁸⁹ The token formed part of the permanent display at the Finch Foundry Museum, Sticklepath, Devon, when visited by the author in 2012.

⁹⁰ Calculated from entries in the *Universal Directory of British Trade and Commerce* (1798), IV, pp. 708, 814; *Biennial Directory for the Brass and Copper Trades, 1816–17*; *Worcestershire Directory* (1820); *Pigot’s Directory of Worcestershire, 1822*; *Staffordshire Directory, 1837, 1845*; *Post Office Directory of Worcestershire, 1845*; *Kelly’s Directory of Staffordshire, 1864*; *Kelly’s Directory of Worcestershire, 1876, 1896*. Spade, shovel, and fork production was carried on around Stourbridge, Halesowen, and Lye: ‘crown’ scythes at Belbroughton and Chaddersley Corbett; plantation hoes, cane knives and machetes at Halesowen, Wolverhampton and West Bromwich; agricultural and woodmen’s tools at Oldbury, Wednesbury and Cannock.

were added at the new North Mill at Churchill Forge, near Kidderminster, and soon after a tilt hammer at the South Mill.⁸⁸ A rare penny token issued by the Withymoor Scythe Works of Netherton near Dudley in 1813, depicts two tilt hammers and a pair of shears, emblematic of the revolution then beginning to transform the west midland tool trades.⁸⁹ The increase in the numbers of spade, shovel, and hoe makers listed in local directories between 1800 and 1825 reflects the increased importance of water power in Black Country forges in the early nineteenth century, their numbers rising from three or four in 1800, to 20 in 1825, to 45, now mostly steam-powered, in the mid-1860s.⁹⁰

In his 1866 survey, Timmins noted that the edge tool trade of Gloucestershire had now been absorbed by the midlands, where some 3500 workers were now employed in their manufacture, and in the major firms up to 300.⁹¹ In the late 1870s, a leading trades journal went so far as to attribute most of the improvements in tool design and manufacture in the previous half-century to the efforts of west midland manufacturers.⁹²

III

We turn to consider the origins, technical characteristics, and performance of the tilt hammer, the dominating element in the technological revolution which had begun inauspiciously in Somerset and Gloucestershire late on in the pre-industrial period. An attribute of the waterwheel was that its rolling motion could be harnessed to a hammer beam or helve by means of cams attached to the driveshaft or axle, alternately lifting and releasing the beam, and allowing the head to fall back onto the anvil under its own weight.⁹³ Tilts differed from other types of hammers in the positioning of the cam between the pivot and the hammer head, as shown in Figure 3. A typical small edge tool mill had two hammers, a 'plating' hammer for spreading and moulding the iron blank, supplied commercially or cut to size by automatic shears activated by the axle, to form the blade or body of the tool, and a 'steeling' hammer for welding a 'string' or wedge of steel onto, or as in the case of axes, inserted into the body, to form the cutting edge.⁹⁴ Both operations were performed at high heat – 850°C and 1000°C in the plating and steeling forges respectively – and at speed. Depending on the tool, the steel was either wrapped around an iron core, applied as a tip, or sandwiched between two iron plates. Made from cast iron, the head of the plating hammer weighed 100–250 kg, or as much as 350 kg in a spade forge; and the steeling hammer 50–150 kg, the former delivering 80–120, and the latter 200–360, blows per minute. The even more powerful 'belly-helve' hammer, found

⁹¹ Timmins, *Resources*, *passim*. *Farmers Weekly*, 16 Dec. 1938, pp. 28–9.

⁹² *Martineau and Smith's Hardware Trades J.*, 28 Feb. 1879, pp. 52–3.

⁹³ R. F. Tylecote, 'Iron in the Industrial Revolution', in J. Day and R. F. Tylecote (eds), *Iron and steel in the Industrial Revolution* (1991), p. 246; R. F. Tylecote, *Metallurgy* (sec. edn, 1992), pp. 1035ff.

⁹⁴ In scythe and plantation hoe making the steeling preceded the plating; in that of reaping and billhooks, the reverse. Because of their greater length, up to 6 feet,

scythe blades were forged in sections working along the blade.

⁹⁵ For more about tilt hammers see, Gailey, *Spade making*, p. 28; J. G. Timmins, *The forge and the wheel* (1968); H. R. Schubert, *History of the British iron and steel industry, c.450 BC–1775 AD* (1957), pp. 299–302; Harris, *British iron industry*, pp. 15ff, 44–5; Marshall & Davies-Shiel, *Lake Counties*, ch. 3.

⁹⁶ Pers. comm. Mrs Nora Peters, East Hanham, Devon, July, 1985.

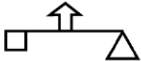
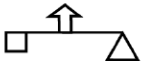
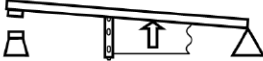
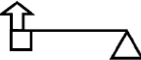
Type	Position of resistance, effort and fulcrum	Class of lever	Forging arrangement	Example
belly-helve		third		Milton Ironworks, Yorkshire
belly-helve		third		Wortley Top Forge, Yorkshire
head-helve		second		Part of Jessop tilt, Abbeydale
tilt hammer		first		Tilt Forge, Abbeydale

FIGURE 3: Types of water-powered hammer showing forging arrangements.

Source: *Scythe making at Abbeydale, Information Sheet*, Sheffield City Museums (4th edn, 1976), p. 3. Drawing by Catherine Glover.



FIGURE 4: Pair of tilt hammers at Holbeam Mill, Devon, c.1930.

Source: Museum of English Rural Life, University of Reading, Photograph Collections, Negative number 35/16571.

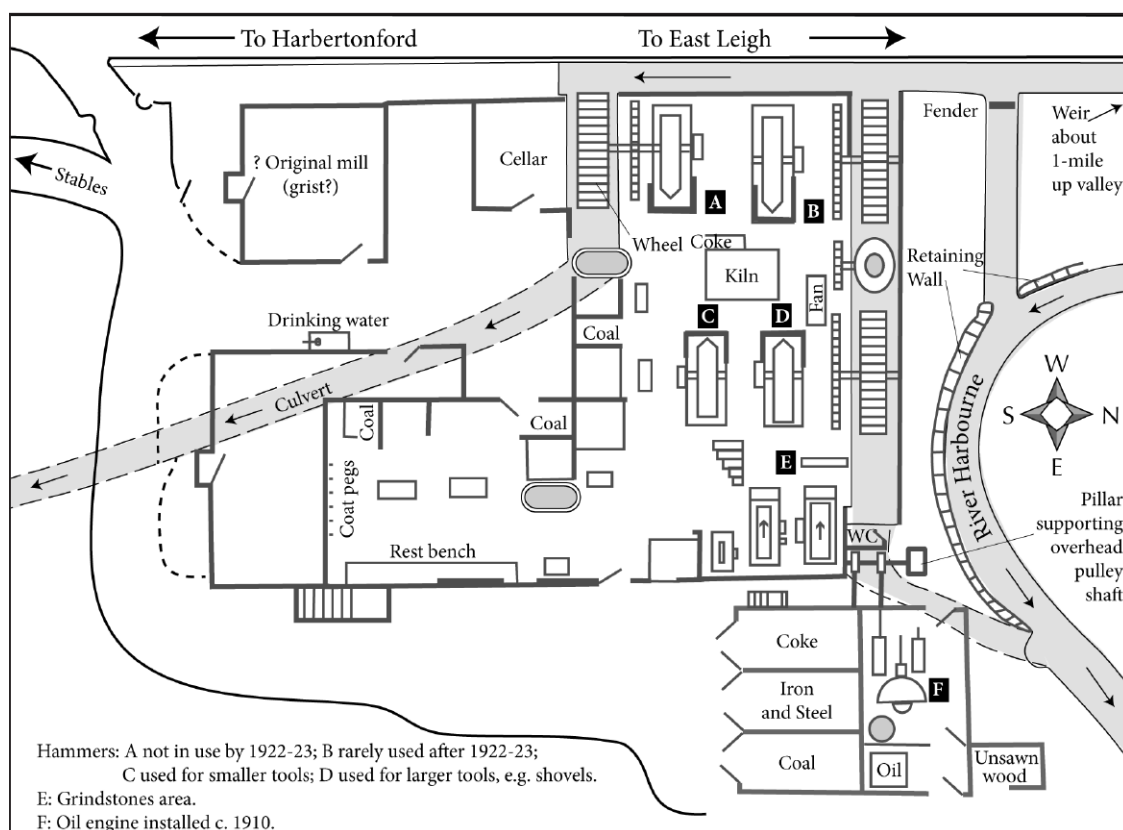


FIGURE 5: Floor plan and layout: Harborton Mill, Devon, c.1930.
Drawing by Catherine Glover, based on an original sketch by Mrs Norah Peters.

in iron forges and foundries, was heavier again, but slower-working. It follows that in terms of its potential for work, the tilt hammer was many times more productive than a 6–8 kg sledge or 2–4 kg steeling hammer used in a hand forge.⁹⁵

The tilt hammer was a powerful machine designed to deliver a succession of heavy blows at a preset point. Figure 4 shows a photograph of a pair of hammers, one working, at Harborton Mill, Devon, c.1930, and Figure 5 a floor plan of the works at about the same date, drawn from memory by the manager's daughter.⁹⁶ It shows a well-equipped mill, equipped with four hammers and hearths (A–D), one pair for large tools such as shovels, the other for small tools, three waterwheels together producing 25–30 hp, a mechanical shears, an oil engine installed c.1910, two pairs of grindstones, an oil bath for tempering, a water-powered fan (in place of the original bellows), an iron splitter; and a mechanical saw and lathe.

The resulting productivity gains, while unquestionably impressive, are hard to quantify. A

⁹⁷ Armitage, *Chantry land*, pp. 77–8.

⁹⁸ Sylvester, 'Scythe making', p. 11.

⁹⁹ Ex. inf. R. Barron, Sticklepath Foundry, June 1985.
Alec Morris of Dunston Forge told me that his father

made 3 or 4 American wedge axes a day in the hand forge in the 1930s.

¹⁰⁰ Brades Works Diary, Worcestershire RO, 706 866 BA 7974/3.

two-man tilt at the Skelton Mills in Sheffield, it was claimed, could forge 12–15 dozen scythe blades per day, compared with half a dozen by a team of the same size in a smithy.⁹⁷ At the Abbeydale Works, a team of four turned out 10–15 dozen (or more) scythe blades per day, as against a dozen by hand.⁹⁸ The norm at the Sticklepath Foundry, in the 1930s, was 10–15 dozen per day, whereas a smith and striker made 10 at most.⁹⁹ Thus, output per head in a tilt hammer forge was upwards of 10 times higher than in a hand forge. Steam hammers were more productive again: at the Brades, at Oldbury, in 1888, the works' diary records that four men with a steam hammer and press could make 50 dozen or more (plantation) hoe blades in a day.¹⁰⁰ Plating and steeling were but two in an extended sequence of operations, following which the part-finished blades had to be hardened and tempered, trimmed, then ground, stamped, polished and painted, and finally fitted with a handle, ready for sale. Thus, the overall productivity gain was in practice less spectacular than might first appear, which may partly account for the tilt hammer's slow rate of diffusion before 1790.

Water-powered hammers were an old technology, employed in iron forges and fulling mills in the later middle ages, and in steelworks and slitting mills since the seventeenth century. Archaeologists, though, have discovered what may have been a water-powered forge for producing edge tools at Bordesley Abbey in Worcestershire, a Cistercian house.¹⁰¹ Though open to doubt, this interpretation has a certain credence, in that the Cistercians were renowned for their hydrological and metallurgical skills, and it is claimed they employed a tilt hammer in an edge tool forge at Fontenay Abbey in Burgundy, as early as 1220.¹⁰² There exists, however, no evidence of similar such installations at other Cistercian houses in England.

There is no obvious reason why Britain should have lagged so far behind mainland Europe in mechanization. Braudel distinguishes two main types of hammer in use on the Continent in the seventeenth century: the 'German', for forging and refining iron, similar probably to the English belly-helve hammer; and the 'Italian', clearly a form of tilt or trip hammer, which delivered short rapid blows, and is believed to have originated in northern Italy at Brescia, an important weapon- and armour-making centre.¹⁰³ The 'tail' hammer was introduced into England from Germany in 1573 for working iron bars into rods and bands, followed in the early eighteenth century by the faster-working 'Osmond' hammer.¹⁰⁴ A smaller hammer, the 'martinet', was used for plating tools in Wallonia in the Belgian Ardennes, a region famous for its metallurgical industries and use of water power.¹⁰⁵ The provenance of the hammers erected at Mells and Coaley in 1744 is nowhere stated, but may not have been, as this author first supposed, somewhere in the west midlands, possibly a steelworks, but much closer to home, at Bristol sixty miles distant.¹⁰⁶ A recent article on the origins of the Bristol brass industry

¹⁰¹ G. G. Astill, *A medieval industrial complex and its landscape: the metal working watermills and workshop at Bordesley Abbey* (1991), p. 246.

¹⁰² See www.abbayedefontenay/forgede-buffon; www.grandforgedebuffon.com.

¹⁰³ F. Braudel, *Capitalism and material life*, trans. M. Kochan (1974), pp. 279–80.

¹⁰⁴ Schubert, *Iron and steel*, pp. 295–302; Cleere and Crossley, *Iron industry*, pp. 296ff.

¹⁰⁵ A. de Visscher (ed.), *Les plus beaux villages de Belgique* (1981), pp. 121ff.

¹⁰⁶ Sir John Clapham, *A concise economic history of Britain* (1949), p. 227.

¹⁰⁷ J. Day and T. Coverdale, 'The Avon Valley copper and brass industry', *Bristol Industrial Archaeological Soc. J.*, 46 (2013), pp. 1–18. Figure 5 shows a battery of hammers similar to the Sticklepath, Holbeam and Abbeydale examples.

suggests the inspiration may have been an advanced design of hammer used for plating and hollowing brassware at Aix-La-Chapelle in the Meuse-Rhine region of Belgium, brought to England by a company of Bristol businessmen about 1700. Brass was first manufactured at the Baptist Mills on the River Frome in 1702, and in 1704 hollowed out at the Downe Mills by batteries of hammers, each powered by a waterwheel. Any one of seven similarly equipped works in the Bristol region nearby, could have served as the model for Mells and Coaley.¹⁰⁷

The virtues of the tilt hammer were most compelling when making large-bladed tools, which could now be forged in a single operation, inside a few seconds, without losing welding heat, as reheating made the metal brittle and weakened the bond, thus rendering the tool useless. Moreover, the hammer head fell with a dead blow, whereas other types of hammers bounced about on the anvil, making for inaccurate work. For this reason, it was claimed, Sheffield scythe makers preferred water- to steam-powered hammers.¹⁰⁸ Water power remained the chief energy source in the scythe shop at the Belbroughton Works until the early 1950s, and at the Bache Foundry near Kidderminster as late as 1970.¹⁰⁹

Making an all-iron spade by hand was highly labour-intensive, and the result uncertain, because the blade tended to bend under stress. Indeed, spade making was considered among the most difficult of the qualifying tasks for membership of the Scottish Corporation of Hammermen.¹¹⁰ Labour and materials were so costly that, up to the eighteenth century the blades were normally made of wood, encased in a steel shoe.¹¹¹ The tilt hammer removed much of the drudgery, but until 1840 it was still not possible to forge-weld iron and steel directly because of the adverse reaction of the fire on the bare steel, which required the blade to be inserted between two layers of iron to protect it from the flame. All-iron spades were anyway heavy and cumbersome, but if made lighter, were not strong enough.¹¹²

Why should the tilt hammer have been first employed in south-west England rather than in Sheffield or the west midlands? There are institutional constraints to be considered such as tradition, over-regulation, vested interests, and hostility to labour-saving innovations. Such constraints were weaker in the south west, where edge tool making was a new industry and water power was already in general use in the textile and iron industries. Other factors need to be considered though. Gloucestershire and Kent were among the leading industrial counties in the seventeenth and early eighteenth centuries, their prosperity based to a large degree on an intensive use of water power. The one gave birth to a highly successful edge tool industry based on new technology, so why not the other? The application of water power to drive hammer mills was not unknown in Kent. C. W. Chalklin writes tantalizingly of a watermill at Ravenbourne in north Kent, which ‘moves the Engines by which the famous Ephraim How makes the best knives in England’,¹¹³ referring perhaps to a form of hydraulic hammer, similar

¹⁰⁸ Blackwell, ‘Sickle/Scythe Trades’, p. 139.

¹⁰⁹ Ibid.

¹¹⁰ A. W. Beaver, *The art of blacksmithing* (new edn, 1976), pp. 193–5.

¹¹¹ R. Webber, *The village blacksmith* (1971), p. 45.

¹¹² The problem was solved in the early 1840s by the Birmingham spade makers, A. and F. Parkes, who developed a protective flux to separate the two metals

during welding.

¹¹³ C. W. Chalklin, *Seventeenth century Kent* (1965), pp. 138–9.

¹¹⁴ Visscher (ed.), *Plus beaux villages*, p. 121

¹¹⁵ Martin Watts, a working millwright and mills historian, Pers. comm. June 2010; Crossley *et al.* (eds), *Water power*, pp. 117–18.

to the 'martinet' used in Wallonia for plating tools.¹¹⁴ Kent was well placed to have developed along the lines of Gloucestershire, but instead did the opposite, undergoing a resurgence in hand-forging.

Hydrology was a key determinant. The energy requirement of a small edge tool mill was far greater than that of the average corn, fulling, or blade mill. A pair of fulling stocks, for example, consumed an estimated 2.5 hp, and a pair of millstones 4 hp, compared with the 10–15 hp of an edge tool mill equipped with two hammers, a pair of grindstones, a mechanical shears, a fan or bellows, and a lathe.¹¹⁵ At the Sticklepath Foundry, in Devon, the hammer and shears used five or six times more power than a set of grindstones.¹¹⁶ Energy inputs at large works, such as Abbeydale, Coaley, or Tavistock, exceeded 50 hp, and the very largest, such as Mells and the Elwell, works at Wednesbury, with multiple sets of hammers and other machinery, upwards of 100 hp

Recent calculations of national energy supplies and utilization imply that only a small percentage of watermill sites had the potential to drive a tilt hammer. Indeed, output per wheel is estimated to have averaged only 4 hp in 1700, 5 hp in 1800, and 6 hp in 1850.¹¹⁷ Admittedly, only very little of the energy capability of most English rivers was utilized for industrial purposes. Yet in heavily industrialized districts, competition for sites was often fierce, and the best sites already occupied in 1750.¹¹⁸ Although by 1830 steam had supplanted water as the nation's primary energy source, water power usage in industry and mining peaked much later, around 1870.¹¹⁹

The average energy potential of Sheffield rivers is put at less than 4 hp. Thus, energy-intensive industry tended to be sited on the more powerful rivers, such as the Don and Sheaf, and the less demanding on the smaller streams. The first steam engine, erected in 1789, was for blade grinding, not forging. Birmingham's rivers were neither very powerful nor reliable, their flow reduced sometimes to a trickle during droughts.¹²⁰ In the Black Country, the area drained by the upper Tame river system, being one of low relief and gentle gradients, generated very little power. Iron mills and after 1790 edge tool mills were situated mainly in the lower Stour valley, where Stourbridge and Halesowen became major centres of heavy edge tool manufacture.

The emergent edge tool industry in south-west England owed much to the largesse of its rivers. In Gloucestershire, the majority of the 18 watermills in the Dursley valley, and many of the hundred or more in the Stroud and Cam valleys, were rated in excess of 10–15 hp.¹²¹ Of the 11 mill sites in the Mendips surveyed by the Centre for Sustainable Energy, three had a potential of more than 30 kw (42 hp), and seven of 5–10 kw (7–14hp).¹²²

¹¹⁶ Ex. inf. R. Barron, Finch Foundry, June 1985.

¹¹⁷ P. Warde, *Energy consumption in England and Wales, 1560–2000* (2007), pp. 49–57. The increase in wheel output and efficiency was part due to a switch from under-shot to over-shot and wooden to cast-iron wheels.

¹¹⁸ See R. B. Gordon, 'Cost and use of water power during industrialisation in northern England and Great Britain: a geological interpretation', *ECHR* 36

(1983), pp. 240–59.

¹¹⁹ Warde, *Energy consumption*, pp. 56, 74–5.

¹²⁰ R. A. Pelham, 'Water power crisis', p. 64. See also S. D. Chapman, 'The cost of power in the Industrial Revolution in Britain: the case of the textile industry', *Midland Hist.* 1 (1971), pp. 1–23.

¹²¹ Ex inf. Osman Goring, Coaley Mills, June 2010.

¹²² 'Mendip Mills energy makeover', www.cse.org.uk/projects/view/1006.

There remain the questions of why the tilt hammer was first applied to forging edge tools in the mid-eighteenth century, and whether this was a response to shifts in supply or demand: to which the answer is probably both. On the supply side, there was a breakthrough in hammer design, initially, it is suggested, for beating brass, then applied to edge tools. On the other, we can postulate a marked upturn in demand, particularly for large-surfaced tools, sufficient to have generated the economies of scale needed to justify investment in expensive industrial plant. The expansion of mining and quarrying in south-west England was a powerful stimulus, as evidenced by the location of many of the new edge tool works close to mineral workings. In Somerset, the mainspring was the opening up of the Mendip and Bristol Coalfields – Mells had its own colliery, serving both as a market for its tools and a cheap source of fuel for the hearths, and in Devon and Cornwall the growth of non-ferrous mining.¹²³ The Severn ports provided access to south Wales, Ireland, and the Americas. Every slave in the Caribbean colonies, it was said, consumed yearly ‘two hilling hoes, two weeding hoes [and] two grubbing hoes of English manufacture’.¹²⁴ By the 1770s, plantation hoes – all-purpose digging tools – and cane knives, had become major items of Atlantic commerce, benefiting from the close working relationship between manufacturers, agents, and merchants, centred on Bristol. In the 1770s, a merchant with plantation interests living near the city, contracted with the Frenchay Iron Company nearby to supply axes, spades and hoes for export to North Carolina.¹²⁵ Other triggers would have included the rapid expansion of the coppice trades and hop industry in south-east England, and arable extension and enclosure on the Cotswolds and southern chalklands.¹²⁶

Whether and to what extent the slow uptake of the tilt hammer prior to the 1780s was due to a shortage of investment capital is a moot point. By eighteenth-century standards, an edge tool works was a relatively costly undertaking, representing an outlay of up to £1000, and in the case of large works, such as Tavistock, Coaley and Mells, considerably more. The housing needed to be robust, preferably of stone, to withstand the vibration of the hammers and the erosive effect of fast-flowing water. Converting an existing mill, while usually cheaper than a new building, would normally have involved further outlays on additions, adaptations, and upgrading the water supply. Most edge tool mills had a long working life, typically 70–120 years, and 200 years exactly in case of Coaley. Their longevity attests to the long-term viability of water power as an energy source, and of the tilt hammer as the technological mainspring.

¹²³ J. B. Richardson, *Metal mining* (1974), pp. 97–8; ‘Mells and the Wadbury Valley’, www.bgs.ac.uk/mendips/localities/mells.html.

¹²⁴ Evans, ‘Plantation hoe’: I am grateful to the author for further helpful comments.

¹²⁵ Owen Ward, ‘Frenchay Iron Company 1776–1780’, *Bristol Industrial Archaeological Soc. J.*, 30 (1997), pp. 25–33.

¹²⁶ Kent and Sussex were among the most heavily wooded counties in Britain, over 60% coppiced. Between 1835 and 1878 the Kent hop acreage grew from 25,740 to 46,600 acres. In the 1830s an estimated 25M new poles were needed to establish new grounds and as replacements. E. J. T. Collins, ‘The coppice and underwood trades’, in Collins (ed.), *Agrarian History of England and Wales*, VI, 1750–1850 (1989), p. 488.

IV

What business historians would probably consider the industry's defining feature can be touched upon only briefly. This was the coexistence until the early twentieth century of a wide range of different types and sizes of firm, employing widely varying levels of technique, making broadly the same products, selling for much the same price, quality for quality. In 1866, Timmins wrote glowingly of the technical advances in the midland hardware districts, and in 1883, *The Ironmonger's* Wolverhampton correspondent described the many great improvements in tool design and manufacture in his district, with the leading firms now equipped with eye-punching machines, hydraulic presses, and steam hammers, and making all-steel tools from mild steel plate, innovations which together revolutionized the production and quality of Brazilian hoes and Anglo-American picks.¹²⁷ The south west, meanwhile, with a few exceptions, still relied largely on water power, with steam an emergency backup.

In the 1860s, Sheffield and the west midlands may together have produced upwards of 90 per cent of national edge tool output, and enjoyed a near monopoly of sales. Yet in the 1920s many rural districts in the south east and south west were still to a remarkable degree self-sufficient in agricultural and forestry tools, barring saws and scythes, and, in parts of the peninsula, likewise spades and shovels. When Alec Morris took over the Dunsford Works in the 1930s, he reckoned 'foreign', mainly midland, firms supplied about 50 per cent of the West Country market.

The metalworking trades, as Maxine Berg observed in her classic history of manufactures, spawned 'a distinctive form of specialisation and artisan skill'.¹²⁸ More so than other craft occupations, edge tool making was synonymous with a deeply embedded and highly conservative craft culture rooted in obsolescent skills, which delayed mass-production and product rationalization until after the Second World War. The underlying causes, however, may have been less sociological than technical, namely the intrinsic nature and working properties of the two principle raw materials, wrought iron and high-carbon steel. The former was dense, tough and malleable, well-suited for blades and bodies, but difficult to machine; the other, ideal for edges, but difficult to forge and weld. Steel being very expensive, tools were made principally of iron: in the case of plantation hoes the ratio of iron to steel was about 6:1. But while much cheaper and thus more affordable, making welded tools – plating and steeling the bodies then the tempering – demanded special skills. Quickness of eye and fine judgement were needed to shape the bodies, and join together the two metals, each with different welding and melting heats, within a narrow temperature range. At the Elwell Works, in the 1920s, only four of the 25 platers in the forge shop were reckoned really good with edge tools, able to replicate the many different patterns – over one hundred in the case of billhooks – accurately and at speed, with a minimum of rejects.¹²⁹ Whether in a Sussex hand forge, a century-old West Country watermill, or a large Black Country factory firm, making welded tools remained the preserve

¹²⁷ Timmins, *Resource*, p. 657; *Iron Age*, 29 Mar. 1883.

¹²⁸ Berg, *Age of manufacturers*, p. 268, and ch. 11 for the further development of this theme.

¹²⁹ I am grateful to the following for this and other useful information about the west midland tool trades

and techniques employed in the interwar and early post-war periods. Stanley Hyde of the Elwell Works, Wednesbury; Frank Ellis and John Billingham of Wollaston Mills. Uniquely useful was Edmund Marlow's *Reminiscences*.

of highly trained and experienced craftsman, the aristocrats of the workforce, until the 1950s, when production ceased.

Tools made from 'Bessemer' hot blast and Siemens open-hearth steels, a form of low-carbon iron, could be engineered or press-moulded in just one or two operations using semi-skilled or unskilled labour. But though cheaper, they were less well adapted than wrought-iron tools to withstand the shocks of repeated heavy blows, and were prone to bending or breaking. Despite the use of much improved steels, hedgelayers and woodcutters still much prefer craftsman-made pre-war iron and steel welded tools to the modern, mass-produced all-steel types, which they complain, 'haven't enough iron in 'em'. Being no longer manufactured commercially, they are having to be sourced from car boot sales or second-hand tool dealers. In country households, old tools bearing the mark of some long-extinct maker are treated almost as heirlooms, passed down the generations.

By the late nineteenth century the manufacture of first-quality edge tools was dominated by a few large firms, with national, in many cases international reputations, and countrywide distribution networks. How then, at an advanced stage of industrialization, in a shrinking market, were small producers in rural areas able to beat off outside competition, especially as most towns and larger villages now possessed one or more hardware merchants? Survival depended on being able to exercise a degree of monopoly power through the exploitation of a niche market. Businesses serving remote country districts with poor communications were the best placed. Parts of the Weald and Devon hill country were at times inaccessible in winter until opened up to regular commerce by the motor lorry and macadamized roads in the 1920s. Close-knit social networks made for customer loyalty and a high percentage of direct sales. 'Craftsman-made', customized specialist tools were often more expensive than best-quality factory-made tools sold by ironmongers. Local makers were often the sole source of specialized tools such as 'twybills,' employed in Kent for cutting mortices in gate hurdles, or 'binman's hooks' for cutting down bines in the hop fields.¹³⁰ Market failure was the ultimate threat, and the collapse of mining and quarrying in the south west and of coppicing and associated trades in central southern and south east England, took a heavy toll. In the woodland districts of Kent and Sussex, the popularity of chestnut post and wire fencing for use on building sites and public open spaces in London and the Medway towns helped offset the loss of traditional markets. The fate of the country tool smith was sealed by the decline from the 1920s of the working horse, and with it the blacksmiths in whose forges he had worked, and an essential secondary source of income. The final blow was the blocking of supplies of Swedish charcoal iron in the Second World War, for which there was no immediate alternative.

Business survival was largely a matter of opportunism. In 1903, William Smith of Seal, Kent, decamped to Staffordshire where he made edge tools bearing the firm's original marks for sale in Kent, Sussex and the Home Counties, but by 1935 his firm had transformed itself into 'agricultural, electrical and motor engineers', with edge tool making occupying a minor role in a now much larger organization.¹³¹ Alec Morris at Dunsford chose to specialize in West Country, especially Fussell patterns, copying the really old ones, and supplying customized

¹³⁰ Ex. inf. Fred Hams, Challock, Kent. See also Tabor, *Kentish Billhooks*, for other examples of Kent tools.

¹³¹ Fox *et al.*, *Seal*, p. 131.

tools to order with guaranteed delivery. Several businesses were saved by being bought up by midland manufacturers as going concerns, or by undertaking contract work.

V

In conclusion: it is hoped that the paper has provided fresh insights into the history of edge tool making in southern England during and after the Industrial Revolution. Technological and structural change, and the transition from hand-forging to full automation, are shown to have been a complex and protracted processes. Contrary to the received wisdom, in the earlier period south-west and south-east England stood firm in the face of northern and midland competition, and grew market share. In 1914, ten West Country water-powered works, and in Kent and Sussex 20 or more hand forges, were still working.

Perhaps the most important finding, deserving, one hopes, of at least a footnote in a history of the Industrial Revolution, is the emergence in south-west England of a regionally important edge tool industry, which pioneered the use of water-powered hammers for plating and steeling, the crucial first stage of mechanization, and laid the foundations of a new branch of the industry specializing in large-surfaced tools. From the mid-1740s to the end of the Napoleonic Wars, the south west set the pace, at the same time playing an important role in the Atlantic trade, and serving as a model for the Black Country. Water power provided the initial impetus, and for many firms in the south west remained the predominant energy source throughout the nineteenth century. Whereas in Sheffield and the west midlands the industry became increasingly urban-based, in the south west it remained a predominantly rural industry throughout.

Three contrasting models of industrial change have been identified: in the south west an industrial revolution; in the south east a counter-revolution; and otherwise a protracted decline, which gathered pace after 1850. By 1920 traditional tool making had come to an end almost everywhere. Further research will hopefully throw more light on change on edge tool production in particular and the manufacturing sector in southern England in general throughout the largely uncharted territory of the early Industrial Revolution.