The versatility of bone, ivory and horn – their uses in the Sheffield cutlery industry

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ABSTRACT
The Sheffield cutlery industry is at least 700 years old. Historical descriptions of the trade have generally concentrated on the craft organisation by the Company of Cutlers in Hallamshire and the manufacture of steel for the blades. Examples of knives and razors from the 17th century onwards survive in museums and private collections and are often displayed as examples of artistic craftsmanship, usually because of the material and design of the handles. Such items are attractive and form pleasing displays, but the trade in the handle materials and the methods of manufacture have often been ignored. Cutlery handles may be manufactured from costly and exotic materials such as ivory and tortoiseshell, or from bone or antler on more mundane and lower quality knives. Bone, horn and stag antler could of course be locally sourced – cattle bone and horn, and sheep and pig bone from slaughter houses while the trade's use of so-called 'stag' (antlers from any species of deer) could come from native herds and abroad. Other materials, such as ivories, tortoiseshell, horn from buffalo and 'stag' from exotic deer species, had to be imported from around the world. Not only could these materials be made into attractive handles, but some also lent themselves to carving and inlays, adding further to their desirability. This paper will highlight the documentary sources available for the Sheffield trade, which indicate the use of animal-derived materials for the cutlery industry, and will combine archaeological evidence to consider some of the methods of manufacture.

KEY WORDS
Sheffield cutlery industry,
bone,
ivory,
horn,
knife handles.

RÉSUMÉ

La polyvalence de l'os, de l'ivoire et de la corne – l'industrie de coutellerie de Sheffield.
La coutellerie de Sheffield a au moins 700 ans. Les descriptions historiques de cette industrie se sont en général intéressées à l'organisation du métier par la Compagnie de Couteliers de Hallamshire, ainsi qu'à la manufacture d'acier pour les lames. Des exemples de couteaux et de lames de rasoir du 17e siècle subsistent dans des musées et dans des collections privées, et ils sont souvent exposés comme des exemples de métiers d'art, habituellement en raison du matériau dont ils sont fabriqués et de la décoration de leurs manches. De tels items sont attrayants et constituent de plaisants objets d'exposition, mais le commerce en matériaux pour les manches et les méthodes de manufacture ont souvent été ignorés. Les manches de coutellerie peuvent être manufacturés à partir de matériaux exotiques et dispendieux, tels que l'ivoire ou l'écaille de tortue, ou encore à partir d'os ou de bois de cervidés pour des couteaux plus banals et de moindre qualité. L'os, la corne et le bois de cerf pouvaient bien sûre être obtenus localement – les cornes et os de bestiaux, os de cochon et mouton provenaient des abattoirs, tandis que le soi-disant « cerf » (les bois de n'importe quelle espèce de cervidés) utilisé par l'industrie pouvait provenir de troupeaux locaux et étrangers. D'autres matériaux, tels que l'ivoire, l'écaille de tortue, la corne de buffle et le bois d'espèces de cervidés exotiques devaient être importés de partout au monde. Non seulement ces matériaux faisaient-ils des manches attrayants, mais certains pouvaient aussi se prêter à la gravure et l'incrustation, ajoutant à leur désirabilité. Cet article mettra en lumière les sources documentaires disponibles au sujet du commerce de Sheffield traitant de l'utilisation de matériaux animaux dans la coutellerie, qu'il combinera avec des données archéologiques dans une étude de certaines méthodes de manufacture.

MOTS CLÉS
Industrie de la coutellerie
de Sheffield,
os,
ivoire,
corne,
manches de couteaux.

INTRODUCTION

The aim of this paper is to review existing scholarship on the use of animal-derived material in the cutlery trades and to extend this by combining the surviving artefacts from excavations and museum collections with varied documentary sources in order to reconstruct the possible work processes and practices found in the Sheffield cutlery industry. Examples will be given in short case studies highlighting aspects of this research. It would appear that the archaeological work linked to urban redevelopment has increasingly focused attention on more recent industrial activity, which is certainly the case in Sheffield. There is therefore a need to understand and appreciate the part-finished items which have been found and contextualise them as part of the manufacturing practices.

BACKGROUND AND THE COMPANY OF CUTLERS IN HALLAMSHIRE

Sheffield, England, is justly proud of its long heritage and tradition in the manufacture of cutlery and steel. The earliest surviving document relating to the industry is a tax return for 'Robert the cutler' in 1297 (Brown 1894). With increasing numbers of men involved in the trade by the mid-16th century, the resident Lords of the Manor of Hallamshire used the manorial court system to provide some organisational structure. The court could thereby control the numbers of apprentices and register identifying craftsmen's marks. Later, the Cutlers' Company was incorporated by an Act of Parliament in 1624 and, centred on the parish of Sheffield, it operated as a latter-day craft guild as the Act formalised and codified the manorial system of organisation and control. Between 1624

Fig. 1. – Silver plated knife and fork with carved ivory handles. Late 19th century. Cutlers' Company collection.

and 1814, when the Company lost control over apprenticeships, there remains documentary evidence for 28,000 such apprenticeships, giving an indication of the size of the industry. Half of the boys became Freemen with the right to manufacture and market their own goods. There was no written rule to prevent girls becoming apprentices, but none ever did. Some widows continued their husband's work through journeymen or employees, but any actual work undertaken by women was in the final subsidiary processes of polishing and packing knives; it was not until 1974 that a woman became a Freeman of the Cutlers' Company.

The existence of the Cutlers' Company throughout the formative decades of Sheffield's industrial history means that a wealth of documentary evidence has survived. Although there are no accurate population figures for the 18th century, a local census in 1736 suggests the population of Sheffield and its rural surroundings was about 14,500 (Hey 1998). During the previous 20 years, 1,401 men became Freemen. As only about half of the apprentices ever reached this status, and assuming they were still alive, there could be at least 3,000 men involved in the cutlery trades by 1736, amounting to a fifth of the town's population. In the 1851 census, 9,500 people described themselves specifically as cutlers – out of a total population of 135,000 (7%). Although this is a small proportion, it must be remembered that all the associated trades are not included in this figure and that by 1851, the cutlery industry was being eclipsed by the vast expansion of the heavy steel and engineering trades and an influx of workers, principally from adjacent counties. The Cutlers' Company continued to survive, even during the decline of its core trades, and its records provide associated documentary evidence for many aspects of the manufacture of cutlery.

STRUCTURE AND MANUFACTURE OF KNIVES

Cutlery, in Sheffield's manufacturing terms, includes items that 'cut', i.e. knives, scissors, shears, sickles and scythes. There are material characteristics which determine the precise methods involved in the processes of forging, grinding and assembling, and while it is still possible to see individual craftsmen at work in Sheffield today, any reconstruction of past work practices has to rely on archaeological and documentary evidence.

One important historical aspect of the Sheffield cutlery trade is its continuity of working practices. A knife is a small metal object which can be made in a limited space and with limited technology. From maps, surviving tenement factories and outbuildings adjacent to houses, it is possible to determine that a room of about 25m^2 could accommodate a smithy hearth, bellows, an anvil and workbench. Provided with a supply of bar metal, blades can be forged at a small hearth using hand-held tongs and hammers. Grinding the edge can be achieved by holding it against a rotating grindstone – powered by human or animal, water, steam, gas or electricity. With a supply of appropriate power, this process too, can be undertaken in a small, confined space. Assembling a knife blade with its handle, likewise requires a small workshop bench. The excavations of cutlery sites around Sheffield reveal an industry

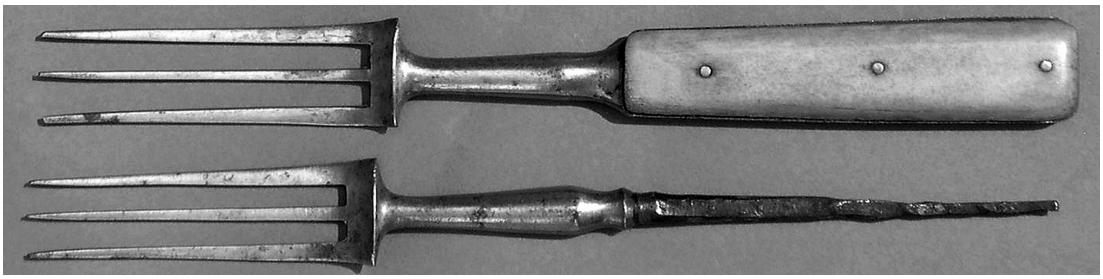

Fig. 2. – Two 19th century forks. The top specimen has bone scales riveted to the flat scale tang; the bottom fork has a round tang and would require a solid handle. Cutlers' Company collection.

that did not necessarily require major investments in space, machinery, tools or stock.

The addition of a handle to a blade is a necessary requirement for its safe use, but the type of material chosen becomes a matter of style and taste. Handles could be made from simple, cheap and utilitarian materials such as wood or bone; or from the more desirable ivory or pearl used for high-quality cutlery (Fig. 1) Not only did cutlers make a choice in the materials they used for the handles, but those handles then gave scope for creative decoration.

The supply and manufacture of handles can be deduced from the available evidence: the archaeological artefacts and documents, confirmed by surviving examples in museums. This research can be seen as an integration of the following three aspects: (1) the archaeological evidence from finds excavated on a number of sites around Sheffield, many of which have been financed as part of urban regeneration schemes; (2) although there is no contemporary documentary description of the manufacture of knife handles from bone or ivory in the 17th and 18th centuries, there are details about the supply of raw materials to Sheffield craftsmen and their usage; and (3) the examples of knives in private collections and museums, together with handcraftsmanship currently surviving in the Sheffield trade. An understanding of manufacturing processes gives further appreciation of the skill of cutlers and handle makers.

Knives come in a range of shapes and functions and include knives for hunting, food preparation, dining and for specific trades. They may have fixed or folding blades, like open razors which have long blades folding into the handles. The function of the knife determines its structure and what materials will be used for the handles, which the industry call 'hafts'. The handle material is attached to the knife, or fork, by the tang – an extension of the blade, which can be either round or flat. The round tang requires a solid handle bored down the centre, while the flat tang (also called a 'scale' tang) takes two thin plates or scales; one rivetted to each side (Fig. 2). Scale tang handles were usual for table knives until the later 19th century, but are now more commonly found on trade and hunting knives. Folding knives and open razors also require handles with two scales, which are thin and often decorative as well as functional.

Morphological properties of bone, ivory and horn dictate which can be used in each case. For solid handles, the material must be thick and dense in order to have a hole bored down the centre, so ivory, buffalo horn and some antler, are suitable. Ivory and buffalo horn can also be used for thin scales, often utilising the scraps cut from larger pieces. However, bone and cattle horn can only provide thin sections of usable handle material (Fig. 3). Cutlers could buy material for their knife handles from specialists who cut it to size and shape known as 'blanks'; or a craftsman might buy the raw bones, horn and pieces of ivory tusk and cut up the material himself. The processing of the natural handle material could be unpleasant; as in boiling bones, the sawing of tons of these animal parts produced fumes and dust and the Factory Acts gave little protection to the bone and horn cutters in their workshops (Pollard 1959: 122). Joseph Rodgers

and Sons, Cutlery Manufacturers, boasted in their firm's history that:

"With regard to the process of manufacture, the same care and attention is paid [as with the storage of material] and the condition in the work rooms is made as pleasant and healthy as possible, so that in all improvements in the conditions of labour this firm can justly claim to be a pioneer" (Anon 1911: 27).

The precise manner in which the suppliers and cutlers dealt with bone, in particular, has been demonstrated by the finds from excavations and is discussed below.

The knife handle provided an opportunity for decoration, especially the fine-grained ivory which could be elegantly carved and inlaid with silver. Horn, both from cattle and water buffalo, could be pressed with surface decoration or stained to imitate tortoiseshell. Bone was the cheapest material and little time would therefore be expended in adding decoration to these handles. However, some surviving bone scales have scored lines and geometric decorations produced by files, which could be extremely attractive. Other surface treatment of bone included efforts to replicate the surface texture of the more expensive and desirable stag antler, by staining it brown. So important was this particular aspect of the bone handle trade that tools were developed for the task of creating this imitation antler, known as 'bone stag' (United States Patent Office 1880). Today, plastic imitation stag scales are used on knives.

Fig. 3. – Figure 3. A 30cm folding knife with buffalo horn scales. Cutlers' Company collection

INDUSTRIAL ORGANISATION

The traditional working unit of master, journeyman and apprentice, together with the limited requirements of space was no hindrance to the expansion of the Sheffield cutlery industry. This industrial organisation allowed for versatility, adaptation and an easy response to changing markets, but the manufacturing requirements were the same for the small workshop unit and a huge cutlery factory. The difference was one of size, with more powered machinery, not of different materials, products, suppliers or markets.

Specialisation developed but the industrial organisation of the cutlery trade in Sheffield was small-scale and the work practices that evolved over the centuries meant men could make goods to fill outside orders and/or to sell for themselves. They would carry only sufficient raw material and stock. Differences arose in the 19th century with the mass-production of blades and handles and the employment of large numbers of people in one integrated factory, but there was still a demand for the individual specialist craftsmen.

The manufacture of cutlery requires a supply of raw materials and the associated secondary services in supplying grinding wheels, polishing and packaging equipment, etc. Until the beginning of the 18th century, Sheffield imported its steel, as well as any exotic handle materials such as ivory, tortoiseshell, buffalo horn and pearl. More common handle material such as cattle bones and horn or 'stag' (antlers from any deer species) could be supplied locally, but as the industry expanded, supplies would have to come from further afield.

Buying in the handles as part-made 'blanks' would be determined by the amount of knives being made and the cost. A large manufacturer might have employed specialist cutters to maximise the material from their ivory tusks and cattle horn, whereas a individual cutler probably would not have the skill or time for this process. Similarly, a large manufacturer requiring tons of bone, etc., would have cash flow and storage issues, so they may also have

Fig. 4. – Bone found on the site of the Sheffield Assay Office, Portobello Street, Sheffield, excavated by Northamptonshire Archaeology Unit, 2009. Top: bone sawn to length; bottom: dense bone sawn from round the central core leaving distinctive bone scrap. Scale in cm.

chosen to buy in ready cut 'blanks', as and when needed. It was all a balance of time and cost. Both large and small manufacturers might follow both routes of supply, which would change from time to time. Since the structure of the knife handles was determined by both function and fashion, the manufacturing processes were the same in both large and small workshops. Any difference in making these handle parts would be in the amount of powered machinery available to drive belt-driven saws and or treadle-driven drills for boring the holes.

REVIEW OF AVAILABLE EVIDENCE

EXCAVATED ARTEFACTUAL EVIDENCE

The use of bone and related materials for cutlery handles can be seen in complete knives surviving in museum and private collections, but it is the part-made pieces found in archaeological excavations that provide clues to the manufacturing processes. The use of bone in the Sheffield cutlery industry was so widespread that it is almost impossible to excavate a site in and around Sheffield without unearthing bone at various stages in the production of handles, as unfinished or broken handles, or as the scrap residue from these processes. These artefacts show that bone was sawn into sections, roughly shaped and then smoothly finished with a fine grinding/polishing wheel. It is clear that the bone finds from various sites indicate the probable sequence of work involved (Bell 2008).

The favoured bone material came from the metapodials of various animals: primarily cattle, sheep and pigs, though any larger animal would do. After de-fleshing and cleaning, the ends of long bones were sawn off and the shaft sawn to length, usually 8-12cm, as suitable for handles. Narrow segments of dense bone around the shaft were sawn off vertically in sections, having a flat inner side and a domed and rounded outer surface. They were thus almost perfect for the scales of knife handles, requiring only finer shaping and fitting. The centre of the bone shaft was left as a distinctive hollow 'box-like' piece of scrap (Fig. 4). Ribs and shoulder blades are relatively thin and flat but can provide a thin broad scale, suitable for attaching to a folding knife.

An unusual group of bone handles was found at Sylvester Wheel, a water-powered site near the centre of Sheffield, excavated in 2005-6 by a team from Archaeological Research and Consultancy at the University of Sheffield (ARCUS). Sylvester Wheel was initially a small grinding wheel, possibly dating from the late 16th century, but by the early 19th century it had been enlarged and was coverted to a cutlery factory (Ball *et al.* 2006). Bone handles were recovered from an unstratified layer in the flywheel pit. As stated above, a major problem with bone was that it only produced thin usable pieces, limiting its use to scale tang knives. However, metapodials are round in section, with the medullary cavity forming a naturally hollow centre – a 'ready-made' handle requiring minimal work (Fig. 5). This seems to be such an obvious use for the bone that it is surprising that no finished example seems to survive in local cutlery collections.

Only one of these metapodials was found attached to a corroded knife blade on this site; none of the rest had been used. However, most had been extensively decorated with geometric designs of filed straight lines and cross-hatching. These are the only examples of this form of bone use that has been found in all the industrial excavations in Sheffield and casual enquiries to museums' colleagues have found no further examples. It is unfortunate that the finds are from an undated layer.

The dense buffalo horn and ivory were sawn into rectangular handle-sized 'blanks' to maximise the material and leave little waste. Pieces of ivory and horn are less frequently found in excavations in Sheffield – the implication being that comparatively less was used and their value justified complete utilisation, or any pieces left around in a workshop would be valuable enough to be removed.

The scraps and waste from the processing of bone, ivory and horn formed the raw material for other industries, such as button-making, or the production of agricultural fertilisers from bone waste, following the innovation of bone-crushing mills in the 19th century. It is suggested that this practice developed in and around Sheffield because of the vast amount of bone being used by cutlers. The *Bulletin of the New York Agricultural Experiment* Station in 1891 stated that about 800 tons of bone waste was produced in Sheffield in a year and that this had been used on the land, probably from the end of the 18th century. The beneficial use of bone and horn waste as agricultural fertilisers was of interest in the developing fertiliser industry (Loria 1967: 169; O'Connor 2001: 46).

Fig. 5. – Metapodials sawn to length for knife handles, the centre one has filed decorated, excavated by ARCUS from the Sylvester Wheel, Sheffield, 2005. Scale in cm.

DOCUMENTARY SOURCES

The Cutlers' Company records contain some of the earliest information for the use of bone, ivory and horn by cutlers. In 1680, the Company set up a Storehouse where craftsmen, particularly scissorsmiths, could buy their iron and steel, paper and pack thread and for the cutlers, the Storehouse purchased bone, ivory, horn and tortoiseshell (Company of Cutlers of Hallamshire D19/1-5). The Company attempted to give some protection to cutlers from abuses by merchants, both in selling raw materials to and buying the finished goods from the artisans. This Storehouse enterprise lasted less than a decade, having had chronic cashflow problems, but its lists of goods provide an insight into costs and usage.

Other groups of documents indicate the quantities of handle material the cutlers might have been using. As part of the process of proving a will after the death of an individual, an inventory was taken of the deceased's goods. It was customary for three neighbours to survey the house and premises listing and valuing all the possessions, affording us a fascinating glimpse into people's lives, from the richest to the poorest. Held at the Borthwick Institute in York, these probate inventories exist for Sheffield from the later 17th century to the mid-18th century and those for cutlers give some indication of the size of the bone, ivory and horn trade. However, the amount listed in a probate inventory cannot be taken as an accurate estimate of the scale of a

cutler's manufacture, as he may have been selling off his goods and winding down his business when he became old or too ill to work.

A later source of information regarding industrial use of bone, horn and ivory comes from the compensation claims made following a disastrous flood in Sheffield in 1864, in which 250 people were killed. Late one Friday night in March, a crack was observed in the recently constructed dam wall of the Dale Dyke reservoir, high up the river Loxley, to the north-west of Sheffield town centre. The frantic attempts to relieve the pressure of water failed and, when the dam wall gave way, the water surged down the narrow valley at an estimated 40 miles per hour – too fast for any warning to reach people down river in houses, hamlets and in the centre of Sheffield.

The valley of the river Loxley was lined with water-powered workshops and rolling mills, which were seriously damaged. At the confluence of the rivers Loxley, Rivelin and Don, the floodwaters spread out, flooding houses and factories over a wide area. After the water subsided, claims for compensation were made against the water company and eventually money was paid out to individuals and manufacturers for their losses. The record of these claims provides a wealth of information of social and industrial relevance (Sheffield Flood Claims Archive).

Additionally, the usual sources of industrial data from the late 18th century onwards, such as trade directories, trade and exhibition catalogues and newspaper advertisements, can be included in the overall framework constructed to describe the industry's requirements of raw material and the processing of it into knife handles.

MUSEUM AND PRIVATE COLLECTIONS

Although a knife handle is subsidiary to the main function of the blade, the handle can become an attractive feature in itself, providing marketable features based on style, fashion and desirability. The more striking the handle is, the more likely the knife is to survive in collections. For this reason, archaeogical finds and documentary sources are vital to achieve a more comprehensive understanding of knife handle manufacture, especially because fewer bone-handled knives tend to survive.

The fine grain of the ivory takes intricately carved details and metal inlays but these additional processes were confined to the most expensive cutlery (Fig. 1). Ivory is such an attractive material that it is desirable even without further decoration and there are plenty of ivory handled table knives, carving knives and expensive hunting knives. Small, thinner scales used for open razors and for the more delicate pen- and pocket-knives make them attractive also. Because of this, ivory hafted knives are commonly preserved in museum collections.

Malleable cattle horn and denser Asiatic buffalo horn can also produce beautiful handles, which are polished or pressed into a variety of shapes for the scales of open razors and pocket knives. By staining clear strips of cattle horn with brown/red dyes, they can be given the appearance of tortoiseshell so that, as with bone, this cheaper material can be used to imitate more costly handles.

CASE STUDIES

The following three case studies will take different aspects of this research by combining the three sources of information and show how they can add meaning to the tiny fragments of bone, ivory and horn found on excavation sites.

Wholesale Suppliers Of Handle Material

The supply of exotic handle material is of interest to researchers tracing the origins and trade routes of imports. Once it arrives into Britain, it was sold, usually by auction, and distributed in various quanitites before it eventually reached the cutlers. The origin of the ivory and buffalo horn was necessarily from their natural environment of Africa, the Indian sub-continent and the Far East. The interest here is what happened at a local level, particularly with respect to quantities and prices.

Ivory has been imported in England since the Roman occupation and used as a desirable decorative material. In the 1680s and probably before and after, ivory came to the Cutlers' Company Storehouse via the London merchant, Mr. Guil-

lams, but it is not known were the ivory originated. The Storehouse records demonstrate how the system worked in practice. An inventory of goods in 1681 showed that the Company had bought almost £79 worth of ivory, including 36 'teeth' and other unspecified ivory from Mr. Guillams. Using a comparison of the retail price index, the equivalent value in 2008 would have been £10,400 (Officer and Williamson 2009). There were also 66 further teeth and two parcels of ivory, totalling almost a ton in weight, but the value is not recorded. With this exotic material in the Storehouse, cutlers could then purchase it for their use. A cutler called Robert Nichols purchased the most ivory during the time of the Storehouse, spending £16 14s 8d. on seven 'teeth'. The Storehouse also bought bone 'shanks' and antler 'tips'. Tips came in barrels and hogsheads, which held around 50 gross (7,500 tips) and cost 12d. per gross.

The Cutlers' Company Storehouse records provide the earliest definitive evidence for the supply of ivory to cutlers. Later records indicate how the trade had developed by the mid-19th century. In the 1850s, a paper was reported in the *Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire*, in which estimated amounts of bones and horn were given (Fisher 1849-1859). The data appear to be based on import duties charged on goods, and the annual estimated average used in Sheffield was: 400,000-450,000 bones; approximatley 1,400 tons of horn; and about 360 tons of buffalo horn. Fisher reported that:

"Buffalo Horns are sold by weight. And are at present worth from £15 to £30 per ton — the count runs from 700 to 2,000 to the ton, and taking the average at 1,400, the mortality among Buffalos in the East required to supply our Sheffield needs will be about 245,000 per annum" (Fisher 1849-1859).

By the end of the 19th century, more information can be found in auction notices such as the one in the *Liverpool Mercury*, April, 1894. Ninety-seven tons of ivory were advertised for sale: 84 tons of elephant ivory from various parts of Africa, India and the Far East; two tons of 'seahorse teeth' (originating from various sea creatures); half a ton of walrus and narwhal ivory and eleven and half tons of ivory waste. Evidence such as this indicates that at this time, most ivory came from elephants of various origin, with Britain benefiting from its extensive colonial trading links.

CUTLERS USAGE OF HANDLE MATERIAL

How much handle material a cutler bought and what he did with it are indications of work practices, trade organisation and the size of the industry. A typical example of the information found in a probate record (an inventory taken in order to prove a will) is that of George Harrison, a cutler, who died in 1690. He was about 40 years of age. He had a work chamber with a hearth and five anvils, a number of hammers, saws, files and tongs – all his possessions valued at a total of £46 16d 0d (£7,000 equivalent using 2008 retail price index). George must have died suddenly, as he had unfinished knives – 156 'rough blades' and 72 glazed (polished) blades. His knives included ten tortoiseshell knives, six 'olivante' (ivory) knives and 36 horn knives, while his stock of handle material included 39lbs (18kg) of tortoiseshell, 21lbs (9.5kg) of horn and 200 horn scales. Twenty years later, a cutler called John Shirtcliffe died; his stock included 1,000 beef bones and a 'parcel of ivory teeth'.

Other probate inventories specify not only the handle materials being used, but suggest work practices, especially relating to horn. Horn from domestic cattle and from imported species such as buffalo, is a malleable, thermoplastic material. It can be boiled to soften it and then it can be placed between dies to press it into the required shape and/or to impart surface decoration. It is a simple, low-technology method of producing a desirable and attractive item. The presses could be made from wood, as is the case when pressing horn spoons, or metal, which can be engraved with highly detailed designs and pictures. Surviving examples, especially the pressed horn scales for open razors, demonstrate the skills of the engravers (Fig. 6). It is clear that Sheffield cutlers were familiar with this method of producing decorative work and examples in some probate records specify the required tools:

- 1690: 17 dozen horn scales; three dozen plain knives to press; two vices;
- 1714: a parcel of rams' horn; a pressing vice;

Fig. 6. – Top, horn pressing vice; middle, large cattle horn (courtesy of the Hawley Collection); bottom, 19th century open razor with pressed horn scales. Cutlers' Company collection. Scale in cm.

- 1729: 300 horns; two pressing vices and 12 pairs of presses;
- 1732: a parcel of scales; four pairs of presses; a vice.

Vices attached to the cutler's workbench were required to exert strong pressure on the pairs of presses or dies and multiple pairs of presses suggests that each carried a different design. By the 19th century, scale pressers had become a sizeable group in the trades supplying the cutlery industry.

At the beginning of the 20th century, a large cutlery manufacturer, Joseph Rodgers and Sons, produced a history of the firm and included a number of photographs of their showrooms and storerooms (Rodgers 1905). Rodgers' stock of ivory tusks was bought quarterly from Liverpool, London and Antwerp, amounting to 12 tons a year. This however, was a reduction from 1878 when 2,561 tusks were used, averaging around 23lbs, approximately 23 tons. By 1905 the storeroom, held around 15 tons, valued at £22,000 (Rodgers 1905: 27; Tweedale 1996: 263).

One final type of documentary source is the trade catalogues produced by manufacturers. These, together with internal ledgers and stock books,can give some indication of the materials being used. Trade catalogues do not specify the type or origin of ivory – classifying it by their perceived quality. Without detailed purchase ledgers or an analysis of surviving examples, it is impossible to suggest the level of usage of hippo or walrus ivory, etc. There is oral evidence for some use of mammoth ivory 'in the past', but nothing seems to confirm the scale of the trade in documents. Today, mammoth ivory can be bought and is still used for high quality hunting knife handles.

The Size Of the trade

It can be seen from the above case studies that a single cutler would use a considerable amount of handle material, especially of the cheaper kind. It is evident that ivory, bone and horn came to Sheffield merchants via auctions and other wholesalers, though this is an area which has not been particularly well researched. From street and trade directories, the numbers of merchants, scale pressers, ivory cutters and slaughterhouses can be counted, but this gives little indication of the size of their operations. The unique set of documents relating to the Sheffield flood of 1864 does give some idea of the trade.

The references to bone, ivory and horn working come from the claims for damaged stock, machinery and for loss of earnings. Examples of loss of earnings give rates of pay for bone cutters, ranging from four to seven shillings per day (£127-£222 at 2008 rate). These losses were incurred principally because of the damage to many of the tenement factories near the rivers. Further details come from the claims for loss of materials and tools. Typical claims include the loss of 21 tons of bone shanks at £14 per ton (£8,900 at 2008 prices) and four tons of bone 'sawings' at £8 per ton. Damaged bone scales were auctioned off, raising £53 (£33,700 at 2008 prices) and further claims were made for 4,500 horn scales and 700 horn cuts. One manufacturer also claimed for eight circular saws, suggesting powered saws for bone cutting. The loss of this

amount of handle material would have had a serious effect on the cutlery industry until rebuilding and re-stocking took place.

CONCLUSIONS

This paper focuses attention on the use of animal-derived material in the Sheffield cutlery industry from the 17th to the 20th centuries. The industry's requirement for materials suitable for knife handles was dictated by the structure of the knife itself, and on the availability, cost and desirability of the handle materials, which changed over time. The physiological structure of bone determines its use principally as handle scales, while horn and ivory can be used both as solid handles or thin scales and the quality of the material also determines its subsequent decoration, with the close-grained ivory lending itself to fine carving and the thermoplastic horn taking pressed relief decoration. The survival of everyday items from the 16th century onwards has usually depended on their rarity, and the beauty or costliness of the handle material and therefore they are not necessarily representative of the millions of ordinary knives that were manufactured. The value of the documents and the excavated fragments is vital in complementing museum exhibits.

Research into the manufacture of knife handles is sparse, with few publications. There are publications which are descriptive of museum items and aimed at collectors, or information might be found in the 'grey literature' of excavation reports. The redevelopment of large parts of Sheffield in recent years has brought to light many objects from demolished factories and workshops which have provided 'missing links' in the understanding of work processes. These data allow for the extrapolation into meaningful descriptions of earlier industrial processes and further research can add more detail or, like the Sylvester Wheel metapodial handles, raise awareness of differences.

Subsidiary and related evidence has been collated in order to deduce manufacturing methods, and Sheffield is fortunate to have two unique documentary resources. One is the archive of the Company of Cutlers (especially the records of its Storehouse undertaking in the 1680s) and the other is the Flood Claims archive, giving such incredible detail about the industrial and social life in Sheffield in 1864. With these resources it has been possible to provide an integrated interpretation of data available for a neglected aspect of the industry and to establish a framework for future work, such as comparing any changes over time and comparing similar processes both in other parts of Britain and abroad.

ORIGINAL DOCUMENTS

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Sheffield probate records; probate records are listed with the dated will (no registered numbers)
The Company of Cutlers in Hallamshire, Sheffield:
The Storehouse records, D19/1-5
Hale Brothers' pattern book, U26/1
Sheffield Archives, Sheffield:
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