New light on old iron: recent work on Iron Age iron production, consumption and deposition in Britain

Staré železo v novém světle: nejnovější studie výroby, spotřeby a deponování železa v době železné v Británii

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Over the last decade, there has been a noticeable increase in the number of projects and discoveries relating to Iron Age iron in the UK. These include the discovery of one of the earliest smelting furnaces at Messingham, North Lincolnshire, an extensive industry along the Thames Valley and finds of iron objects including swords and spearheads within the graves of the Arras culture of Eastern Yorkshire, for example at Pocklington. There has also been an encouraging increase of the number of PhD theses being undertaken in UK universities on early iron objects and their production and deposition, including those supervised and examined by the writer. This contribution will consider the origins of iron production in Iron Age Britain and the relationship between iron production, its uses and the deposition of iron artefacts within the landscape in the light of these recent discoveries.

iron – Britain – Early Iron Age – smelting – deposition

Během posledního desetiletí došlo k výraznému nárůstu počtu projektů a objevů souvisejících se železem doby železné ve Velké Británii. Patří mezi ně objev jedné z nejranějších tavicích pecí v Messinghamu v severním Lincolnshiru, rozsáhlá výroba tradičních nástrojů podél údolí Temže a nálezy železných předmětů včetně mečů a hrotů kopí v hrobech arrasské kultury východního Yorkshiru, například u Pocklingtonu. Došlo také k povzbudivému nárůstu počtu doktorských prací realizovaných na britských univerzitách (*některé pod autorovým vedením*)*, zabývajících se nejstaršími železnými předměty a jejich výrobou a deponováním. Příspěvek se zabývá počátky výroby železa ve Velké Británii a vztahy mezi výrobou železa, jeho použitím a ukládáním železných artefaktů v krajině ve světle těchto nejnovějších objevů.*

železo – Británie – starší doba železná – tavení – deponování

This article aims to provide a review of recent work being undertaken on iron in Iron Age Britain, focusing on aspects of production, consumption and deposition. Some of the earliest iron objects yet discovered are socketed axe heads, replicating copper alloy examples (*fig. 1*; *Rainbow 1928*; *Manning – Saunders 1972*; *Boughton 2015*). These demonstrates considerable skill at this early period, as unlike copper-alloys, iron had to be forged and pieces welded together. The process of iron smelting, bloom refining and forging of artefacts is more complex than the manufacture of non-ferrous artefacts. The pattern of distribution of these axe heads is interesting as the majority were found south of a line between the Wash and Severn estuary, with a concentration along the River Thames and in South Wales (*Boughton 2015*; *Jinks-Fredrick 2017*). Further examples have been recorded through the Portable Antiquities Scheme (https://finds.org.uk/) in North Yorkshire (*Collins 2014*) and Norfolk (*Rogerson 2016*). Of the five Scottish examples recorded by *Boughton* (*2015*, 144, fig. 5.59) all are near rivers or the coast.

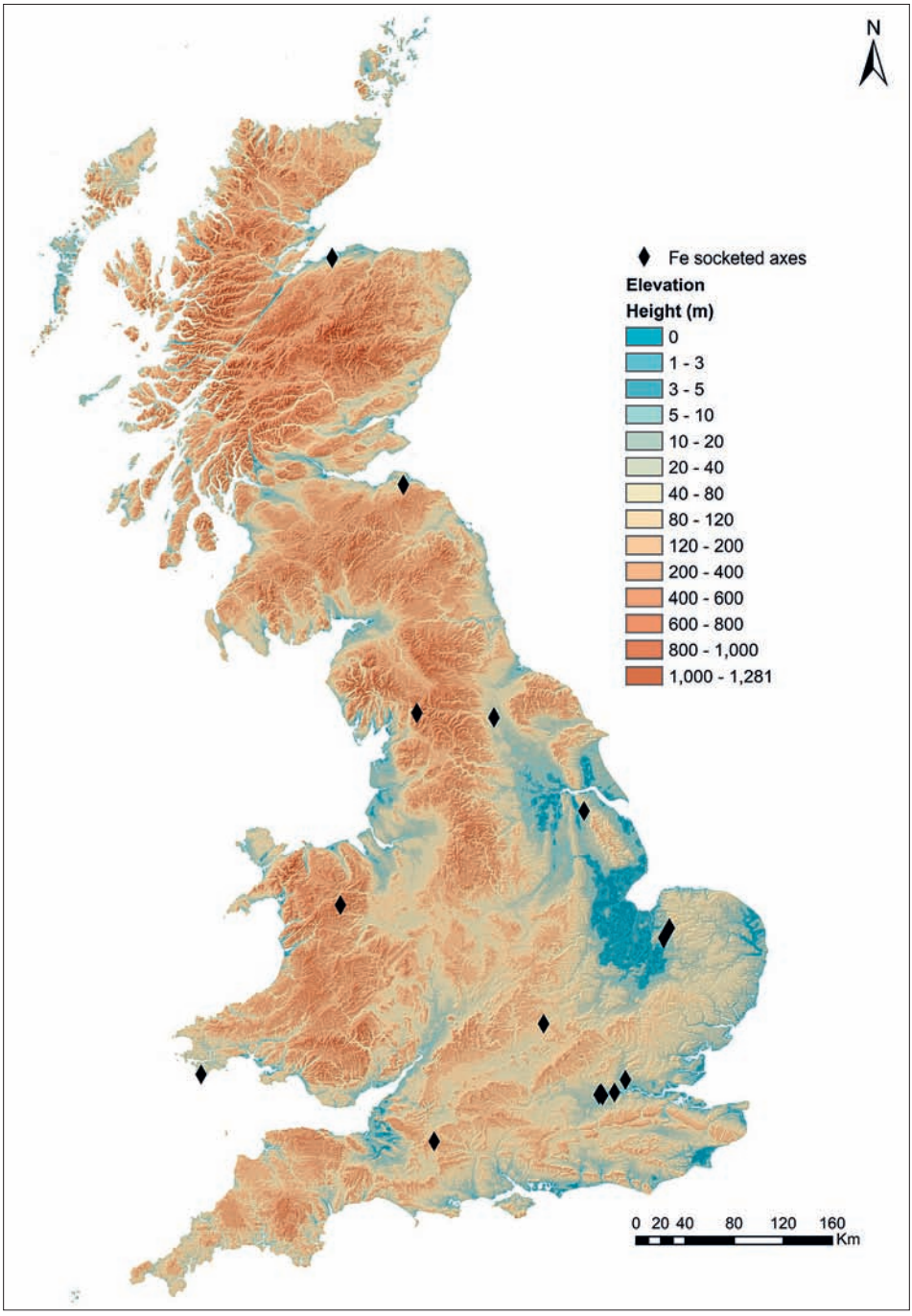

Fig. 1. The distribution of early Iron Age iron socketed axes (after Jinks-Fredrick).
Obr. 1. Prostorová distribuce nálezů železných sekerek s tulejkou ze starší doby železné.

Other items usually made in copper alloy include sickles and pins, like those found in the Llyn Fawr hoard, which was probably a ritual deposit in this south Welsh Lake around 750–600 BC, along with a range of copper alloy objects including cauldrons, weapons and horse trappings (*Fox – Hyde 1939*; *O'Connor 2007*; *Needham et al. 1997*). The Hallstatt C iron sword from Llyn Fawr is another example of the replication in iron of an item normally made from copper alloy and shows considerable skill on the part of the blacksmith responsible.

The earliest recorded iron objects from East Yorkshire are a pin or part of an iron loop and ring from Staple Howe (*Brewster 1963*) a small hill fort on the northern edge of the Yorkshire Wolds dating from Cal BC 753–402 (1 sigma) 765–350 (2 sigma) (*Dent 1995*; *2010*). Further to the East along the North Sea coast, at Scarborough Castle, pieces of iron rod were found with Ewart Park phase copper alloy objects in pits (*Smith 1928*; *Challis – Harding 1975*, 46). Iron fragments were also discovered in ditch fills at Grimthorpe Hillfort (*Stead 1968*, 166, 5–7) dating from 1150–400 BC.

A number of contenders have been proposed as the earliest place for the manufacture of iron in Britain (*fig. 2*). At Hartshill Copse, Upper Bucklebury, Berkshire (*Collard – Darvill – Watts 2006*) hammer scale was found in a late Bronze Age context dating from the 10th century BC. Other early iron production sites include Aldeby, southern Norfolk, where furnaces and slag were found during a watching brief along with later Bronze Age and early Iron Age pottery (*Trimble 2001*). At Shooter's Hill, London (*Dungworth – Mepham 2012*) 63 kg of slag from smelting was discovered in a ditch with later Bronze Age or early Iron Age pottery dating from c. 700–400 BC. At Broxmouth, East Lothian, Scotland, extensive evidence for iron production was found associated with a hillfort dated to 800–400 BC (*Armit – McKenzie 2013*).

In 2016, however, the earliest conclusive evidence for iron production in Britain so far was found in the shadow of the Scunthorpe steelworks at Messingham, North Lincolnshire, consisting of a furnace and 630 kg of slag. Charcoal samples from within the furnace structure and outside provided ^{14}C dates of c. 780–590 Cal BC (*Pitts 2016*).

These sites share a number of characteristics. Both Hartshill Copse and Shooter's Hill are situated relatively near to the Thames Valley, Aldeby lies close to the River Waveney, 10 km from the North Sea at Lowestoft, and Broxmouth is near the Firth of Forth in Scotland, and the North Sea. Further north, a cluster of Iron Age iron production sites has been identified around the Moray Firth (*Cruikshanks 2017*). Messingham lies close to the valley of the River Trent and 20 km south of the Humber estuary itself.

All these rivers are tidal and connected to the North Sea basin, albeit at some distance in the case of the Thames Valley sites. These locations provide access to already well established European communication networks and although independent insular innovation is possible, iron objects and perhaps iron production itself may have arrived by these routes and that 'connections across regions (are) implied by the sharing of new technologies and artefact types' (*Webley 2015*, 126). *Cunliffe* (*1995*) has proposed that the Atlantic seaways of western Britain may have been a conduit for the introduction of iron technology from the European continent, which appears to correlate with the distribution in Britain of later Bronze Age iron objects and Carp's tongue style swords (*Collard – Darvill – Watts 2006*). A cluster of such swords in north-western France also supports *Cunliffe*'s (*2005*, 72) idea of zones of influence and contact.

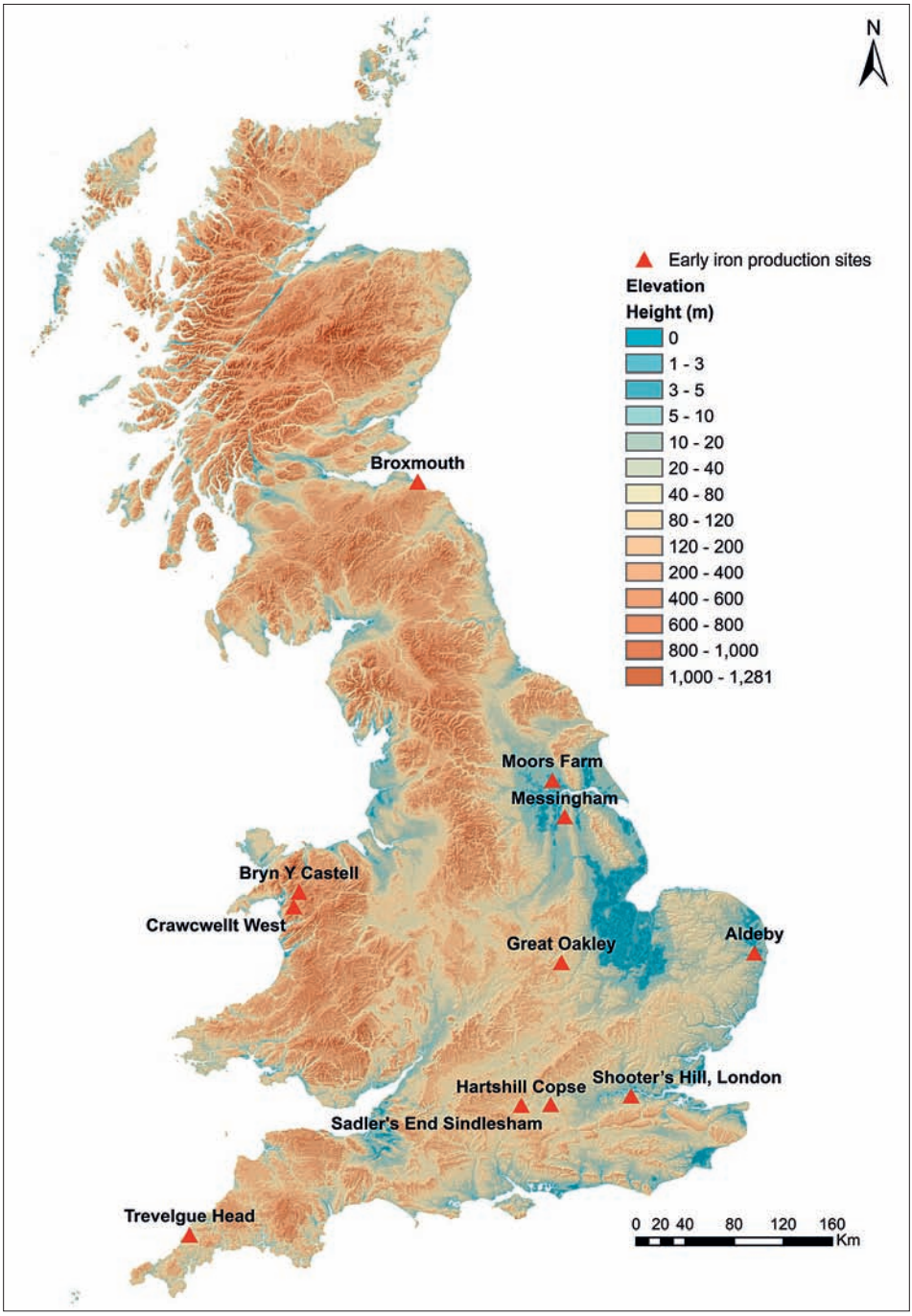

Fig. 2. Early iron production sites in the UK.
Obr. 2. Lokality s ranou výrobou železa ve Velké Británii.

Confirmation of the apparent relationship between early iron production sites and tidal river systems can also be seen within the Foulness Valley, East Yorkshire where long-term research has led to the discovery of a substantial industry (*Halkon 1997a*; *2012*; *Halkon – Millett 1999*). During a programme of field walking, 18 iron production sites were identified within an 8 × 8 km landscape block, the majority around the head of a tidal estuarine inlet of the River Humber. This inlet was created by a combination of factors including a tidal incursion somewhere between 800 and 500 BC and raised sea levels of around 0.7 m OD (*Halkon – Innes 2005*; *Coles 2010*). This opened up the region to trading networks established for a considerable time, as a number of Bronze Age and Neolithic items, including All Over Corded Beakers, are thought to be derived from continental Europe (*Manby – King – Vyner 2003*, 58).

The means by which such communication could be undertaken is well illustrated by the Bronze Age North Ferriby boats found on the northern shore of the Humber. These date from 1940 to 1680 Cal BC (*Wright et al. 2001*) and part of a similar vessel from Kilnsea, on the Holderness coast dated to 1870–1670 Cal BC (*Van de Noort et al. 1999*). So far, no Iron Age sea going vessels have been found in this region, although there is a cluster of log boats around the Humber Basin. These include the Hasholme boat, constructed from an oak with a felling date of 322–277 BC (*Millett – McGrail 1987*), the South Carr Farm log boat (*Halkon 1997b*) and Brigg boat in North Lincolnshire (*McGrail 1990*). The Hasholme and South Carr Farm boats sank in the tidal estuarine inlet and creek system mentioned above and may relate to iron production sites at Hasholme and North Cave.

At Moors Farm, Welham Bridge, a slagheap was found which contained over 5.3 tonnes of slag (*Halkon – Millett 1999*). Charcoal within the slag was radiocarbon dated to 400–200 Cal BC (68%) and 410–170 Cal BC (95%) (HAR 9234) and 520–390 Cal BC (68%) 770–370 Cal BC (95%) (HAR 9235). Further east along the Foulness Valley there were clusters of iron production sites at Bursea and Hasholme, Holme-on Spalding Moor (*Halkon – Millett 1999*) and to the east of the Walling Fen tidal inlet at North Cave (*Dent 1989*; *Halkon 2014*; *McDonnell 1988*).

To the east up the Humber estuary, Iron Age iron production was found along the River Hull at Thearne (*Campbell 2008*; *Halkon 2014*), and Arram (*Wilson et al. 2006*). At Elmswell, near the headwaters of the River Hull, a heap of around 1.5 tonnes of slag was excavated on a site with Iron Age, Roman and Anglo-Saxon activity (*Congreve 1938*) although it is not certain to which of these periods the heap belongs, the excavator's description implies that an Iron Age date is most likely.

The riverine and wetland distribution of these early iron production sites can also be explained by the availability of raw materials, particularly deposits of bog ore. In the case of the Foulness and Hull Valleys, recent analysis of smelting and smithing slag confirms the use of high phosphorus bog ores (*Hall 2017*). In many general books on Iron Age Britain the ubiquity of iron ores is referred to (e.g. *Harding 2014*, 90; *Cunliffe 1991*, 453) and the presumption made that any iron ore could be smelted using Iron Age technologies. Subsequent experimental archaeology, however, has demonstrated that iron production is much more complex than previously thought and some of the better-known 'modern' deposits were not fully exploited until the introduction of the Bessemer process. This is supported by *Schrüfer-Kolb* (*2004*, 16) who states, '… the economic assessment of ore sources is a complex undertaking and the simple plotting of chemical data against each

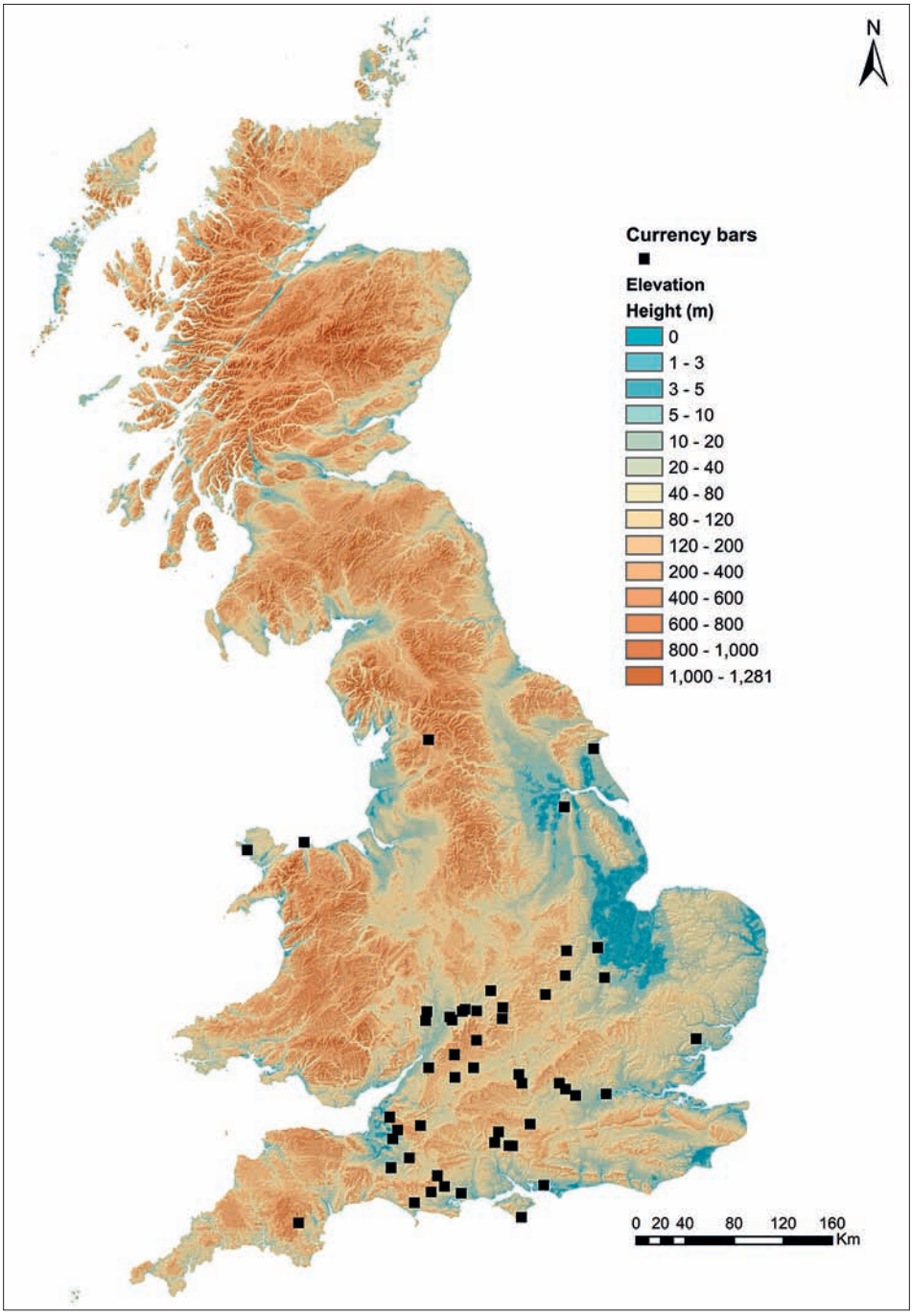

Fig. 3. The distribution of currency bars in the UK (after Jinks-Fredrick).
Obr. 3. Prostorová distribuce nálezů hřiven ve Velké Británii.

other is an over-simplification. Ancient resources must not be measured against modern standards'. Ore resources, particularly siderite ores from the Jurassic ridge, which runs from the Bristol Channel to the North Yorkshire Moors, were exploited during the Iron Age and Roman periods, particularly in the East Midlands in Northamptonshire, with a site at Great Oakley, near Corby, thought to be one of the earliest in this region (*Schrüfer-Kolb 2004*, 52; *Jackson 1982*). The area around the hillfort at Hunsbury is thought to have been a further centre for iron, although this is partly based on the concentration of currency bars there (*Schrüfer-Kolb 2004,* 105), artefacts which will be discussed later.

At Trevelgue Head, Cornwall, once thought to be the earliest large iron producing site in Britain, siderite ores, from a lode running through the headland, with surface deposits eroded to limonite and goethite, were exploited (*Dungworth 2011*) however the amount of slag found there is relatively small compared to more recently discovered sites.

It is noticeable that in these early stages of iron production, objects made of iron tend to be relatively small, and the full potential of the metal little understood. By the middle Iron Age, there appears to be a radical change, demonstrated most clearly by the contents of chariot burials, the earliest so far found in Britain being at Newbridge, Edinburgh, dating from 5th century BC (*Carter – Hunter – Smith 2010*). The shrinking of iron tyres onto wheel rims without nails represents a major innovation in blacksmithing. It had been suggested that this technique was developed in the Aisne-Marne region of France, arriving in the environs of Paris and East Yorkshire around the same time in the late 4th century BC (*Anthoons 2007*; *2011*). New radiocarbon dates, however, show that the seven chariot burials around Wetwang and the outlying Yorkshire example from Ferry Fryston (*Brown et al. 2007*), date from 'no more than a few decades around 200 Cal BC, some two centuries after the main phase of vehicle burial in northern France and the middle Rhine' (*Jay et al. 2012*, 182; *Hamilton – Haselgrove – Gosden 2015*). All but two of the 27 chariot burials known so far from Britain have been found in Eastern Yorkshire, most recently in 2017 at Pocklington (*Symonds 2017*) and on a site to the south of this region, between the Yorkshire Wolds and the Humber banks (Paula Ware pers. comm.).

Over the last two decades, experimental archaeology has provided insights into Iron Age iron production and demonstrated the considerable time and resources required for its production (*Crew 2013*). It has been estimated that the chariot fittings including the tyres would have needed around 36 kg of iron. Based on Crew's calculation this would have required a total of some 288 person days. A strong relationship between control of iron production and social status within Middle Iron Age society in this region may be possible. It may not be coincidental that the cemeteries with the most chariot burials at Arras and Wetwang are relatively close to the iron producing zones of the Foulness Valley and Hull Valley respectively.

Further south, the Thames valley remained important for the production of iron later into the Iron Age. At Sadler's End, Sindlesham, in Berkshire, the largest quantity of Iron Age smelting slag yet discovered in Britain was excavated, the majority in a 10 m spread weighing over 21,216 kg. This was estimated to be the residue from the production of 1.8 tonnes of iron, which could have been forged into c. 2000 currency bars (*Lewis – Crabb – Ford 2013*). According to Crew (pers. comm.), this appears to be a very low iron-slag ratio. Slag analysis showed that the raw material had been bog ore but not from the immediate vicinity. A ^{14}C date of 185–50 Cal BC was obtained from charcoal in Furnace 303.

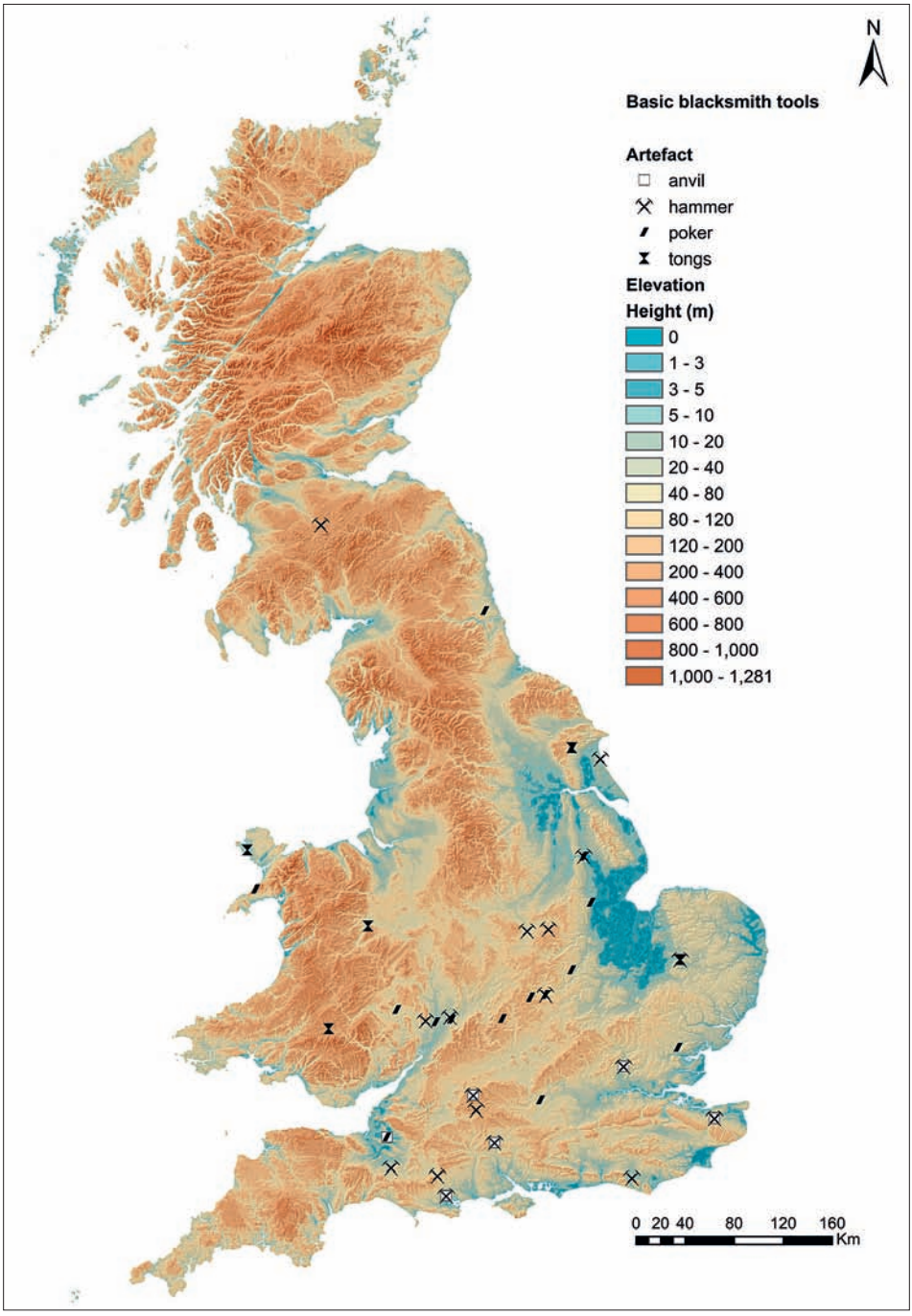

Fig. 4. The distribution of blacksmith's tools in non-burial contexts (after Jinks-Fredrick).
Obr. 4. Prostorová distribuce nálezů kovářských nástrojů z nehrobových kontextů.

The size of the Sadler's End slag heaps far surpasses what was until recently the largest amount of Iron Age slag from Britain, which weighed 6.5 tonnes (*Crew 1998*; *2009*), excavated 1990–1998 on a settlement with round houses at Crawcwellt West, Merioneth, North Wales, with iron production being undertaken c. 300 BC to 100 BC. At Bryn y Castell, a small hillfort near Ffestiniog, Merioneth, bog ores were smelted at around the same time, but the quantity of slag found here at 1200 kg was much less. A special feature of this site was a snail-shaped stone structure in which blacksmithing had been undertaken (*Crew 1987*; *2009*). The high quality research undertaken on these two sites remains pivotal in our understanding of early iron production and led to Crew's vital experimentation (*Crew 2013*).

So far, much attention has been paid to iron production. A feature of both the East Yorkshire and North Welsh production centres is the relative lack of 'currency bars', now generally accepted as a semi-product allowing the quality of iron to be assessed, rather than an early form of monetary exchange (*fig. 3*). Of around 1500 known examples, which can be divided into around 20 groups, few have been found in the north of England and Scotland (*Crew 1994*). Five bars were included in the hoard of iron objects from Llyn Cerrig Bach on Anglesey, which were of two types, one of which may be unique to North Wales (*Crew – Crew 2012*). In East Yorkshire the only bar known so far was found at Gransmoor near Driffield, close to the head waters of Hull Valley and the mouth of Wetwang/Garton Slack (*Halkon – Starley 2012*). The Gransmoor bar is of particular interest, as it comprised two smaller bars welded together. Analysis showed differences in quality between both sides of the join. The tip comprised heterogeneous phosphoric iron/low carbon steel and the socket section heterogeneous phosphoric iron/carbon below steel composition. It is almost certain that it was made from local bog ores. Considering the scale of the East Yorkshire industry there should be many such items and finished iron may have been traded in other forms.

The majority of currency bars have been found in hoards and the circumstances of their deposition is a matter of debate. *Hingley* (*1990*) argued that many were deliberately deposited as a form of structured deposition, particularly at boundaries and settlement and hillfort banks and ditches. A similar explanation has been put forward for other items made of iron or a combination of iron and copper alloys. A recent example is a 'special deposit' of the chariot fittings from several sets of harness found in a reused pit at Burrough Hill hillfort, Leicestershire. Here the fittings were laid in a box on a bed of chaff, which was then burnt and buried in a reused pit (*Farley et al. 2017*).

Current research on iron objects from non-burial context in Britain (*Jinks-Fredrick 2017*) is showing variations in the types of tools and weapons deposited, with certain locations preferred for specific object types (*fig. 4*). The distribution of all types of smith's tools, i.e. hammers, tongs and pokers, broadly matches that of currency bars, with a concentration in the Midlands between the Severn Estuary and the Wash (*fig. 5*). Iron objects, including currency bars, were deliberately deposited in the grain storage pits at Danebury (*Crew 1995*; *Hingley 2006*), and have been interpreted as some kind of offering in return for the successful preservation of grain, a pattern of deposition noted in other Wessex hillforts (*Sharples 2010*, 134).

An outlier from this distribution are the tongs, poker and possible forge spoon from a grain storage pit at Garton Slack in Eastern Yorkshire (*Fell 1990*; *1991*; *Brewster 1980*; *Halkon 2012*). Weapons, particularly swords (*Stead 2006*) are often associated with watery

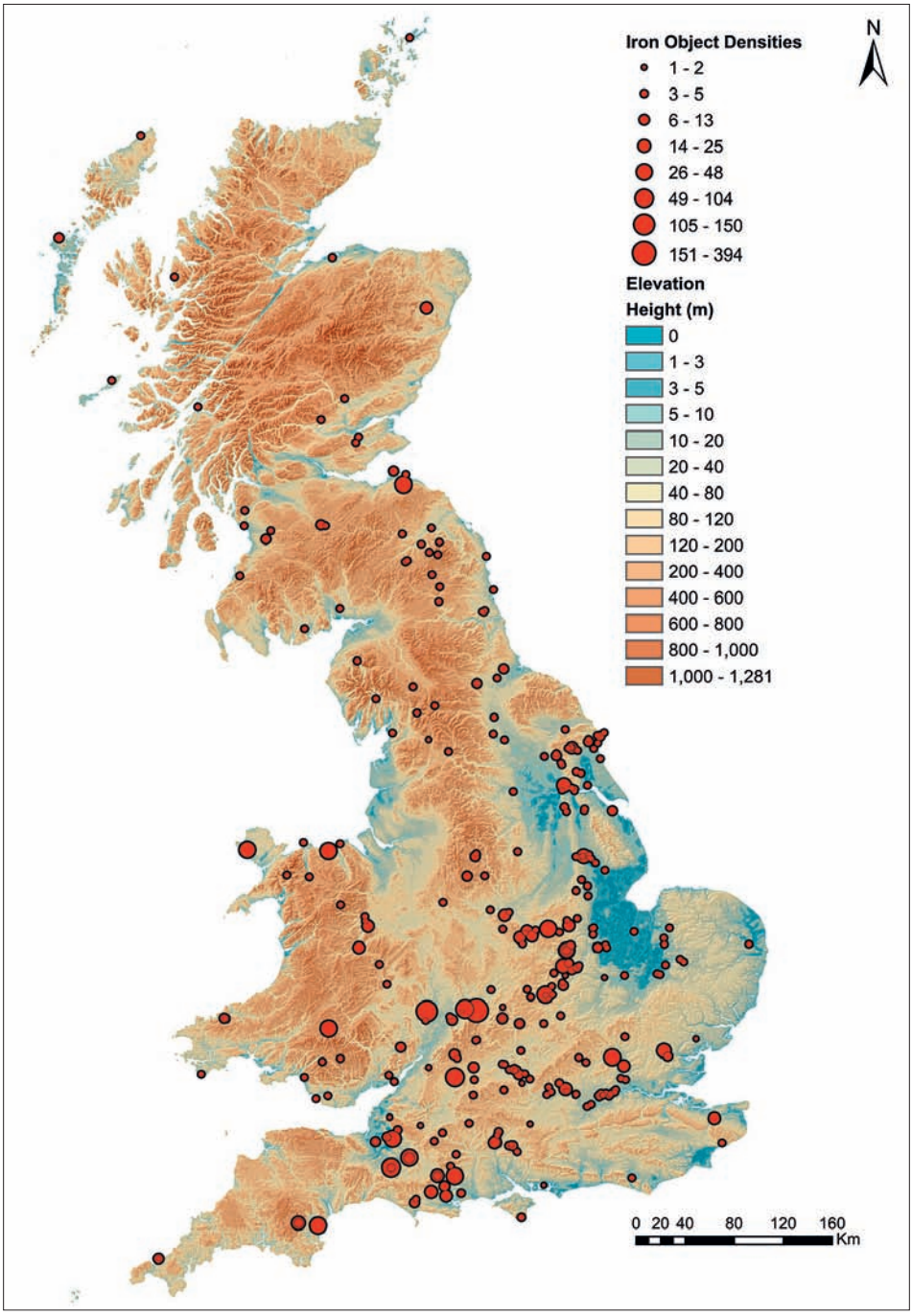

Fig. 5. The density of all iron objects in non-burial contexts in the UK (after Jinks-Fredrick).
Obr. 5. Hustota nálezů všech železných předmětů z nehrobových kontextů ve Velké Británii.

places following Bronze Age practices (*Bradley 1990*; *2016*), but by no means exclusively as in the case of the remarkable weapons cache from South Cave (*Evans 2006*; *Marchant – Halkon 2008*) which contained five swords in decorated sheaths and 33 iron spearheads, placed in a settlement ditch. Various interpretations have been put forward for its deposition. Carefully wrapped in organic material (long since decayed) and covered by sherds of Dressel 20 olive oil amphora, it may have been hidden ready for retrieval in a last act of resistance against incoming Roman forces around AD 70. Conversely, its location close to springs and overlooked by a possible hillfort at Mount Airey, may relate to some act of structured deposition (*Halkon 2008*; *2013*). Whatever the reason for disposal the swords, with their confident embellishment with exotic materials including enamel, sperm whale tooth, and elephant ivory, they mark a high point of metalworking in Iron Age Britain, following the expertise demonstrated in the earlier Kirkburn sword, which accompanied a burial in a large Iron Age cemetery in East Yorkshire (*Stead 1991*).

Given the probable size of Iron Age populations in Britain, the lack of inhumation burials is noteworthy, with other options chosen for the disposal of the dead in many regions (*Whimster 1981*; *Harding 2016*). Eastern Yorkshire has the largest concentration of inhumations, generally enclosed by small square or, in some cases, circular ditches. Iron in chariot burials has been referred to above. Of the less than 2000 burials in Iron Age Britain, excluding Eastern Yorkshire, only around 5 % of these contain iron artefacts, 30 % being weapons, with around 17 % being items of personal adornment and the same percentage of utensils. This contrasts greatly with Eastern Yorkshire were over 17 % of the around 1070 burials contained iron objects, most of which were brooches and spearheads (*Halkon 2012*; *Inall 2016*). Of around 80 burials with weapons in Iron Age Britain, more than half are in eastern Yorkshire (*Inall 2016*, 44) the most recently discovered by Northern Archaeological Associates between Burstwick and Rimswell in Holderness during an excavation prior to the laying of a pipeline (*Turner – Cooper 2017*, 10). This crouched burial resembled others in the Arras Culture tradition, as it included pig bones, a shield and more remarkably a sword, which had been deliberately bent almost double. It is not clear whether the spear in this and a burial close by followed the so-called ‘speared corpse’ ritual characteristic of eastern Yorkshire (*Stead 1991*; *Giles 2012*; *Halkon 2013*; *Inall 2016*).

So far two burials are recorded as containing blacksmiths tools, both accompanied by weapons, Burial 154 at Rudston, East Yorkshire (*Stead 1991*) and at Whitcombe, Dorset, which included a spearhead, a sword, a file and an iron hammer (*Stead 1990*). Not only finished artefacts were included as grave goods; at Pocklington (*Halkon 2017*), several burials contained iron slag, a phenomenon also noted in Ireland (*Williams 2015*).

In the space available it is only been possible to provide a brief overview. There is still much to be done. A priority, following recent French and German initiatives (*Dillmann et al. 2017*) should be trace element analysis to facilitate more precise provenance studies. Further characterisation and metallurgical analysis of slag is also essential (*Stetkiewicz 2016*). More controlled experiments particularly on slag-pit furnaces and assessment of the different qualities of iron objects are also needed. Above all, there needs to be better communication between archaeometallurgists and conventional Iron Age archaeologists to explain the complexity of iron production and its great potential for understanding past societies. Conferences such as ‘Iron in Archaeology’ at Prague will hopefully facilitate this process and continue the work of one of early iron’s greatest pioneers, Radomír Pleiner.

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