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Social ontologies

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There is room for considerable cooperation between archaeology and neuroscience, but in order for this to happen we need to think about the interactions among brain–body–world, in which each of these three terms acts as cause and effect, without attributing a causally determinant position to any one. Consequently, I develop the term social ontology to look at how human capabilities of mind and body are brought about through an interaction with the material world. I look also at the key notion of plasticity to think about not only the malleable nature of human brains, but also the artefactual world. Using an example from the British Iron Age (approx. 750 BC–AD 43), I consider how new materials would put novel demands on the bodies and brains of people making, using and appreciating objects, focusing on an especially beautiful sword. In conclusion, I outline some possible areas of enquiry in which neuroscientists and archaeologists might collaborate.

Keywords: ontology; plasticity; brain–body–world; materials

1. INTRODUCTION

Neuroscientists study the brain to throw light on human capabilities, sometimes glossed as mind. Archaeologists study objects to understand past human collectivities, sometimes glossed as society. Both mind and society are abstract entities, somewhat hard to bring into contact due to their ghostliness. Rather than now concentrating on these two ghosts, mind and society, both neuroscientists and archaeologists are emphasizing material aspects of the brain in its body on the one hand and the physical properties of objects as they affect the body on the other. The triangle of brain–body–world is the point at which neuroscience and archaeology meet. What is needed to make this meeting most productive is a series of ideas that allow us to think about brains, bodies and material things in combination. In the first part of this article, I set out what I hope will be some bridging concepts between the two disciplines, before sketching out how these might be worked through in an empirical case.

I shall develop a notion of a social ontology, which holds that human life unfolds through an equal input from materials and from people, as a key bridging concept. People and materials bring out the characteristics of each other in particular cultural contexts, so that we need to think both about the manifold characteristics of people, and of things, as well as the manners in which they might relate through webs of connection. It follows that human social life cannot be understood apart from its material entailments, so that our lives arise from a combination of human skills in dealing with materials, the varying qualities and quantities of those materials and the social impacts of both skills and materials. In what follows, I shall outline some of the implications of the view that skilled bodies and socializing materials help constitute the nature of human life, looking first at some theoretical concerns, before moving on to more concrete implications.

Ontology is a word with varied meanings, but one key element is that it designates a theory of reality. Such a view implies a thinking being who constructs a theory about how the world is and works, which can be tested or put at risk against physical reality. Physical reality, at least as conceived of in a western modern view, is seen crucially in terms of cause and effect as constructed by the physical science disciplines of physics, chemistry and biochemistry. Such views are obviously historically contingent and culturally constructed, so that many in the world have developed very different images of reality, and now new pictures of ontology are emerging in western academia. Interestingly, there is some considerable synergy between new western views and those found elsewhere. Key to western rethinking is that ontology is an achievement of people and things together, rather than an appreciation of the giveness of the world. If we follow this line of thought, the world we come to know and understand is the world we work and engage with. Our picture of that world derives from our modes of activity within the world and activity is a joint product of people and the material world. This is definitely not a socially constructivist view of the world in which we create an image of reality deriving from our social and cultural conditions of life and also not an objectivist view in which the nature and structure of reality will impose itself upon, or reveal itself to, any suitably trained and disinterested observer. Ontology is an active matter arising from modes of interested activity as people go about the process of daily life with substances such as earth, wood, skins or clay, which, as the focuses of activity, all have in their role to play in shaping, channelling or constraining that activity. In this creation of a mode of reality, a form of active understanding, people bring the capabilities of human beings to play, which derive from the nature of hearing, taste, sight, sound, muscular activity or the processes of digestion, whereas materials are material each in their

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own way. This means that there are not two modes of being, where the physical world of cause and effect meets the more interesting, but less tangible, realm of social relations. Just as there is no objective reality to be more or less encompassed in a theory of how reality works, so there are no pure social relations. All relations between people are also material in their form and content. Such a mixing of people and of things brings into question the academic division between the physical sciences on the one hand and the human or social sciences on the other. The massive nature of this edifice makes us realize how much entrenched thought needs to be overcome to start thinking in a manner which mixes people and things. A first step in this overcoming is to look at how people objectify themselves in objects and how objects subjectify themselves in people (to paraphrase Marx in the *Grundrisse*).

Nowadays, many in the social sciences are starting to think about the combined capacities of people and things. To some degree, this represents a harking back to older issues in anthropology and archaeology. I shall look first at nineteenth century interests in concepts such as animism, before briefly looking at more contemporary thought.

2. MODES OF ACHIEVING AN ONTOLOGY

In his synthetic book *Primitive culture*, Tylor (1871) put forward an evolutionary progression in the history of human thought and understanding, which saw a movement from magic to religion to science. The first of these terms designated a mode of operation and understanding in which people attempted to intercede with and manipulate the spiritual powers of the world through spells and acts. His notion of magic was linked to the idea of animism in which it was thought that the world contains a large number of powers and spirits inhabiting various plants, animals and objects, which might then be animated and able to intervene in human lives. Magic and animistic beliefs differed from religions in which powers were concentrated in a more or less singular god who needed to be supplicated through prayer. Both of these were essentially false understandings of the way in which the world works, according to Tylor, with a truer understanding only coming about with the rise of modern science over the last few centuries. However, it is often said that Tylor did not make clear the distinctions among his three key terms of magic, religion and science, so that in many ways magic and science were linked as modes of affecting the world, the first spurious and naive, the second rigorous and based on a real understanding of the modes of operation of matter. Both were opposed to religion. In a much more recent book, Tambiah (1990) has surveyed modes of magical, scientific and religious thought, looking at Malinowski's counterview to that of Tylor, in which magic was seen as a performative act, which galvanized the community into various ways of confronting a problem—it was not the claims to truth that were the defining feature of magic for Malinowski, but its rhetorical power and social effectiveness. Tambiah is ultimately convinced by neither of these thinkers but takes his lead from Lévy-Bruhl (1926) who sums up so-called 'primitive' thought as one of participation, which posits the consubstantiality of people and things, whereby the same set of processes are seen to animate the world as a whole, whether the human or the non-human element. Tambiah refines this view to say that there are two basic human orientations to reality, one which stresses causality and the other participation. Both modes of understanding are found in all human cultural forms, but in a different balance, with more romantic modes of understanding still alive and well in the rationalistic, scientific West.

Lévy-Bruhl's views find echoes in those being developed by Latour and others nowadays (Stengers 2000; Latour 1993, 2005). The difference between these twenty-first century views and those of a century earlier is that the nature of the material and human material engagements are the key starting point rather than modes of thought about reality. There are a number of key thinkers who are covering similar intellectual ground emphasizing the entangled nature of people and of things. Latour has developed what he calls 'symmetrical anthropology' in which he says that in any analysis both things and people must be included and that we should not prejudge the capacities of either, especially as we in the west tend to think of people as active and objects as passive. More animistic notion of things should be encouraged so that we can look at what sorts of circumstances things will have a determinant effect on people. One of the key issues that Latour has focused on is scientific decision making in which he wants to get away from either a social constructivist view of science, in which it is seen that it is the social and cultural preconceptions of scientists that determine their results, or a purely empiricist mode, whereby the nature of material realities being studied leads inevitably to conclusions about how the world works. Rather, a more entangled view is the only realistic possibility, Latour feels that the cultural preconceptions of scientists are always put at risk and challenged by the nature of the phenomena they are investigating. The analytical point of science and technology studies is to work out how decisions about complex questions, such as global warming or bovine spongiform encephalopathy, are reached looking at the relative weights of the evidence and cultural or political considerations in reaching conclusions. A second current thinker who draws inspiration from animistic forms of thought in looking at the relations between people and things is Ingold (2000). Ingold wants to shift our basic set of images about the world and people, together with the language used to describe it. He uses metaphors of growth and development to look at the manner in which people grow into sets of relationships with plants, animals and materials in manners which change all within that relationship. People's capabilities come about in the context of particular sets of ecological relationships (where ecology is used broadly to include human products) through play, performance and labour in a manner which is profoundly interactive and doing away with any fixed divisions between culture and nature. Intelligence is enacted, coming into being through work in the world, so that thought and reflection are dependent upon people's action rather than the actions directed by mental structures. Another anthropological thinker, Alfred Gell, has been very influential of late

(Gell 1998). Gell has looked at objects commonly considered to be art (a problematical category in any case) and said that our primary question of such objects (and maybe, by extension, of all objects) should not be what do they mean, but what do they do? Gell attends to how people affect people and the relations between people. Key examples for him are objects which enchant through the complexity of their making, the high degree of skill needed to produce them and the materials used in them. Objects which enchant can overawe and influence people, so that they find it hard to resist the blandishments of their makers in other spheres, such as those of exchange. Enchanting objects are active presences in our lives, influencing a whole range of social relations between people. Each of these thinkers have significant differences in their approach, but they all are more or less united in their attempts to understand human life as developing in a partnership with the world.

This is my point of emphasis too and it is an important opening position in thinking about brains, bodies and worlds. We need to join two areas of thought, concerning identity on the one hand and the nature of our relationship with the world on the other. The mode of our presentation of ourselves as members of groups and as individuals is intimately tied up with our understanding of the other and of how the world works more generally. Modes of presentation of self take at least two forms: Mauss (1935) noted that the techniques of the body used for performing our most frequent acts of daily life are open to approval, recognition and evaluation by the social group as a whole, so that when they work they are efficacious both practically and socially; the presentation of self also takes more staged and performative forms, through housing, clothing, ornament and burial to name only a few, and these forms are at once material and social. Thus, in order to present a human individual or a group, the world needs to be mobilized in particular ways that depend partly on the material nature of the world and partly on the methods of mobilization. As groups and individuals are brought into being, subverted or reinforced, so is the world given particular forms to be understood in a determinate range of ways. At its heart, the joint process of becoming and knowing is a process of transubstantiation whereby the values attaching to the forms that objects take help attach values to people, with the reverse also being true—the forms that people take help attach values to objects. The notion of the formal qualities of things is key—it is the forms that things and people take which gives them impact, an impact which is felt in human terms as emotions and feelings. The crucial nexus is between aesthetics, deriving from an appreciation of form, and emotion which is a means of describing the human impacts of form. The senses are the key link here, educated in different ways by material things in various parts of the world, so that sensing is not the simple apprehension of material things and their positions in space or changes through time. Perception is what Noë has called 'enactive' (Noë 2005)—it helps explore the world and to form categories as things are sensed from within the context of action on the world. Action is directed by the forms of things, but also creates or changes those forms.

One thing uniting most of these views is their stress on dynamic relations between people and things. Into this broader discussion of dynamism, neuroscience brings a key concept—that of plasticity. My crude understanding of this notion as applied to the brain is that the activities of the body help to differentially develop areas of the brain, so that relative size and shape of different areas depend on the most common actions of the brain's owner. A famous example of this is the right hippocampus of the London cab driver which is more developed than in most people, due to the acquisition of The Knowledge, encompassing all the complex mass of routes through London (Maguire *et al*. 1997). Archaeologists are very aware of the plasticity of the object world (although they would seldom use that term). The manner in which space is constructed as new settlements are laid out, landscapes develop and routeways come and go is complemented by changes in the artefactual world, so that when new materials are brought in their novel properties create unprecedented possibilities and constraints. The brain has its part to play in these changes, helping develop new modes of engagement. A key element of the recursive relationship between people and the world is the plasticity of both brains and objects: brains help make new objects, which in turn help create new brains.

Let us consider these issues from an archaeological and therefore object-centred perspective, before returning to the possible links between neuroscience and archaeology.

3. IRON AGE ONTOLOGIES

I am going to look at a single artefact from the later Iron Age period in Britain. The Iron Age in Britain ran from approximately 750 BC until the Roman invasion of AD 43 and for most of this time, people lived in a series of small settlements surrounded by arable fields and keeping animals such as sheep, cows and pigs. As might be expected, they had a varied set of crafts ranging among textile making, pottery, carpentry and metal working. They were also skilled at shaping their landscapes, digging long ditches, sometimes many miles long presumably as land boundaries and creating large centres of activity with impressive banks, ditches and gateways known as hill forts. We can guess that most people in the population shared many skills in common needed for growing food, processing and cooking it, as well as the skills to build houses, rear animals, make pots and work wood. Some skills were obviously much more restricted, including those of metalworking and weaving. The name of the period derives from one of the materials found commonly at this time—iron being one stage in the so-called Three Age System developed generally for Europe in the earlier nineteenth century and still in use with many qualifications today. The naming of the Stone, Bronze and Iron Ages represents the centrality of material culture to archaeological thought from its earliest beginnings. New approaches can potentially make use of an enormous amount of analysis and thick description contained in 150 years of archaeological

Figure 1. The handle and top of the scabbard of the Kirkburn sword.

accounts in Europe and on other continents. I shall attempt to give a hint of how this might be done, to flesh out the notion of a social ontology.

I shall start with one complex item, which, as it happens, is made partly of iron: the so-called Kirkburn sword. This is one of 274 swords, sword fragments and scabbards found in the British Isles during the later Iron Age (see Stead (2006) for details of all the material). There are differences of style and life histories between the south of England and the north at this time, so that in the south swords were predominantly thrown into rivers and in the north the ones we have were mainly placed in graves. In either case, there were probably many which did not make it into the archaeological record. The Kirkburn sword, which comes from East Yorkshire in the northeast of England, was found with the inhumation of a man who was lying on his back with his head orientated to the north. The sword was underneath him and placed upside down.

The Kirkburn sword was a complex construction which it is worth looking at in some detail (figure 1 gives some impression of the handle of the sword and the upper part of the scabbard). The sword has an iron blade of some 697 mm long (obscured by the scabbard from which it cannot be removed due to corrosion). The sword has a handle made of multiple components, which protrudes from the scabbard that is made of a front plate of bronze, which is decorated and a rear plate of iron, with a suspension loop to attach it to a belt probably made of animal skin (see figure 2 for an exploded reconstruction of the scabbard as understood from X-ray analysis and visual inspection). The lower part of the scabbard is covered in a chape that has enamelled glass decoration. The handle of the sword is especially complicated. In its upper part (or pommel), it is composed of an iron frame containing a piece of carved horn through which iron roundels have been fastened, separated from the horn by bronze washers. These roundels were covered with sheet iron coated with red glass, applied in a liquid state to a roughened (or keyed) surface. The handle itself is a cylinder of horn also covered in sheet iron with cells excised, which was then filled with red glass, so that the contrast between the iron and the glass forms a complicated pattern, which is different on the forward facing side of the handle from that nearer the human body. The bottom of the hilt and the top of the scabbard also have roundels covered in red glass.

Below these, the outer face of the scabbard, made of bronze, is covered with so-called tendril and leaf decoration engraved onto the surface of the plate, terminating in curved triangular decorations on one side, but forming a continuous curved tendril on the other linking the design along the whole length of the scabbard. The bottom of the scabbard, known as the chape, is rather corroded now but has a circular shape, which was once covered in red glass.

The sword and scabbard condense many histories, some local to them and others from long ago and far away. The sword was made in approximately 250 BC, but may have been deposited in the grave some 150 years later. It had a complex history as can be seen from a number of repairs. At some stage, the front and back scabbard plates were split longitudinally and then rejoined; on the back, iron plate riveting was used, which was much cruder than the original work. To split a scabbard without destroying it would have required much skill as well as being a violent act. It is worth noting in passing that many swords and other objects were 'killed' before deposition by bending or breaking, acts which often required metalworking skills possessed only by a few. In the case of the Kirkburn sword, violence was acted on it at some point during its life cycle rather than at its end. There were other forms of damage to the scabbard deriving from more general use which had also been repaired. The chape has also had a half plate added to it as a repair, with a slightly different decoration from the original piece. These repairs and the time gap between production and burial indicate a long and complex biography linking a number of human generations, with the sword and scabbard being a possibly important link in generating human genealogies. The splitting of the scabbard and other aspects of its story might well have acted as a mnemonic for stories to be maintained and told, a key material prompt to an oral culture.

The Kirkburn sword is one of the three, which are so similar in the details of the roundels on the handle, enamelling, length of blade and decoration that they were almost certainly produced in the same workshop and probably by one person. The other two swords were from the burial site of Wetwang Slack, a few miles from Kirkburn, in burials of men with carts or chariots (Stead 2006, swords with Stead's catalogue numbers 173 and 174—the Kirkburn sword is 172). Unlike the Kirkburn, these swords have little evidence of repair and may have been placed in graves much closer to their production date of 250 BC. Although the Kirkburn burial did not contain a cart (which often had fine metal adornments for the cart and the horses that pulled it), there were similarities in the burial rite. Both the body at Kirkburn and that at Wetwang with

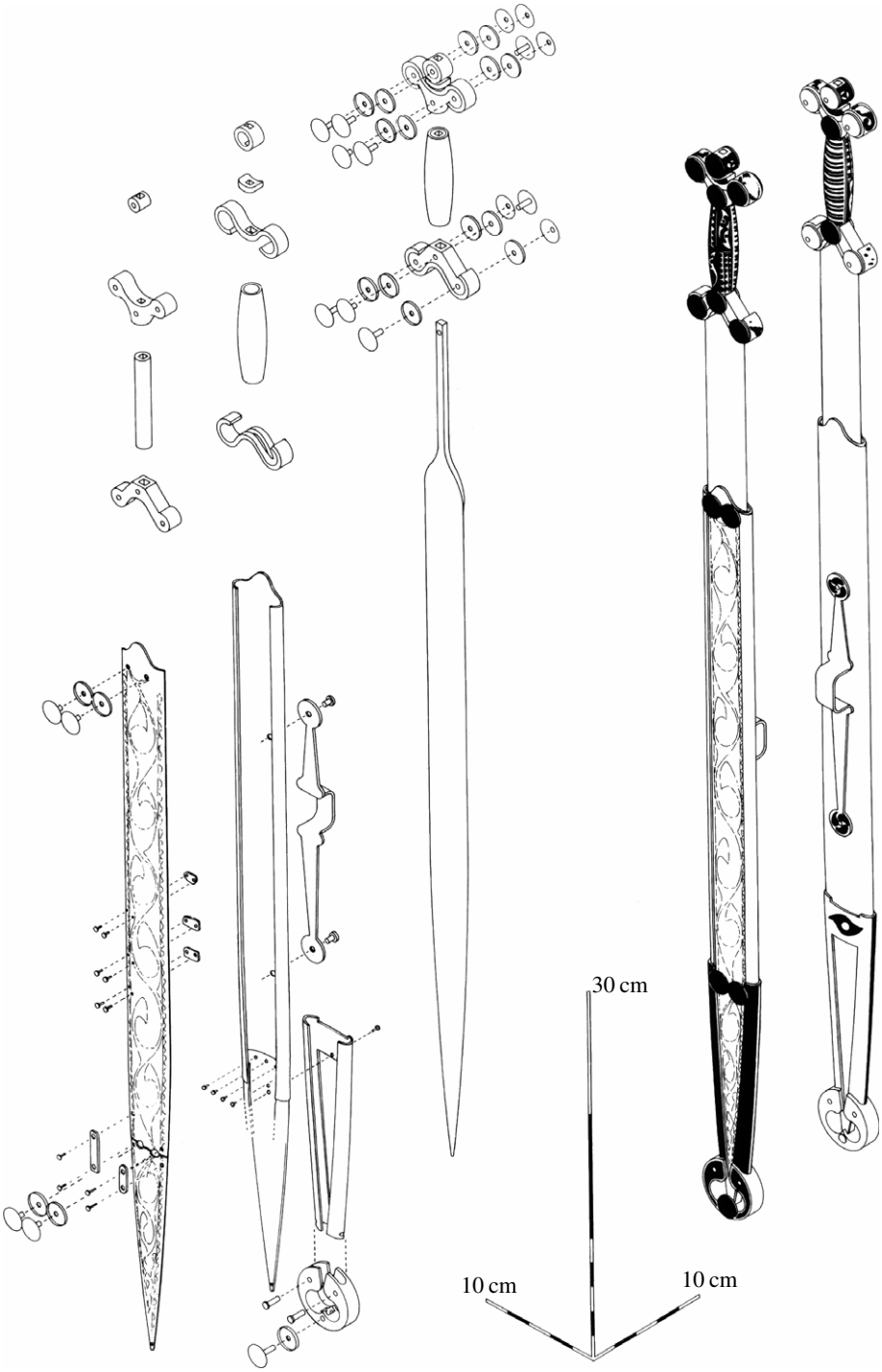

Figure 2. An exploded and a reconstructed view of the Kirkburn sword.

sword 173 had been speared after death with three iron spears in the former case and seven in the latter. What this might indicate shall be considered below. We can also not be sure why there were such differences in the life cycles of the three swords, but it must have been something to do with particular conjunctions between objects and people.

The Kirkburn sword also contains much longer histories that we can peek into now, with at least one history for every material used to make the sword. The horn of the handle represents the oldest element of the technology by far. Fine working of bone and horn occurred from approximately 40 000 years ago in the Upper Palaeolithic of Europe from when we have the first good evidence, but bone working for tools and ornaments goes back much longer, probably at least to the point at which the first stone tools were used some 2.4 Myr ago. Bronze working in Britain has a much lesser antiquity, but still predates the Kirkburn sword by some 1500 years. Bronze is an alloy of copper with tin or lead. Copper was first worked in the eighth millennium BC by Neolithic communities in the Middle East where it took its place as beads and small ornaments alongside other brightly coloured stones and shells. Around the sixth millennium in either northern Mesopotamia or Anatolia, the first metals were smelted, a process whereby copper ores were heated in a reducing atmosphere low in oxygen, with charcoal, to produce molten metal. Copper smelting moved across Europe, from a possible point

of independent invention in the Balkans, to reach Britain in approximately 2500 BC. It is probable that the control of firing for pottery, a rather older technology, provided the know-how for the earliest smelters. Copper is difficult to cast and is a very soft metal. However, when it is combined with between 5 and 10% tin (lead alloys came later), it is much more ductile and forms a harder finished product known as bronze. Bronze first occurred in Anatolia and Mesopotamia in approximately 3000 BC and spurred the need for considerable trade, as tin is a rare metal and is almost never found in conjunction with copper. Bronze working started in Britain in approximately 2200 BC after a brief period of copper working. A few centuries later, bronze working started in northern China and southeast Asia.

Copper and bronze metallurgy are technologies like no other which preceded them (except possibly for cookery) in that they are radically transformative, starting with the stone of the ore body which is transformed into a liquid but then re-crystallized as a solid. Once this point is reached, the object can be melted down and reformed, a common aspect of the life cycle of metal artefacts. The working of metals requires a large amount of embodied knowledge. Ancient metallurgists were able to control firing temperatures in the smelt or forge, as well as the atmospheres around the objects, add quantities of metals together very precisely or arrive at a desired surface finish for an object, all without the thermometer or means of measuring gases or precise means of estimating weight. Some of this knowledge would have been transmitted orally, but books, plans or chemical formulae were all absent, so that much would have come from learning the heft of the tools, the colour of flames or metal and the right amount of air to pump in with the bellows. Bodily intelligence, rather than mental construction, was the key to skilled productive activity. Intensely skilled activity was needed at the point of production, which would also have encompassed many other materials and forms of work in the world to supply wood or charcoal for the furnaces, wax to fill moulds in the so-called lost wax process, and other metal and stone tools which would have been needed for working. Once bronze became common, trade was needed to bring together the various components of the alloy, so that modes of travel, skills of rhetoric and persuasion, and the creation of other items to be traded were all necessary to cement deals in ways that made material sense but also helped oil the sets of relations between people. Bronze technology created a great range of new objects—axes and ornaments, chisels and tools, and later swords and daggers, objects developed for the first time in the Bronze Age with profound implications for human relations. New skills were needed to make bronze artefacts, but once these spread through the population re-skilling was needed on a large scale, not only in terms of using functional items, but also skills of perception and discrimination as people became adept at recognizing and understanding the new sets of styles and varieties of bronze form brought about. People were re-skilled and re-socialized, being brought into new relations with materials and with each other, arriving at novel understandings of both.

Bronze spread fairly fast once invented, but iron was a much more reluctant technology. The first iron was worked in Anatolia in approximately 2200 BC (when bronze working initially arrived in Britain), but remained a very minor component of metallurgy for many centuries. Iron working probably started in Britain in approximately 1000 BC (Collard *et al.* 2006), but it did not become common for another 300 years. Such a time lag gives the lie to the old Three Age System in which it was thought that a new superior technology would quickly displace the old. This successive and progressive view of technology is profoundly misleading for Europe at least, where technologies are often accumulative with a new one being added to the older forms, rather than replacing them. Bronze was repositioned by iron working, not eradicated, with many ornamental and other items being produced in bronze through the Roman period and beyond. It is worth bearing in mind that prehistoric European iron working was quite a different mode of production than bronze and, although they are both joined in the modern mind through a general equivalence between metal working techniques, this might not have been the case in the Iron Age. It is only possible to melt iron, and thus to cast it, once a temperature of 1530°C is reached and while the capacity to do this developed in China from the ninth century BC, this did not occur until well into the historical period in Europe. Iron objects, like swords, were formed not in moulds, but by hammering when hot. Also, there are formidable problems in removing the metal from the slag in the smelting process, it then needs to be combined with charcoal and other materials to gain the right degree of hardness and finally quenched, a process by which the temperature of the hot-worked object is rapidly reduced, usually achieved through immersion in a liquid such as water or oil. Bronze transforms from rock to liquid to solid but iron is changed within a solid state and through considerable difficulty, manual labour and danger. There are indications that bronze and iron were treated differently in Iron Age Britain. Bronze was often deposited in watery places of rivers or bogs, whereas iron is more commonly found in the ditches around settlements or pits within them. Hingley (2006) has recently studied the deposition of iron objects generally in Iron Age and Roman Britain, working on the general premise widespread in British archaeology that varying modes of deposition of objects in rivers, ditches, isolated hoards or in graves often represent purposive acts rather than casual loss, telling us a lot about people's attitudes to objects and the world more generally. There is a shift from deposition of iron objects, such as the so-called currency bars, in the ditches enclosing settlements in the Iron Age to deep burial in wells or deep pits within settlements in the Romano-British period. Iron may have held a number of associations, partly concerning danger, so that its presence at boundaries might have protective effect and these might be derived from the difficulties of production, but also regeneration due to the fact that iron rusts and decays easily in comparison

with bronze, gold or silver. Iron can be taken out of the ground as ore, formed but then put back into the ground as artefact, possibly to help maintain general forms of fertility. The possible association between iron and danger on the other hand might be reinforced by the fact that the bodies in the graves at Kirkburn and Wetwang were pierced with iron spears, in some sort of apotropaic act in which iron was more efficacious than bronze. Whatever the accuracy of these observations, they alert us to the fact that we need to attend to the whole life cycle of objects from production, use and final discard as each element in this process has important things to say about the ontologies involved.

The final material involved in the Kirkburn sword is red enamel or glass. This is probably a by-product of copper working. From approximately 750 BC in Britain and Europe, there was a desire for red materials on metal objects, so that early pieces were inlaid with coral from the Red Sea or amber from the Baltic. Starting in approximately 400 BC, red glass (and later yellow and turquoise) was added to artefacts of iron and bronze. The glass may have been originally imported from the eastern Mediterranean. The history of glass working is still being investigated, but production probably goes back to Mesopotamia in approximately 2500 BC where glass is linked to the development of glazes, first as a covering for quartz crystals and later for pottery. Glass was also made in Britain, with the Kirkburn sword being a striking, but in many ways typical, example of enamelling using red as the sole or dominant colour. We seem to be dealing with definite aesthetics here in which red, with its possible associations with blood and danger, played a key role.

A further example of aesthetics, as well as an important part of the broader histories in which the Kirkburn sword played a role, are the modes of decoration known as 'Celtic art'. The enamelling that we have just mentioned is found throughout Europe, but is an especially marked element of British Iron Age decoration. The wave and tendril decoration on the scabbard is found on many thousands of items in Britain and across western and central Europe. These engraved decorations, together with three-dimensional decorative forms, such as neck torcs, linked a large number of communities through common styles. Many of the vegetal motifs may have an ultimate origin in Greek art, which itself was influenced by the Middle East, but these undergo a series of transformations as they cross Europe. Objects in these styles are first found in Britain probably from approximately 300 BC onwards, but by the time the Kirkburn sword was made in approximately 250 BC, a series of insular styles had developed with their own forms of artefacts, an emphasis on red enamel and special modes of engraved ornament.

In stylistic terms, the Kirkburn sword can be seen to condense a number of spatial scales. The smallest scale is the local workshop which produced it and at least two other recognizably similar swords with their own particularities; but this object also belongs to a class of northern British swords which show links with those from Ireland. At the most expansive scale, the sword is part of a conjunction of form and decoration found over large areas of Europe and which lasted for many hundreds of years in a changing manner. Each of these material histories, local and short-term or widespread and ancient, would have had significance for any single object. Things were positioned within a dense skein of relations stretching back to many millennia, not known in detail but giving general qualities to materials and the people involved with them, as well as leading to more particular local engagements.

4. PLASTIC ONTOLOGIES

A sword, like the one found at Kirkburn, required many skills. The many materials that went into the sword's making were probably beyond the compass of a single individual, so that a number of skilled bodies collaborated in its production. There was also the training of the arm, hand, eye and whole body needed to wield the sword in a skilled manner, which must also be linked to the skills of appreciating the forms, colours and surfaces of the sword, in movement or at rest. A sword like this could combine a scintillating moment of movement with a long-term biography of the sword itself and the lineages of the materials from which it was made. Objects extend and change the body schemas of those using them and their interactions with others. Our peripersonal space is that within the reach of limbs and this can be extended through objects, both in terms of our reach and effective action, and also through extending the image our brains have of our bodies (Holmes & Spence 2004). Peripersonal space also reaches out in interpersonal space within which much face-to-face social life is enacted. The creation of a sword has considerable implications for all these forms of space and the links between people through objects. We can consequently argue that a world of metals helped to create quite different sets of social ontologies to those found in the Neolithic when metals did not exist. We could put forward as a point to be argued that a world of metals engaged the whole body more than many previous materials. To be skilled with a sword involves all parts of the human anatomy from feet to forehead, albeit with a concentration of attention on that composite region from the shoulder to the tip of the sword. It also requires a skilled and changing perception of any others with swords in the vicinity. Even another skilled sword wielder can quickly create an interpersonal space that will absorb all one's attention! The axe, a key instrument in the Neolithic, was probably not really a weapon in any case and would have required quite different skills of use, focusing on repetitive chopping actions in contrast to the varied chops, parries and thrusts of a sword. Peripersonal space and social interaction were constructed differently in the two periods.

Things can be seen to animate in the sense that they bring different muscular and sensory modalities into play, creating in the process different senses of the body and relations with other bodies. The conjoined nature of people and things, bringing each other into being, has at least three implications for brain research. The first concerns the long-term history of the structure of the brain. Human ancestors have used

tools for at least 2.6 Myr, over which period brains have changed hugely in size and structure. Can we discern long-term effects of making the world on the nature of the brain, which has in the short-term been continually reshaped by bodies and their objects? Secondly, are different types of action and use of objects differentially effective in shaping brains and bodies? Can we make a distinction between sedentary activities, like flint knapping, in which hands, eyes and arms are heavily engaged, but the rest of the body more passive, and whole-body activities, such as dancing or sword use, in which the organism as a totality is involved? Lastly is an area of considerable technical difficulty as far as brain scanning is concerned—what are the linked effects of objects and bodies within social settings? Joint attention and joint intention studies show how people are joined and directed towards certain features of the world in their interactions with objects. Can we start to look at the forms of brain activity brought about by people and things in combination, as the characteristics of people are highlighted by things and the capacities of things are highlighted by skilled human users?

The world of the Iron Age in Britain brought into use more varied sets of materials than those of the preceding Neolithic and Bronze Ages. More materials in play would have the effect (one would guess) of engaging more aspects of bodies and brains. The Iron Age was about to be succeeded by Britain's incorporation into the Roman Empire, which brought about a further explosion of new things and in much greater quantities than ever before, often deployed in a world suddenly more rectilinear in its forms. Here, too, is cause for thought. As far as we can tell, the people of the Iron Age created few straight lines. The carpentered interior environments of the Romans created straight walls in contrast to earlier circular huts, with domestic spaces joined by the legendary straightness of the Roman roads. Human sensibilities were re-tuned bringing about unprecedented forms of social ontology, which might also have involved different (more linear?) conceptions of cause and effect (Gosden 2005*a*,*b*). In the world of the present, interesting cross-cultural work could be carried out on the brains and bodies of people brought up with different geometries of domestic spaces and of landscape organization.

Archaeology, commonly seen as the study of the old, and neuroscience, with its reputation for being at the cutting edge of twenty-first century technologies and debates, might seem poles apart. If it is true, however, that action through objects reshape the brain, then archaeologists know a lot about objects and would like to know much more about the brain and its histories. There are many benefits of collaborative work, especially if we avoid sliding into either neural determinism, in which the brain is seen as the centre of the human world or as an object fetishism, which holds that objects make people. The complex actions and interactions of brains, bodies and worlds are what make us human and historical. I hope to have shown that an idea like social ontology can help us track the complicated interactions of the neural and the artefactual, which will only really be possible through programmes of inter-disciplinary work.

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