An Ontology of Technology: Artefacts, Relations and Functions

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Abstract
Ontology tends to be held in deep suspicion by many currently engaged in the study of technology. The aim of this paper is to suggest an ontology of technology that will be both acceptable to ontology's critics and useful for those engaged with technology. By drawing upon recent developments in social ontology and extending these into the technological realm it is possible to sustain a conception of technology that is not only irreducibly social but able to give due weight to those features that distinguish technical objects from other artefacts. These distinctions, however, require talk of different kinds of causal powers and different types of activity aimed at harnessing such powers. Such discussions are largely absent in recent technological debates, but turn out to be significant both for ongoing technology research and for the recasting of some more traditional debates within the philosophy of technology

Keywords: Ontology, Philosophy of Technology, Critical Realism, Artefacts, Functions

1. Introduction[1]

It is fair to say that the term technology is used to refer to very different kinds of things. Material objects (some, but not all, of which have been transformed by human doings), practical knowledge and knowledge embodied in things (often material objects but not always), particular practices, even social institutions are all regularly considered to be types of technology. At the very least, this state of affairs has the unfortunate consequence that many heated debates about technology, and its relationship to the social world, are complicated by the fact that different authors are actually arguing about different things.

Not only is there a general failure to reach consensus about the meaning of the term technology, but there is often little attempt made to establish a meaning of technology at all. Indeed, many argue that technology may be seen as the archetypal black-box category of social science. Perhaps the most obvious example of this can be found in the discipline of Economics, where technology is simply anything that is important in constraining the feasible combinations of certain inputs to produce certain outputs. Once knowledge of different shaped production functions is to be had, no further knowledge of technology itself is sought. It might also be argued that, until fairly recently at least, even within the philosophy of technology there has been some degree of black-boxing of technology as a result of focusing upon the social consequences of technology rather than on the nature of technology itself. However, a variety of more recent contributions have attempted to reorient the study of technology towards describing the nature of technology prior to addressing its likely effects. It is with this in mind that, for example, Mitcham argues for a bridging of the gap between what he terms engineering philosophy of technology (concerned with what technology is) and humanities philosophy of technology (concerned with the social consequences of technology) (Mitcham 1994). A similar point is made by Pitt who pleads for a movement away from putting social criticism before a study of technology itself (Pitt 2000).

Kroes and Meijers go so far as to discern an empirical turn in the philosophy of technology (Kroes and Meijers 2000: 20). However, the focus on empirically adequate descriptions of technology and engineering practices (their meaning of an empirical turn) need not of course actually generate a general definition of 'technology'. And indeed much of the constructivist literature of technology in recent years, which can be understood as exemplifying the move that Kroes and Meijers identify, has rarely gone beyond a concern with specific technologies; attempts to provide definitions of 'technology' being generally accepted as either pointless or dangerous (usually betraying essentialist tendencies).[2] This is unfortunate in that the very literature that has had most to contribute to our understanding of the social dimensions of technology, has tended to shy away from any general statements about the social dimension of technology. Thus there is consensus about the fact that technology is irreducibly social, but little precision concerning the ways in which technology in general is social or of what implications follow from different conceptions of the social.

The aim of this paper is to give an explicitly ontological account of technology that focuses upon the social dimension of technology. It is worth pointing out from the outset, however, that such a focus upon ontology should in no way be seen as an attempt to give an account of technology that is 'out of history' or *a priori* in any sense.[3] More specifically, whilst the form of ontology I wish to pursue here (which might be termed accommodative ontology) is in keeping with ontology traditionally conceived of in that it is concerned with the most fundamental or basic constituents of the (social) world, history enters into the account explicitly in at least the two following senses. First, the account draws upon and develops currently prominent accounts of social ontology - thus starting with a particular, historically transient account that is nevertheless aimed at illuminating or conceptualising the most fundamental categories of relevance to technology. Secondly, some attempt is made throughout to compare, contrast and where possible accommodate existing conceptions of technology – their insights, preoccupations etc.[4]

In short, then, the idea is to move towards a conception of technology by iterating between 'extending existing ontologies' and 'accommodating substantive preoccupations'. Some distinctions will be of a more conventional nature than others. For example, in developing an account of technology it turns out that conceptualising the general category 'artefact' is relatively straightforward from the state of existing ontological theorising, but making the finer distinction between types of artefact (which are needed to distinguish technical objects from other artefacts) requires more conventional criteria. Specifically, I shall attempt to extend the best account I know of social ontology to a focus upon the general processes through which artefacts (understood broadly) come to be. Starting from the observation that technical objects, like all material artefacts, have a dual constitution – i.e. not only are they made up of objects that are material but that are irreducibly social too – the aim is to give an account of social activity that engages with objects of this dual nature. Alternatively put, the task is to spell out the ways in which this dual nature depends upon social activity.[5]

The third section of this paper provides quite different kinds of arguments to arrive at a more substantive definition of technology. Whereas the aim in the second section is to give an account of the artefactual world, such an account is as relevant to art and food as technology. Finer distinctions are then required to talk of any of the special features that technology might have. Thus I shall try to make further distinctions based upon the types of causal power that can be considered to be essential to different kinds of objects. In order to do this I inevitably have to deal with the problem of distinguishing and/or relating social relations and functions. The argument made is that although technical objects are irreducibly relational, social relations are not *essential*

for their causal powers, an aspect of technical objects that distinguishes them from social objects. I then argue that the facet of technology that function is often used to express, is rather better conceptualised in very general terms as a concern with the extension of human capabilities. Various advantages that follow from this conception of technology are then drawn out.

2. A transformational conception of technical activity and a relational conception of material artefacts.

The social ontology[6] I wish to draw upon is that developed within a string of related accounts that have come to be known under the heading of Critical Realism.[7] More specifically, I wish to focus upon the particular conception of social activity that has been developed in these accounts (namely the Transformation Model of Social Activity or TMSA). So doing has two main advantages. First, it makes it possible to avoid problems that recur throughout the social sciences but are particularly dogged in technology studies: how to clarify the constitutively 'social' character of technology insisted upon by social constructivists without reducing technology to simply a social phenomenon (where its material basis or physical structure effectively count for little of nothing in an account of what technology is); and secondly how to give space to traditional concerns of the philosophy of technology such as technology's 'out of control-ness', without resorting to any form of determinism. Technical objects simply cannot be understood other than in terms of the various activities involved in their design, production or use. Thus the model of social activity I shall start with is not only a model for technical *activity* but also an integral part of the account of what technical *objects* are.

The basic features of the TMSA have been presented in different ways, notably as a corrective to existing voluntaristic or reificatory accounts of social structure or as a transcendental argument from the existence of generalised features of experience of the social world, such as routinised practices.[8] Either way, the main point that arises is that social structure exists only in and through the activity of human agents, even though it is not reducible to such activity. Put another way, against individualistic or voluntaristic accounts of social structure, structure pre-exists and is a necessary condition for all intentional agency, whilst, against reificatory accounts, structure only exists in virtue of the activity it governs. Thus if social structure always pre-exists actual behaviour this does not mean that individuals create structure in any sense but that it is actively reproduced or transformed. Similarly, if it is something that only exists in virtue of human activity, there is no sense in which it is outside of or external to human activity. However, neither are structure and agency simply moments in the same process – they are different kinds of thing. And it is this transformational nature of the connection between the two (interestingly, for my purposes, often conveyed by the Aristotelian metaphor of the sculpting artist fashioning a product out of the material and with the tools available) that lies at the heart of the TMSA. The resulting emphasis, then, is upon transformation.

Society, conceived of as the sum of the relations between agents is the ever present condition and continually reproduced outcome of social activity. Society acts as both an enabling and constraining influence on behaviour as well as, more constitutively, as a socialising force, thus impacting on how individuals react to the structural constraints and enablements they face. But as structure is only ever reproduced or transformed through human action, where such structure endures, its continuity as much as its change is a significant object of analysis. As such, social change is inherently non-deterministic. To capture this aspect of structure, following Giddens, the term 'duality of structure' is often used. Similarly, it should be clear that although action reproduces certain structural forms, this will typically not be the intention of this activity. Thus,

my speaking English is not intended to reproduce the grammar of the language, although it does generally do so. Following Bhaskar, the 'duality of practice' is used to capture this dual aspect of action. Such conceptions of duality come together in what Bhaskar has termed the position-practice system: a set of mediating concepts used to refer to the 'slots' in the social structure into which acting subjects must slip in order to reproduce it (see Bhaskar 1989: 40-41). Thus agents occupy relationally articulated positions with rights, responsibilities, duties, obligations etc., that are reproduced by a variety of practices including the incumbent's fulfilment of those rights, responsibilities etc.

Let me draw out one more aspect of this account before we can return to a discussion of technology. Specifically, the TMSA can also be seen, as set within an argument for a qualified or critical naturalism[9], as an attempt to elaborate how the social and natural worlds differ. Ultimately, the differences between the natural and social world hinge upon the fact that the latter depends on us in a way that the former does not. Gravity would still be here tomorrow even if human societies disappeared over night, but the high-way code would not. For example, both (gravity and the high-way code) are necessary parts of a causal explanation of why a car stops at a traffic light. Both gravity and the high-way code are best understood as causal mechanisms[10], but they have different *modes* of existence. The high-way code is an emergent feature of human interaction – without such interaction the highway code could not exist.

Both natural and social science are understood to involve a focus upon causal mechanisms that are not reducible to events or states of affairs (see Harré 1970, Harré and Secord 1972, Harré and Madden 1975). Science, on these accounts is not restricted to such forms of inference as induction or deduction, which only concern movements from particular to general statements or vice versa *at the level of events*, but with forms of inference that lead from the observation or experience of events and states of affairs (e.g. falling apples) to the underlying structures and mechanisms that could give rise to them (gravity, curved space, or whatever). The difference between the two kinds of science then rests on the differences between the kinds of structures or mechanisms that feature in the respective (social/natural) domains. For present purposes the important differences can be thought about from the perspective of what must be the case for (successful and replicable) experiment to have the status it does in the natural sciences but not in the social sciences. In natural science, it would seem, closures are possible to achieve. Thus it must be the case that some mechanisms or sets of mechanisms have a sufficiently consistent internal structure to behave the same way under the same circumstances. Additionally, such structures or mechanisms must be isolatable from other disturbing or countervailing factors. Such possibilities rarely exist in the social world.

A major point of the TMSA is that social structures only exist in virtue of the activity they constrain or enable. Thus social structures depend, for their existence on the activities of agents and the conception agents have of such structures. As such social structures will not tend to endure across time and space in the same way that natural mechanisms do. Such differences (or ontological limits to naturalism) can be summarised as the relatively greater activity-concept-time-space dependence of social structures (see Bhaskar 1989: 37-54, 174-9). The major epistemological limit is that whereas the differentiability of natural mechanisms means that the natural world may well be characterised very usefully in terms of closed systems,[11] this is unlikely to be the case for much of the social world. It is important to point out, however, that this does not amount to saying that the social world is open and the natural world is closed. Both the natural and the social world are open, the differences between them lie in the possibilities that

exist for the manner, and likely success, of strategies designed to close off particular regions of either the social or natural world.

For those familiar with critical realism at least, this much should be familiar if not uncontentious. But how is any of the account given so far of relevance to a conception of technology? The relevance comes technology's dependence upon social activity. The TMSA above is an attempt to draw out the main features of human agent's relationship with social structure through the medium of social activity. The focus is on the domain of social relations. However, such activity can be viewed under another aspect – as technical activity. Technical activity, at a very general level, is like all human activity in that people act intentionally, in conditions not of their own choosing but transforming the materials to hand, etc. But here a distinction can be made between technical objects, which serve as the condition and consequence of technical activity, and technical subjects, those human agents engaged in technical activity. As with the TMSA, these can be combined to provide a transformational model of *technical* activity (or TMTA, see Lawson 2007a).

Here the technical subject and object are, similarly, not reducible to or derivable from each other, they are different kinds of things, even though both are, in some sense, the condition and consequence of each other. As with social structure in the TMSA, the state of technological development both enables and constrains human activity. The idea that technology enables, or simply is, the control of nature is pervasive, at least since Bacon. But as new technological objects enable different sets of human actions to take place, this will always set new constraints, e.g. solar power enables cheap/sustainable electricity but is best located in sunny places, laptops make it possible to work in the library, but only near electricity points, etc. But the idea of constraint can be understood more systemically too. For example, Hughes focuses on the fact that technical objects are not used, and do not exist, in isolation – people use or deal with systems of technical objects. At any point in time there will be a weakest link in this technological systems that effectively acts to constrain the working of the whole (Hughes refers to these as reverse salients – Hughes (1983)). These constraints then act to give directionality to future technical activity. Constraints, as with the TMSA, are much more than any (metaphorical) fixed cage.

It is particularly important for present purposes, however, to point out that technical objects do not simply constrain or enable particular human behaviour – but have some effect on the nature of the human actor also. Of course, this is a recurrent theme in the study of technology, whether in Veblen's account of the machine process, or Heidegger's comparison of craftsmanship and new technology, or the Amish Bishops' decisions about which technology to 'endorse', the question that recurs is 'what does using this technology make us become'? The term socialisation, which features in the TMSA, should no doubt be replaced by something like technologization, but the idea is the same – technical objects (like social structure) do more than constrain or enable. They have a role in shaping the capabilities and competences of those engaged with some technology (a point that is returned to below).

As with the conception of social activity sketched out in the TMSA, technical activity can be understood in terms of transformation and reproduction (this time of technical objects), rather than creation from nothing. And indeed there are some clear advantages to thinking of technical activity this way. Viewing technical activity as transformational, as with social activity, affords a way between voluntarism and determinism. For example it makes it possible to accommodate the insights of those such as Ayres, who argued strongly against the idea of the heroic, lonely inventor creating technology in isolation and rather stress the importance of sequence or path

dependence, etc. (Ayres 1961). As noted, a condition of invention or developments in technology is the state of technology itself. Thus as Ayres observed, similar patents are often filed more or less simultaneously in different places, light bulbs are unlikely to be developed before the invention of electricity, and so on. And indeed the kind of conception underlying Ayres' contributions, much like others considered to be technological determinists, such as Heilbronner (1967), seem to be making the simple point that some things cannot be developed without others being developed first. That is, they are talking about necessary rather than sufficient conditions. In which case a focus on design as transformational captures what is essential to the argument in a fundamentally non-deterministic manner. In other words, talk of constraining, enabling or socialising no more requires (or reduces to) a form of determinism in the TMTA than it does in the TMSA.

It is equally important however, to point out that transformation in the TMTA does not play the same role that it does in the TMSA. And indeed the limits to the analogy are particularly important for the account of how technology differs from other material objects, as I shall argue later. First, there is much in design that cannot be transformed at all. I am referring here simply to the fact that technical objects are constituted by natural as well as social mechanisms. For example, gravity is not something that human beings can change, but something that must be drawn upon or used. The importance of this will depend on the kind of artefact in question. Both a pendulum clock and a book are subject to gravity, but although a book may be very difficult to use in the absence of gravity, for the pendulum clock gravity is essential to its way of working. The designer is thus *harnessing* the powers of existing mechanisms in the design and not transforming them in any sense (see Pickering 1995). Secondly, we tend to see technical objects as 'designed' or 'engineered' on the one hand, and then simply 'used' on the other. Neither action seems to be a form of transformation or reproduction in the senses used above. For example, when we acquire a new CD player we read the instruction manual, which tells us who designed this particular player, what it is for and how it is to be used. Typically, we then use it in line with the designer's intentions. This is clearly different from, say, our use of language or our reproduction and transformation of social relations. If the role that transformation plays in technical action differs from the role it plays in specifically social action, then so too does the role of reproduction. For example, it is hard to believe that we reproduce a hammer by knocking in nails *in the same way* that we reproduce language by speaking.

Technical activity is typically divided up into the stages of design or construction on the one hand, and use on the other.[12] The design stage involves primarily a process of separating off various properties of existing things (artefacts or naturally occurring objects or mechanisms) and recombining them into objects with particular capacities or powers. Use is primarily concerned with identifying objects with particular capacities and powers and inserting (or enrolling) them into particular networks of social and technical interdependencies. The distinctions I have in mind here are essentially those developed by Feenberg in his Instrumentalization Theory (see especially Feenberg 2000, 2002). In order for an object to be open to technical control, it must first be split off from its original environment, then simplified so that certain aspects, that can be functionalized in terms of some goal, can shine through. But for a device to actually function some degree of re-contextualisation needs to be undertaken. This involves insertion within a system of working devices, and within particular social networks of use, as well as some measure of compensation for the simplifications undertaken, that embed the device ethically and aesthetically in particular contexts of use (Feenberg 2002).

It is not simply the case, however, that design is uniquely associated with isolation and use with reconnection. Rather, design and use involve both isolation and reconnection. But the kinds of isolation and connection involved at each end of the spectrum (design to use) do have different characteristics. At the design stage things are perhaps clearer. Particular functional capacities of things or mechanisms are isolated and (atomistically) reassembled in line with some prior criteria or functional requirements. Use, however, provides a more complex example of the isolation and reconnection moments, and centrally hinges on the relational aspect of technical objects. It is true that the form and content of the hammer would not disappear tomorrow if human societies ceased to exist (as say language would). But the hammer, in the eventuality of human societies ceasing to exist, would actually cease to be a hammer; because part of what a hammer is, exists only in relation to those using it. It is only by being used that a collection of wood and nails, or a tree trunk in the forest, become tables. In fact, use involves enrolment in two kinds of (analytically separable) networks, i.e., social and technical networks. For the telephone to work it must be connected to a telephone network, to an electricity supply, etc. But without human societies it is not a telephone at all. However, such relations are not simply concerned with the object's function. When I use my mobile on the train I am certainly reproducing the relation of this object to users in general as 'a communicating device', but I am also reproducing or transforming rules of politeness, etc., depending upon where I use it (in a mobile-free carriage?) and how (by speaking loudly?)

Technical objects are perhaps best conceptualised using similar 'mediating' concepts to those described above as a position-practice system. Such objects 'slot' into social and technical networks of relations, practices and other devices. They have positions in the same sense as human agents occupying social positions, but the practices that reproduce their sociality are undertaken by their users. The objects themselves contribute powers, the harnessing of which is a primary goal of technical activity. In this sense, we might talk of a position-power system for technical objects, in contrast to (but alongside) a position-practice system for human agents.

Viewed in this way, the TMSA has some role to play as a model for the kind of relation between technical object and subject, but it is also part of the relation itself. Alternatively put, the social activity that the TMSA is designed to capture is actually part of technical activity. It is the social relations of the TMSA that are reproduced and transformed in technical activity, as well as being enabling and constraining of that activity. However, technical activity is about more than simply reproducing or transforming social relations. The causal properties of material objects are harnessed and put to work in a process of isolation and reconnection that stretches across the activities of design and use.

By focussing upon technical activity in this way it is possible now to pinpoint the ways in which technical objects may be understood to be social. By social I mean here only those things that depend on us in some way. The first sense in which technical objects are social derives from the design process in which technical objects take a particular form. How different natural mechanisms, existing artefacts, etc., are brought together reflects the values, desires, intentions, etc., of those designers and all the groups that have had some say in the nature of the design, which then become concretized in the very structure of the technical object. Such values, etc., can then be understood to be exerting a continuing influence over technical activity both via the kinds of enablements and constraints noted above but also via the codes of operation built into and mediating their use.[13] This is of course, where the social constructivist approaches to technology have made such a strong contribution to the study of technology in recent years. How particular designs and formulations are settled upon is clearly a very social affair. However, as is brought

out so well in the work of Marx, it is not just values, intentions, etc., that become concretized in this way, but social relations themselves. This is both because, as is brought out in the TMSA, the existing state of social relations are condition as well as consequence of social, including technical, action and because, as constructivists ably demonstrate, so much technology takes the form it does because of the way that disputes between different groups are settled. Thus the very structure of technical objects is irreducibly social.

This sense in which technical objects are social is worthy of note. To say that values, intentions and even social relations become concretized in this way is to talk of essentially social things becoming material. As such, given the relative concept-space-time independence of material things, there is a relative endurability and travel that is possible for those otherwise precarious aspects of the social world. Thus, and this seems to be centrally important for an understanding of the nature of technology, technology is the site in which the social achieves a *different mode of existence through its embodiment in material things*.

The second sense in which technical objects are social is the relational sense. Use involves the insertion or enrolment of technical objects into social and technical networks, which, in so doing, reproduces or transforms a variety of social relations along the way. Alternatively put, the duality of practice is as relevant for technical activity as it is for social activity. Indeed it is more relevant, in that the duality here captures not only the 'thin' sense in which action has unintended consequences, but the 'thick' sense in which in which action to do one kind of thing (technical) achieves another kind of thing (social).

Underlining, and differentiating, these two senses in which technical objects are irreducibly social thus emphasises the importance of transformation and reproduction as types of technical activity. But they have a more qualified role to play in the TMTA. This is because material artefacts have a mode of existence (as material objects) which is not *simply* reliant upon their transformation or reproduction through human activity. Transformation and reproduction, at the very least, need to be supplemented by the important moments of isolation and reconnection. And indeed it seems to be in terms of the latter that much of the changing nature of technology is best understood. For example, it is possible to characterise skills-based, tool-using technical activity in terms of the almost simultaneous acts of isolation and reconnection. Ingold's example of the weaver (used by Ingold to demonstrate that making is not necessarily a simple process of human beings putting some explicit plan or design in to action) could as easily be used to show that in certain contexts the necessary processes of isolation and recombination often do take place together – even tacitly (see Ingold 2000: Chpt 18).

Mass production, in contrast, can be understood in terms of an explicit and even institutionalised separation between processes of design and use, and also between isolation and recombination. Design or research departments often become quite disconnected from the details of how their (primarily isolative) research will be used by other designers (i.e. recombined with other technical objects into useful things), which are in turn disconnected in more far reaching ways from those who may actually use the objects produced (contextualising or embedding these objects in particular social and technical networks). Focusing upon the separation of moments in this way makes it possible to highlight different stages of technical activity (i.e. along the range between design and use). Where full or clear isolation is possible, recombination will tend to be more atomistic (which seems more likely at the design stage) whereas given the internal relatedness of the social networks in which technical objects are combined in use, the form of recombination will tend to be more organic.

To take stock briefly, drawing upon the TMSA I have attempted to give an account of social action that is engaged with material things, and of how these material things must be understood as socially as well as materially constituted. More specifically, I have argued that artefacts are irreducibly social in two distinct senses, both structurally and relationally. First, they are social in that the form they take is effectively a concretization of past values, actions, social relations, etc. Thus to understand why they take the form they do, requires a consideration of human actions of various kinds. The second sense in which artefacts are to be understood as social is the relational sense. Thus some account needs to be taken of the relations in which the artefact stands to people, institutions, etc. This was captured above in that technical action is conceptualised as both reproduction as well as transformation, and by noting that both dimensions of social activity (central to the TMSA and the TMTA respectively) are both in play simultaneously.

It was also noted that such technical activity can be viewed as having two moments – of isolation and of reconnection. And that the scope for separation of these moments would depend both on the nature of the artefacts involved and the institutional circumstances in which such activity takes place.

This broad account possesses a variety of advantages over existing conceptions, not least in being able to accommodate dominant ideas about path dependence, lock-in, out-of-controlness and so forth, without encouraging any form of determinism. But the discussion provided so far does not really provide us with a definition of technology as such. By focusing upon the domain of artefacts, where the social and material come together, I have thus far only been able to suggest broad features that seem relevant to a range of different artefacts. So far, nothing has been said that would help us distinguish between different kinds of artefacts (including art, toys, food, etc.) that traditionally have been contrasted with technology. Indeed nothing has been said that might distinguish material artefacts such as technology from other phenomena, usually understood as social, which also can be understood as the material results of human doings (such as social institutions). However, such distinctions lie at the heart of (or have motivated) much of the literature that deals with the nature of technology.

3. Function and technical objects

How, then, are technical objects to be distinguished from other artefacts? One obvious strategy is to invoke a concept that I have largely ignored so far, i.e., function. It seems undeniable that all artefacts are made or used for a purpose, and so have a *function* of some kind. Is it possible to distinguish a particular kind of function, a technical function, which all technical objects have, thus making it possible to distinguish such objects from other kinds of artefacts? For example Rathje and Schiffer (1982) distinguish technofunctions from socio and ideofunctions.[14] But as their account demonstrates, the problem is that such distinctions do not actually help us distinguish between different kinds of objects at all. Different functions, rather, refer to different properties of artefacts, so that any particular artefact could have all of these functions in different contexts. For example, a throne may have the technofunction of allowing someone to be seated, it may also have the sociofunction of communicating who is the king, conveying status, privilege etc., and it may also have the ideofunction of symbolising authority, monarchy etc. Thus given that it does seem plausible that artefacts have technical, social and ideological (as well as aesthetic, moral, political, etc.), dimensions, we at best have a typology in which many things can be viewed as technology under some description.

A further problem, for the attempt to distinguish different kinds of artefacts in terms of their functions, is that this does not, even in some partial sense, tell us anything about what some artefact must be like or what qualities it must possess to have a technical function and so count as a technical object (even if only under some description). If I were to use a famous sculpture to hang my clothes upon, I would be giving it a technofunction, but this does not really help me assess whether I am using the object incorrectly or whether I might be right or wrong in thinking that some object is indeed a technical object or not. By itself this distinction does not enable us to identify what it is about technical objects that make them different from other kinds of artefacts, and might make us correct to ascribe a technofunction to it. For those such as Schiffer, it is enough simply to say that everything is technology, viewed under some aspect (Schiffer 1992).

More recently, Searle has invoked the idea of function in order to distinguish a range of different entities (especially see Searle 1995). Searle's concern is to ensure that these different kinds of entity fit with his basic ontology of elementary particles and forces. He seems to suggest that there is a more or less continuous line from molecules to marriage, with both technical and social objects situated somewhere along the way. A conception of function is central to his account of how such objects fit in to this 'elementary' ontology. Searle distinguishes intrinsic features of things (such as mass, chemical composition etc) from those features that are observer relative. Whereas the former are easily grounded in Searle's basic ontology, the latter are more problematic (Searle 1995:14). However, it turns out that observer relative features can be accommodated indirectly, via Searle's conception of function. Although, for Searle, functions are pretty much the same in the social or biological worlds (i.e. they are observer relative), he distinguishes three different kinds of function assignment. Agentive functions refer to the use to which we intentionally put objects such as screwdrivers or televisions. Non-agentive assignments are made to biological functions such as pumping blood around the body – these do not serve some practical purpose but refer to naturally occurring objects. Lastly, status functions are a subset of agentive functions in which the object is taken to represent, symbolise or stand for something else. Both a screwdriver and a £5 note have agentive functions but one is a technical object whereas one is a social object. This distinction is based on the idea that for a technical object there is a strong link between function and physical structure, whereas for the latter there is not (which seems to involve the idea that all things used as money do not have a common physical structure). Put another way, the causal properties of the former depend upon its intrinsic structure whereas the causal power of the latter, to exist, depend on collective recognition that the object symbolises or stands for something in particular. As such, social objects have deontic powers (see Searle 2005) which the former, technical objects, do not have.

Putting the argument in these terms serves to highlight that it is actually the idea of causal powers, rather than that of function[15], that is doing the work here (at least in distinguishing technical from social objects). Indeed, whether an object is technical or social, in this sense, seems to depend upon the kind of causal powers that are most essential to it, that is on its intrinsic, physical or material properties rather than its (social) relationality.[16]

It is not, however, that the physical realisation of social artefacts is arbitrary (as Searle seems to suggest (see Meijers 2000:90). To take the usual example of money, even if money is actually not an artefact at all but a social relation, it is not at all clear that its physical realisation is in any sense arbitrary. Money could not be made up from water, or any other non-scarce resource, etc (see also Palmer for a discussion of this in relation to Searle 2003). Rather than arbitrariness, the point at stake here is the relative importance of the different kinds of causal powers it has. Thus, in effect, it seems important to look at whether some causal power is essential to something being

the kind of thing that it is, and whether this power is intrinsic to it (grounded in its material form or content) or relational. This is not, however, the same as arguing that technical and social objects can be distinguished on the basis that technical objects have material effects and social objects have social effects, as other critics of Searle such as Miller propose (Miller 2005). The distinction does not follow from actual functions and actual uses (since artefacts, as Schiffer et al. point out, can in actuality have multiple functions and multiple uses), rather it hinges on different *kinds* of causal powers and different *kinds* of uses. To pursue this further, it is helpful to briefly consider the example of two particular artefacts, namely passports and photocopiers.

What do we know about the causal powers of passports? Clearly they are artefacts in the sense discussed in the previous section, they have material contents, social forms and relations of use. They are made up of complex plastics, paper etc. They are light to carry, difficult to reproduce, resemble their bearer etc. But they are more than any of these things and in fact what they essentially are is more than any of these things. The main causal power of a passport becomes obvious to anyone who has forgotten to take it to the airport to leave the country. The power of the passport to enable its bearer to travel between countries is inherently relational in character. It depends upon a whole network of (social) relations between the bearer and the passport, between the bearer and the airport staff, between the bearer and his or her own nation state, between the nation states that the bearer is trying to travel between and so forth. These relations depend themselves, as noted above, on a whole network of positioned-practices.

As different materials come and go and some technologies for identification become obsolete, it is the relational properties of the passport that are relatively more enduring. This is not to say that the material content of the passport is arbitrary or that the form that a passport can take is arbitrary but that both are relatively inessential to its causal powers.

Let us now consider a photocopier. Perhaps the most striking feature of a photocopier is its constitutional complexity and functional simplicity. An enormous amount of different parts all come together to do one fairly obvious thing. Paper is put in one end and it is returned, with a copy, at the other. There may come a time when archaeologists are uncovering the remains of this civilisation and working out what all our artefacts are for. A passport may be subject to several interpretations, the photocopier (if one survives intact) will not. It should be pretty clear what a photocopier is for. What is more, it really does not depend, as did the passport, for its causal powers on social relations of any kind. Of course, to be 'functional' it must be used by people who know how to use it. And it can always be used for other things (it could acquire a different system function – e.g. it could be sat on). But such factors are inessential to the causal powers of the photocopier viewed overall. I am suggesting then that the photocopier is an archetypal technical object because its causal powers arise most directly from its physical structure. Its relationality, unlike for the passport, are inessential to its causal powers.[17]

From the discussion of function above, we have a conception of certain artefacts that are best understood relationally but for which the essential causal powers are not relational, i.e., where their essential causal powers are intrinsic. In this case, a focus upon relations seems better equipped than a focus on function for distinguishing technical objects. But does this mean that function is irrelevant to a conception of technology more generally? Certainly, reference to function may be required in pointing out particular uses of particular technical objects in particular contexts? And it is also clear that functional requirements have made some impact upon how the artefact is structured. But those functional requirements as well as the enrolment in some system of use relate to particular, transitory, actions of use. Can we not simply do away with the

idea of function and say, rather, that technology is always 'used' in some way or another? However, eating (such material artefacts as food) or playing (with such artefacts as toys) involves 'use' in this broad sense and would seem to require that food and toys be considered as technology? To avoid this, and to distinguish technology more clearly, it would seem that we have to re-introduce some role for the idea of function. If so, I believe the most helpful way to re-introduce the idea of function is at what might be termed the meta level. Specifically, the problems above make it clear how specific functions cannot be simply classified so as to demarcate technical objects. But all technical objects, I want to suggest have a very general function – to extend human capabilities. This one function seems to both distinguish technical artefacts from other artefacts (such as sculptures, toys, food, etc.), and be in keeping with many of the motivations for distinguishing technology in the first place (see Lawson 2007c). Let me briefly elaborate.

Our experience of technology is that, when using it, more is possible (be it good or bad, constraining or enabling). This seems to account for much of the pull or attraction of new technologies that technological determinists have felt the need to address themselves to. But there is no need for deterministic interpretations. The point, rather, is that technical activity, as noted above, harnesses the intrinsic causal powers of material objects for the purpose not of aesthetics, or consumption (directly) but to extend human capabilities. The use of the word extension here is intended to capture various features of the process involved[18]. It is not simply that new possibilities are atomistically 'added on'. What is involved in being human may substantially change in the process of technical activity. Not only does the technical subject change in the sense noted above of technologization, i.e. where using different technologies gives rise to different aspirations, competences etc., but also in accommodating new technologies into our everyday ways of doing things our sense of our own place in our world changes (Merleau-Ponty's sense) as well as physiologically, as Cyborgs, (in Haraway's sense). Extension of human capabilities transforms what it is to be human.

Moreover the use of the word extension is also intended to capture what seems to be fundamental to actor network accounts (and in keeping with the ideas of secondary instrumentalization noted above), that our use of, or engagement with, technical artefacts involves the enrolment of objects (and subjects) into an array of different kinds of networks. The extension of human capabilities comes about through a complicated mix of physical use, relational positioning, etc., in which material artefacts are harnessed to create more (real) possibilities. In this light, the difference between technical objects and toys is illuminating. Toys, it might be argued, perform a role in *developing* capabilities or skills. But they can then be taken away and the skill or capability persists (this, indeed, is the point). Technical objects extend capabilities, at least in part, by their positional enrolment in systems of use – if they are removed the capability is removed too (at least until a replacement is found).T[19]

It is now possible to advance a two part definition of technology. I am suggesting that technical activity is best conceptualised as activity undertaken to harness the intrinsic powers of material artefacts in order to extend human capabilities. As such, technology refers to the material objects that are the (material) conditions and results of this (technical) activity. Although technology can then be taken to refer to the sum of technical objects, the irreducibly social nature (structure and relationality) of these objects also requires an account of technical activity to give a complete account of the nature of technical objects. The term *harnessing* is an attempt to capture the transformational character of technical activity, including its isolating and reconnecting moments, at different stages (from design though to use) whilst conveying that we do not construct or

design those causal powers which lie at the heart of or motivate much of technical activity (in Pickering's sense). Whether we wish to see these powers in terms of non-human actors, or different kinds of causal mechanism, the point is that they are made use of via a process of isolation and recombination, and that this harnessing will involve quite different characteristics, skills, etc., at different stages of technical activity. The focus upon *intrinsic* powers of material objects is intended to capture the distinction between technical and social objects as reconstructed from the discussion of Searle's work. Lastly the idea of *extending* human capabilities is intended to capture the kind of use to which technical objects are put, in contrast to direct consumption, play, etc. Perhaps the main point to note at this stage is that capabilities are realised in social and technical networks, via the enrolment of technical objects, what Feenberg terms secondary instrumentalization (Feenberg 2000). In this case, the moments of isolation and reconnection gain further significance for a general understanding of technology and technical activity.

A variety of advantages follow from adopting the above conception of technology. First, it sits comfortably with the general idea of historically adequate or accommodative ontology suggested at the outset. There would seem to exist a clear set of referents that require naming and theorising in some way or another, irrespective of whether the term technology is most appropriate for the job. And at the same time clear links have been established to the relevance of this conception of technology to a variety of issues and debates within the technology literature. Indeed, although space does not permit development of this point, I would argue that not only does this account of technology refer to and incorporate insights from the existing literature but it actually solves or recasts various tensions or dilemmas within the literature (see also Lawson 2007a).

Secondly, it proves possible to distinguish different kinds of artefacts. Although there are clearly borderline cases, and many artefacts that have a technical dimension or aspect, there are also grounds for distinguishing general features of these without being committed to the thesis that all objects are one kind or another.

Thirdly, the definition is able to incorporate a range of theories that are apparently at odds with each other. On the conception of technology advanced above, technology needs to be understood relationally and processually. More specifically, technology can be thought of most generally in terms of a process whereby, in the production of useful things, ideas, values and social relations become concretized in material artefacts in such ways as to have important implications for social life. Many of the differing conceptions of technology that currently exist result in part from this tendency to focus on just one or other aspect of the process, e.g. on the technical artefact, technical activity, technical knowledge or the process of concretization (Mitcham 1994, Winner 1977). Contrasting disciplinary approaches to the study of technology can also be seen to focus on one aspect or another of this process. For example, philosophers of technology (e.g. Heidegger, Ellul, Mumford, Borgmann) have tended to focus on *implications* – especially, on the degree to which technology's growing role in everyday life is responsible for the more dystopian features of modernity. In contrast, the more constructivist sociologists and historians of technology (e.g. Pinch, Bijker, Collins, Latour) have been more concerned with the *form* aspect of the process. i.e with *concretization.* More specifically, they have been concerned with documenting both how particular technologies come into being through a process of social negotiation, conflict resolution, etc., and which ideas, values and social relations become concretized in particular artefacts (see Lawson 2007d). The above account cannot only situate rival accounts, but go some way to combining their strengths, perhaps the most important example being that of the philosophy of technology and social constructivism. At this level of

analysis the arguments made are not very different from those of Feenberg's Instrumentalization Theory.[20]

Lastly, it is possible to accommodate extremely different perceptions of being with (or using) technology ranging from a preoccupation of designers and beta testers with the intrinsic causal powers or material objects and on the other hand of extending human capabilities, especially by the insertion of objects into networks of use. Alternatively put, it can accommodate and/or ground an interest or competence in quite different aspects of the technical process. For example an interest in the causal powers of material objects may require certain kinds of skills, especially those most appropriate to closed systems (see Lawson 2007a); whereas the extension of human capabilities involves those skills most concerned with 'fit' or the enrolling of objects into networks of use, social relationality, etc. This may well go some way to explaining the observed different experiences of technology, of the relative security or comfortableness of some (e.g. those on the autism spectrum) with the more technical dimensions, etc.

4. Concluding remarks

The aim of this paper has been to provide an explicitly ontological account of technology. More specifically, recent developments within social ontology have been drawn upon to clarify exactly how, in what ways and to what extent, technology is a social phenomenon. The strategy used has been set at a very high level of generality: to give an account of material artefacts set within an account of social activity; to distinguish particular kinds of artefacts – technical objects – in terms of the importance of intrinsic causal powers and the activity oriented to utilising these powers for use. Specifically, I have tried to argue for a conception of technology as the material conditions and consequences of those activities most essentially engaged in harnessing the intrinsic causal powers of material artefacts in order to extend human capabilities. Each of the terms in this definition requires further unpacking (see Lawson 2007a, 2007b, 2007c). But the intention has been to discuss each to a degree that is sufficient to indicate the kinds of advantages that follow from this kind of accommodative ontological exercise.

At the very least, this conception clearly straddles the natural and social world in ways that seem sustainable. By focusing upon the nature of material objects that are irreducibly relational (without their relationality being essential to their causal powers), our view of technology is cast back squarely, although only partially and certainly not reductively, to the importance of the material component of technology and the importance of closed systems, and the isolative moment in artefactual activity. It becomes easy to understand why those such as Heidegger supposed that the essential aspect of technology is its isolative moment. And it becomes clear why those who focus on the reality of living with, and of using, technology (notably social constructivists) tend to focus on the more reconnective aspect of artefactual activity (see Lawson 2007a). In many respects, the most challenging requirement for a conception of technology at present, is the ability to combine both these moments. It is hoped that the account provided here ably meets this challenge.

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Endnotes

[1] I would like to thank Vinca Bigo, Andrew Feenberg, Tony Lawson, Jochen Runde, members of the Cambridge Social Ontology Group and an anonymous referee for helpful comments on an earlier version of this paper.

[2] A typical example is given by Fellows in the introduction to a book of collected essays in the philosophy of technology: “the contributors to this volume do not concern themselves with the essentialist exercise of defining technology; they more or less take it for granted that the reader is familiar with a variety of technologies, such as Information Technology and proceeds from there” (Fellows 1995:1).

[3] The idea that ontology is somehow in opposition to history, although difficult to imagine, does seem to have been encouraged by certain traditions in philosophical thought (see Latsis et al 2006).

[4] Of course, such a project involves judgments concerning which accounts are to be accommodated. But it seems to me that there can be no general strategy about this, each reference or accommodation needs to be weighted *en route* and presumably will have resonance or be useful for the reader to the extent that *appropriate* accommodations are attempted.

[5] It does seem to be widely accepted that whatever technology is, it does combine the material and the social – straddling both the social and natural worlds. But even where this is accepted there seems to be a reluctance to attempt to distinguish the social and material dimensions (e.g. Pickering 1995), or to elaborate exactly what is meant by social in this context (e.g. Kroes 2006) .

[6] It might be more correct to say that I am drawing upon a philosophical, as opposed to scientific, ontology of social phenomena (see Bhaskar 1989). For current purposes, however, the main point is that I am drawing on a relatively established account of the nature of social reality that focuses upon general properties of social phenomena but has not featured, to my knowledge, in discussions of the nature of technology (although see Lawson 2007a and Faulkner and Runde 2007).

[7] For those unfamiliar with such accounts a useful introduction is provided in Archer et al (1998).

[8] For the a statement of the former see Bhaskar 1989 and Archer et al. 1998; and for a statement of the latter see Lawson 1997, 2003.

[9] It is clearly impossible here to do justice to the complexities of the arguments involved. For a detailed account see (Bhaskar 1989; Lawson 2003; Collier 1994).

[10] See especially Bhaskar (1978).

[11] It is also important to point out that the use of open and closed system here does not exactly correspond to that in systems theory drawing upon the work of von Bertalanffy and others. Closed systems within the critical realist literature refer to systems where one (set of) causal mechanisms are so isolated that they always respond the same way under the same circumstances. For a recent discussion of these ideas see Bigo (2006).

[12] See for example Mitcham (1994). Although intermediate stages clearly exist (e.g. the craft worker amending the design of his or her tools in practice to suit the job at hand), such hybrids can easily be understood as combinations of design and use.

[13] Thus the use of technical objects is prescribed not only by the social relations implicated in an object’s ‘position’, but by the rules of use literally built into the object itself. For an expansion of these ideas and their implications, see Feenberg’s discussion of technical codes (e.g. see Feenberg 2002: 20-21).

[14] The latter two kinds are forms of symbolic function. Drawing on earlier work by Binford (1962), Rathje and Schiffer suggest that sociofunctions are concerned with the communication of information about social phenomena, making what they term social facts 'explicit without words'. Examples might be insignia or uniforms, which identify the specific roles of positions such as butcher, doctor, etc. An ideofunction is concerned with a very broad conception of ideology, and refers to that function that symbolises or encodes general values, or ideas. An example might be prayer books which serve to symbolise faith or belief. In contrast to these kinds of function, a technofunction is viewed as strictly utilitarian, relating to such functions as storage, transport, alteration of materials etc (see also Schiffer 1992:9-12).

[15] Although there is little space to pursue these issues here, it is often argued that the term function, in any case, does far too much work in Searle's account. Not only are different conceptions of function conflated (e.g. proper functions (Millikan 1984) and system functions (Cummins 1975), but the term function is used to capture things that are not easily understood as functions at all (in particular anything non-physical). Moreover the usual understandings of function in relation to technology are more at odds with the social content Searle is concerned with – i.e. function is typically counterposed to meaning and incorporation within the lifeworld, thus functionalization refers to a process in which aesthetics, meaning, etc., are systematically stripped away from the relaions in which we stand to different objects. Whether or not this leads to serious problems for Searle's account is not a matter of importance for current purposes (although see Kroes 2003 and Meijers 2000 for interesting discussions). But it does reinforce the gain to be had from recasting these arguments in terms other than that of function.

[16] Now, I am wary that any mention of the word essential sends signals that many will find both problematic and unnecessary. Given this, it should be stressed from the start that such talk of 'essential' in this context is not referring to timeless properties, but properties that can change but are, at any point, responsible for a thing being the kind of thing that it is. In effect, it is doing little more than accepting the implications of the fact that for things to have causal powers at all they must be structured. If things are structured, there would seem to be no reason why all features of some thing will be equally important (or unimportant) at some points in time. To accept this and to inquire into which properties are more enduring or important would seem to be nothing short of an enquiry into what is essential. In this case, technical objects are simply those objects whose causal powers do not crucially depend upon the relations in which they stand.

[17] Stating things in this way requires at least one qualification at this point. Given that I am not suggesting a clear dividing line between essential and inessential, I am not suggesting a clear dividing line between technical and social objects. There are going to be all kinds of borderline cases and blurring of these distinctions. If that is how the world is, however, then so be it. But it does seem to me that this makes it possible to talk of general characteristics of those kinds of things which are essentially more of one type than another. And this is all that is required to talk of technology as a general category.

[18] The term 'extension' has of course a distinct history in the philosophy of technology literature (see for example Brey 2000). Although it is not possible to pursue this here, the conception of extension I have in mind, whilst inspired by some of these accounts, differs in that it is not so much 'faculties' that are extended but what it is that human beings are capable of, and that such extension is a process of enrollment (see Lawson 2007a).

[19] To attempt to distinguish technical objects in this way does need further qualification however, in terms of the kind of definition is being advanced. Clearly this is more of a taxonomic than causal-explanatory aspect of technology's definition, of importance in distinguishing different kinds of material artefacts. But it does have some plausibility in both explaining the preoccupation (in some of the philosophy of technology literature) with such ideas as control and efficiency whilst (in the context of the fuller understanding of material artefacts as social in the senses noted above) being able to locate why such ideas are likely to be only part (and often a small part) of the story.

[20] The differences that are likely to follow are those that relate to the importance of ontological differences between the natural and social world that would appear to be central to an explicit ontological account of the nature of technology. Again, there is little scope for developing these points other than to signal the working out of a dynamic of technology based upon the greater isolatability of causal mechanisms in the natural world as opposed to the social world, and so the different nature of the isolative and reconnective moments of technical activity at the design and use ends of the range of technical activity.