DISCUSSION PAPER

• *ABSTRACT*

This paper explores ways in which the 'social shaping of technology' (SST) approach to the technology-society relationship might be extended, by drawing on ideas which have been developed in media and cultural studies. We introduce the various approaches to the social shaping of technology by discussing, in particular, the work of Raymond Williams and Langdon Winner. We argue that the SST approach is limited on three counts. First, it fails to take account of ideology in the social shaping of technology. We argue that ideology is central to functional and symbolic encoding, and suggest that designers are a key group in these processes. Second, we identify marketing as a process which is central to the shaping of technology: it plays an important part in both constructing the demand for technologies, and in informing their development. Third, we suggest that the SST approach fails to take account of the appropriation of technologies by users. Technologies offer varying possibilities for such appropriation, but these are not limitless: some technologies are more 'open' than others in the range of possible uses to which they may be put. But appropriation is not just about the use *of a technology: it is also about the* meaning *the technology has for its user. These ideas are discussed in relation to recent work on various domestic technologies.*

Extending the Social Shaping of Technology Approach: Ideology and Appropriation

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The sociology of technology is an emerging but as yet embryonic field. In a broad sense, it is concerned with explaining how social processes, actions and structures relate to technology; and in this is concerned with developing critiques of notions of *technological determinism.*

Donald MacKenzie and Judy Wajcman point to the centrality of technological determinism; they refer to it as 'the single most influential theory of the relationship between technology and society'.[1]

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Technological determinism is the notion that technological development is autonomous with respect to society; it shapes society, but is not reciprocally influenced. Rather, it exists outside society, but at the same time influences social change. In more extreme varieties of technological determinism, the technology is seen as *the* most significant determinant of the nature of a society.

Technological determinism is unsatisfactory because technologies do not, in practice, follow some predetermined course of development.[2] Research and development decisions, for example, are significant determinants of the sorts of technologies which are developed. Also, although technologies clearly have impacts, the nature of these is not built in to the technology but depends on a broad range of social, political and economic factors.

The social shaping of technology (SST) approach 'serves as a needed corrective' and 'an antidote to naive technological determinism'.[3] Whilst not denying that technologies have social effects, the focus, rather, is on the social forces which give rise to particular technologies. Sociologists of technology, it is argued, need not restrict themselves to the *effects* of technologies.

Within the sociology of technology there are two broad approaches to the social shaping of technology. The first of these focuses on the 'micro', and can be seen in terms of three schools: the 'social constructivist', the 'systems', and the 'actor-network' approaches.

The social constructivist approach draws on the sociology of scientific knowledge.[4] Here, scientific facts are seen as social phenomena; to social constructivists, technological artefacts are socially constructed. Technologies emerge out of processes of choice and negotiation between 'relevant social groups'; other key concepts include 'closure' and 'interpretative flexibility'.[5] The focus is on design and development, which are seen as embodying these social processes, as encompassing the social interests which they represent.

Hughes' networks, or 'systems', approach sees system builders – inventors, engineers, managers and financiers – creating and presiding over technological systems; heterogeneous people, organizations and disciplines become part of a 'seamless web':

> [S]ystem builders were no respecters of knowledge categories or professional boundaries. In his notebooks, Thomas Edison so thoroughly mixed matters commonly labelled 'economic', 'technical' and 'scientific' that his thoughts composed a seamless web.[6]

The 'actor-network' approach is a programme for empirical

research which is opposed to the social constructivist agenda in that it collapses any distinction between the 'technical' and the 'social' – and, for that matter, between these and the 'scientific', the 'economic' or the 'political'.[7] Dropping any distinction between animate and inanimate things and forces, these conventional categories are replaced by the notion of 'actors' – physical and social – which are involved in the development of technological systems. Technological systems, it is argued, are built by the management, or 'enrolment', of both physical and social actors into networks – using 'heterogeneous engineering', drawing heterogeneous components together.[8] The primacy of human elements in a socio-technical scenario is rejected; rather, the development of a technology is seen in terms of the relationships formed between human and non-human elements of 'actor networks'. Technical knowledge is not privileged by any special epistemological status, but is merely a particularly robust configuration of relationships.

The second broad approach is the neo-Marxist.[9] This argues that technological change cannot be fully understood by reference to individual inventions. Rather, it is argued, we need to examine how wider, 'macro' socio-economic forces (for example, the decision to invest in particular lines of research and development) affect the nature of technological problems and solutions. This approach criticizes the social constructivist approach for ignoring the political and economic context within which a technology is developed. Technology is designed, consciously or otherwise, to secure particular social or political objectives.[10] In this vein, the 'labour process' approach looks at how the social relations of workers and management affect the nature of technologies.[11]

Both broad approaches to the social shaping of technology, then, are concerned with explaining the social process of the conception, invention, design and development of technology; and both see this as embodying particular social relations. Pinch and Bijker argue that only by demonstrating the *choices* which are made in the design process and the social negotiations involved in this can one counter the arguments of technological determinism.[12]

It is interesting to note that the sociology of technology shares with technological determinism an almost exclusive concern with the conception, invention, design and development of a technology.[13] Unlike technological determinism, however, it roots this within a complex of social forces, which not only anchor, but mould the inventing process: 'Our interest is in what shapes technology in the first place before

it has effects'.[14] Raymond Williams' discussion of the social history surrounding the conception and development of television is a pioneering example of an SST approach. Williams challenges the very foundations of technological determinism by proposing that we 'restore *intention* to the process of research and development',[15] instead of mystifying this process. Technologies are created not by lone inventors or geniuses working in a social vacuum, but by a combination of social forces and processes.

Williams contends that, at one level, the history of television is a history of 'isolated names [Nipkow, Rosing, Baird, Jenkins and Zwyorkin]. But at another level it is of EMI, RCA and a score of similar companies and corporations'.[16] He argues that television was not simply the product of an overnight flash of inspiration, but was the result of an evolving complex of social and technical factors. For Williams, the entry of television into the home was a response to a series of needs which, in turn, were a consequence of the developing twin processes of mobilization and privatization. 'There was nothing in the technology to make this inevitable'.[17] It might, indeed, have developed in quite different ways. Here, then, Williams' argument is similar to that subsequently developed by Cowan for the case of domestic technologies:

> Several million American women cook supper each night in several million separate homes over several million separate stoves. This is not an inevitable, immutable situation.[18]

Like Williams, these authors argue that there are alternative ways in which to organize both domestic relations and the technologies which are implicated in these. Charlotte Perkins Gilman, Dolores Hayden, Alice Austin and others argued that the remaining domestic labour in the home could be executed in parallel fashion to the more traditional public practices. This would involve collective payment for communal labour as opposed to atomized, individualized unpaid work. Melusina Fay Pierce and others advocated building neighbourhood headquarters in which collectively organized cooking, sewing and laundry services would be provided for the community. More ambitiously, in 1916, Alice Austin, an architect, designed plans for a 'feminist socialist city'. Once again domestic labour was to be taken out of the home and collectivized: she proposed that each home would be connected to the central laundry and kitchen, by railway cars in underground tunnels.

In short, the influx of domestic technologies into the home was not inevitable. Rather, the development of domestic technologies should be seen as an important sign *in the processes* of individualization and privatization – as a symptom of the broader social changes taking place. And this is the argument developed, for the case of television, by Williams: television *might* have developed in a variety of different ways; it might have been produced differently, have had different content, and have been implicated in quite different producer–consumer relationships.

Clearly, it is no great leap for the SST approach from seeing technology as a social product to seeing it as political. 'Do artifacts have politics?' asks Winner. Clearly, many technologies are political from the earliest stage – wind power, for example, or Moses' oft-cited road system, which exhibited clear political intent.[19]

Moses, the planner of an enormous range of public works in New York and beyond from the 1920s to the 1960s, was responsible for designing numerous parks and beaches, particularly on Long Island, New York. In relation to comparable over-passes built throughout the USA, Moses' were idiosyncratic in one respect: they were extra-ordinarily low – some no more than nine feet from the kerb; in other words, they were designed to exclude tall vehicles. While at first sight this may appear largely innocuous, in fact it is not so.

> His parkways could be experienced only in cars: their underpasses were purposely built too low for buses to clear them, so that public transit could not bring masses of people out from the city to the beach . . . Moses used physical design as a means of social screening.[20]

Whilst Moses' development of parkways was carried out under the rhetoric of recreation for the masses, his concern was for those of a similar class to himself; Caro reports that his concern was to protect his parks *from* the masses, and, particularly, from their use by negroes – by preventing their access by the public transit system, by his low bridges.[21] The depth of his racism is indicated by the numbers and locations of playgrounds he built: 255 in New York City in 1930, of which one was in Harlem. Such encoding as Moses' bridges, clearly, can be enduring.

> For generations after Moses has gone and the alliances he forged have fallen apart, his public works, especially the highways and bridges he built to favor the use of the automobile over the development of mass transit, will continue to shape [New York].[22]

Labour process theory has pointed to both more and less politically intended technological innovations. Braverman identified a long-run tendency towards the degradation of work in capitalist economies; and subsequent contributors to the debate have provided empirical evidence both to support and to refute his arguments.[23] Clearly, that technologies reflect and embody prevailing social relations demonstrates their political nature; but technologies are not simply direct translations of economic imperatives into tangible machines and operations. Rather, various groups are involved in the processes of technological innovation; hence the more sophisticated, less reductionist focus of more recent labour process theory – on, for example, managerial strategies,[24] organizational contexts,[25] and gender.[26] Each of these constitutes a more complex formulation than Braverman's of the nature and role of technology, yet each acknowledges the political nature of technology at work.

While the example of Moses' road system exhibited clear and obvious *intent*, the latter is not a necessary prerequisite for a technology to embody political qualities: 'to recognise the political dimensions in the shapes of technology does not require that we look for conscious conspiracies or malicious intentions'.[27] Winner cites a lucid example of technology design which is unintentionally political.[28] In the USA in the 1970s, people with physical handicaps began to voice publicly their discontent with the design of public facilities. They argued that they were often denied mobility in public spaces by virtue of the inconsiderate nature of the design of public transport, buildings, toilets and streets. In response to this discontent, authorities have subsequently made concerted efforts to remedy existing problems and to ensure that new constructions are designed with the interests of the physically handicapped in mind. On reflection, one might recognize that high kerbs and flights of steps mitigate against a minority's mobility, but this was not the result of conscious or conspiratorial intent. However, because a technology may not be consciously encoded with political qualities does not mean that it cannot help to reproduce economic priorities or power relations inherent in the social formation.

Ideology in the Social Shaping of Technology

Much of the SST approach has been informed by macro perspectives, which prioritize the role of structure over that of subject; they explain

the subject's action in terms of the determining constraints of social structures and institutions. The subject is relegated to a passive, determined, role, as opposed to one which actively constructs the social world.

The remainder has focused on the micro, elevating the subject (in preference to the structure), and has focused on the active role of the subject in determining the conditions of his or her experience. This subject-orientated approach focuses its analysis in the interaction of the subject. Contending that explanation relies upon understanding the subject's construction of meaning in his or her experience and interaction, the approach has failed to take account of broader social processes. Thus although Law argues that actor-network analysis avoids micro–macro distinctions,[29] Latour has been criticized for emphasizing the power of the laboratory and failing to investigate the broader context of laboratory work – competition for research funding, societal attitudes to science, and so on.[30]

The recent debate about ideology provides some resolution to this crucial dilemma within sociology, of reconciling structure and agency.[31] This paper is not the place for rehearsing these debates, but crucial is their concern with the relationship of meaning and power.[32] By drawing on these ideas, as developed in cultural and media studies, we hope to extend the SST approach. A cultural studies approach leads us to analyze technology *not solely* as a process of design, but as a product of three conceptually distinct spheres:

1. conception, invention, development and design;
2. marketing; and
3. appropriation by users.

These spheres are not discrete, causally related, or sequentially ordered. Rather, they should be seen as an heuristic device.

Our *first argument* is that in investigating the factors relevant to the production of a technology, sociologists of technology have accorded an insufficiently central place to ideology as a social force (whether micro or macro) behind the technology. Stewart Russell and Robin Williams,[33] and MacKenzie and Wajcman,[34] have both argued that to explain the development of a particular technology requires a coherent model of the society in which the technology is embedded; without ideology, we would argue, you do not have such a model.

Some work on technology *does* deal with ideology, but not in the way we have in mind: for example, there is work on the ideology of engineers.[35] Such work, however, does not generally relate occupational ideologies to the product of the technologist. The exceptions to

this are the work of David Noble,[36] who deals with the ideology of scientists and engineers, and relates this to the prevailing context of the developing military-industrial complex; work on gender,[37] which has focused on patriarchal ideology (though there is little on gender in the area of technology *design*);[38] and, most fruitfully, in cultural and media studies, work on domestic technologies which has looked at ideology.[39]

It is paradoxical, given the nature of Raymond Williams' work generally, that the role of ideology is conspicuous by its absence from even his account of the social shaping of television; and this limitation is far from confined to Williams' work.

Through the notion of *encoding*, we can probe the part played by ideology. Technologies are encoded with preferred forms of use, with or without necessary intentionality on the part of producers. Moses' road system is an example of *functional encoding*: the overpasses tended to effect Moses' political objectives via the appropriate usage or non-usage of the road system. However, function is not the only medium by which technology may be encoded to advance particular objectives. It may also be *symbolically encoded.*

While acknowledging that technologies retain functional properties, William Leiss and his colleagues argue that technologies (as material objects) also contain symbolic qualities: they draw 'a distinction between [a technology's] use and symbol'.[40] Symbols, and systems of signification, are 'inevitable'.[41] 'In all human cultures material objects are social communicators.'[42]

Adrian Forty's discussion of the design of contemporary electric shavers illustrates the symbolic encoding of (politics into) a technology.[43] Forty investigates the 1980 range of Philips shavers and explores the contrasts between those shavers designed for men, and those for women. The Ladyshave (as it is called) is pink, round and decorated with a floral motif; the male shaver, in contrast, is black, angular and robust looking. Clearly this contrast has little to do with function – it has to do with symbolism which serves to confirm and consolidate existing ideologies of gender and patriarchy, which were mobilized by designers in their efforts to develop product designs which would sell.

In practice, the distinction between symbolic and functional encoding is less clear-cut: a fast car embodies both symbolic and functional encoding – the speed and the image; and Moses' road system is symbolic (of a white suburb) as well as functional. Indeed, it might be argued that the distinction between function and symbol is

misleading, in that it implies that there can be some objective need or function, and that this can be separated from the meaning which the object or technology has for its user. However, the distinction points us to the ideological nature of the encoding process.

Forty argues that, whereas most literature suggests that the main function of design is to make things beautiful, design is better explained in terms of the market nature of the economy. Design is important because it 'can cast ideas about who we are and how we should behave into permanent and tangible forms'.[44] *Designers*, thus, are a key group in the process of ideological encoding. As Jon Bird argues:

> [T]he artist or designer is a member of a social group and thus comes under specific social and economic conditions, shares certain values and beliefs, and in the widest sense of the term represents in his or her work an ideological position.[45]

Like Williams, Bird anchors designers to the conditions of their social existence. Forty, too, rejects idealist accounts of design and shows how the designer should not be ascribed the autonomy so often assumed. He explains how design is a social process, and goes one step further by contending (albeit showing rather a crude understanding of the notion of ideology) that designers work as agents of ideology. He sees their role as serving to condense a complex of ideologies into a singular product. 'In the way it transforms ideas and beliefs successful design is like alchemy: it fuses together disparate ideas.'[46] Thus Forty contends that ideology is a critical ingredient in technological design; and he argues that domestic consumer appliances would never have come to be created 'without the existence of certain ideas about the nature of domestic life and the part that appliances might play in it'.[47] In particular, their form draws on and embodies specific ideologies concerning the spatial and gender division of labour and the role of the housewife.

Unsurprisingly, Forty argues that design is conditioned principally by an overriding commercial interest. He refers to Loewy's account of his redesign of the Lucky Strike cigarette packet and its minor aesthetic improvements. He argues that Loewy's success was attributable to his ability to mobilize symbolically a number of existing ideological discourses surrounding the (ideologically constructed) notion of 'Americanness'. In other words, Loewy's design struck responses in several profound existing social 'nerves' which, when combined, served to epitomize and crystallize a harmony of ideas

which were closely identified with ideological conceptions of Americanness.

> The ideas of cleanliness and Americanness signified by the design belonged in the minds of all Americans and cannot in any way be said to have been an invention of the designer.[48]

The symbolic relationship (in this case between white and cleanliness) is purely an arbitrary one, albeit one which can become accepted by social convention.[49]

Winner points us in the direction of the second and third points of our critique of the SST approach. He argues that as a 'corrective' of technological determinism, the SST approach 'has its own shortcomings'.[50] For, while the social shaping of technology is opposed to technological determinism, it nevertheless shares with it one fundamental concern. In differing ways, both firmly root their focus on the first sphere of a technology – its conception, development and design. The SST approach tends to assume that:

> Once one has done the detective work necessary to reveal the social origins – power holders behind a particular instance of technological change – one will have explained everything of importance.[51]

To suggest that once a technology is produced, or even sold, it reaches the end of its social shaping, however, is to ignore both its marketing and how the technology comes to be used or implemented.

The Role of Marketing in Social Shaping

Taking the first of these, the *second argument* of this paper relates to the marketing stage of a technology. Marketing is a part of the social shaping of technology not only in that it informs design, but also, as we argue, in that it plays a part in constructing demand. Proponents of consumer sovereignty argue that societal members' desires are manifest in their decision to buy or not to buy a given product. 'It is needed because it is bought; if it were not bought, it would not be made'.[52] Obviously, such a decision is not a free choice, since there are plenty of product or technology needs which do not get met.[53] In other words, to exercise the choice depends on the ability to buy. But, even then, the choice that exists for a consumer is confined by the parameters which determine what comes to be produced. It is our

contention, following Arthur Brittan, that consumer sovereignty is not located 'in the autonomous sphere of individual motivation, but it is heavily dependent on the workings of the productive system'.[54]

Raymond Williams discusses the consumer–producer relationship, and argues that a technical response to a socially articulated need is dependent on that need's relation to the priorities of those who control the means of production. One can tease from Williams's work what he perceives to constitute such priorities: 'new capitalism [is] based on a series of devices for organizing and ensuring the market';[55] and 'capitalism's version of society can only be the market, for its purpose is profit . . . rather than any general conception of social use'.[56]

Thus, according to Williams, the social needs of evolving privatization were only responded to with an appropriate technology because such a response could be fashioned to suit the (profit-oriented) interests of the producers. The specific development of television and radio for domestic consumption reflected the desire of producers to develop a large and thus profitable market. For manufacturers and retailers the family household was a more attractive unit of consumption than collective groups. Thus, while radio and television were developed for transmission to individual homes, 'there was nothing in the technology to make this inevitable'.[57]

Historical evidence supports Williams' contention: in Nazi Germany, Goebbels had radios positioned in public spaces, such as street corners, to enable 'compulsory public listening groups' to consume propaganda collectively; further, Geobbels intended to organize the public consumption of television in a similar collective, public manner.[58] In other words, there was nothing inevitable about the production and deployment of private, individual technologies. The latter served to satisfy not only social needs but also the economic priorities of the social formation.

The attraction of consumer domestic technologies is graphically illustrated by Forty's discussion of the Singer Sewing Company.[59] In the mid-nineteenth century, Singer neared bankruptcy, selling a mere 810 machines in one year. Their problem was not the product but the market: they sold their machines exclusively to industrial manufacturers. However, following the precedent set by their competitors, Wheeler and Wilson, Singer produced a machine designed for domestic usage. In doing so they extended their market potential to every household in the country.

The fact that the majority of consumer durables were intended for

domestic use ensured that the family and the home became a primary subject of commercial interest. Arnold relates this to the question of gender:

> The interest of appliance manufacturers in mass markets coincided exactly with the ideological assumptions of their domestic science advisers, whose belief that women's place was in the home led them to think that appropriate appliances would be designed for the individual woman user rather than for shared or communal use.[60]

Frederick suggested that 'every business day approximately 5000 new homes are begun, new nests are constructed and new family purchasing units begin production'.[61] Similarly, the family came to be perceived primarily in terms of its potential for increased commodity consumption, reflecting capital's interest in the consumer market: the emerging family home was smaller and so generated a different pattern and more units of consumption than the traditional extended families. Hence Frederick identified 'a direct and vital business interest in the subject of young love and marriage'.[62]

While we have briefly discussed the material interests which were at play in the promotion of the small modern family, it is useful to recognize the ideological forces involved. Leiss and his colleagues suggest that advertising in the mid-1920s tended to depict people who served as 'exemplars of reigning social values carrying . . . society's commitment to family structure, status differentiation, and hierarchical authority'.[63] The early manufacturers of consumer durables faced a problem. For they required 'a greatly intensified selling effort in order to "move the goods" cascading off their assembly lines';[64] those in control of production recognized the need to expand and mobilize the market.

> Having been schooled in the production ethic of work and thrift, the majority of the population then had to be retrained as consumers. This fact was recognised by many business leaders in the 1920s.[65]

Thus, 'foresighted businessmen began to see the necessity of organising their business not merely around the production of goods but around the creation of a buying public'.[66] Companies were able to encourage consumption through their control over the hours and wages of workers. Thus, while Henry Hoover contended that higher wages were the essence of production, Ware recognized that 'time out of mass consumption becomes as much a necessity as time in

production':[67] the necessity for consumption was thus clearly understood by those involved in production. Jean Baudrillard has discussed this clearly, identifying the crash of 1929 as a turning point:

> The bourgeoisie knew how to make the people work, but it also narrowly escaped destruction in 1929 because it did not know how to make them consume. It was content, until then, to socialize people by force and exploit them through labour. But the crisis of 1929 marked the point of asphyxiation: the problem was no longer one of production but one of circulation . . . mobilised as consumers, their 'needs' became as essential as their labour power.[68]

Interestingly, manufacturers often regulated consumption by explicitly deploying a similar philosophy to that which they used to organize work processes.[69] The extension of scientific management into regulating the market took two forms: first, the accumulation of information about potential customers; and, second, the deployment of that knowledge to organize societal needs, desires and fantasies around the commodity form. The latter largely took the form of advertising, although it was also evident in the design, packaging and branding of commodities. Advertising is central to the mobilization of meanings and associations, in its selling of commodities. A large part of the advertising industry is devoted to the construction and mobilization of symbolic associations surrounding commodities — especially domestic consumer technologies.

> Therein lies the real importance of advertising . . . it is the privileged discourse for the circulation of messages and social cues about the interplay between persons and objects.[70]

According to Webster and Robins, these practices of extending scientific management into the broader social sphere began to mature and congeal into a more systematic scientific approach around the 1920s and 1930s:[71] while market research came to emphasize quantification and scientific procedures in its information gathering, advertising began to practise the sample testing of advertisements and the incorporation of psychological research.

'Sloanism' was being developed to create the consumer.[72] Three key elements of this can be identified: first, there was built-in obsolescence, such as annual model changes. Baudrillard has discussed how 'fashion based' innovation in car manufacture depended on prior social acceptance of the idea of 'obsolescence';[73] and Ruth Cowan has discussed how the development of consumer appliances depended on

psychological acceptance of advertisers' appeals to housewives' guilt.[74] Second, there was marginal differentiation, to enable personalization within the context of mass production. For example: 'According to your desire, you can choose your Mercedes-Benz from among 76 different colours and 697 assortments of internal trimmings'.[75] Third, consumer credit – trade-ins and hire purchase – became available: 'Consumer credit was a way to break new ground in socialising the family to the idiom of mass produced life . . . it would assure the imposition of consuming tendencies'.[76] In these various ways, those in control of production sought to generate the demand for their goods.

In short, demand is socially constructed. Within this framework, however, it might be argued that although the decisions of production reside within the hands of a minority within society, and this constrains what is available, the user or consumer remains sovereign to exercise his or her right to reject a technology. We would contend, however, that the notion of the sanctity of consumer choice – to consume or not to consume – is subject to some serious qualifications.

The Social Appropriation of Technologies

This leads us to the third point of our paper, which is that the sociology of technology has, in general, failed to look at the subjective, social appropriation of technologies.

> . . . close inspection of technological development reveals that technology leads a double life, one which conforms to the intentions of designers and interests of power and another which contradicts them – proceeding behind the backs of their architects to yield unintended consequences and unanticipated possibilities.[77]

Until now our discussion of domestic technologies has been concerned with the social forces which are responsible for their development, production and marketing. However, this account is incomplete because it fails to consider the social forces at work on the other side of the technology: the way that technologies come to be actively appropriated by their users. People are not merely malleable subjects who submit to the dictates of a technology: in their consumption they are not the passive dupes suggested by crude theorists of ideology, but active, creative and expressive – albeit socially situated – subjects. People may reject technologies, redefine their functional purpose, customize or even invest idiosyncratic symbolic

meanings in them. Indeed they may redefine a technology in a way that defies its original, designed and intended purpose. Thus the appropriation of technology is an integral part of its social shaping. 'Goods are neutral, their uses are social, they can be used as fences or bridges.'[78]

However, the appropriation of a technology cannot be entirely separated from its design and development: technologies are designed for particular purposes.[79] How does the encoding of design interact with appropriation? Much labour process theory and sociology of technology does not even begin to consider this question, though there are exceptions: Bruce and Mole have referred to the erroneous separation of those who study the creation of a technology from those studying its effects.[80] Stephen Hill has argued for the linking of invention and consumption in accounts of technology.[81] Fleck is concerned with the impact of technology implementation on technology design, but focuses on a narrow set of technologies, 'configurational technologies'.[82] Richard Johnson's seminal paper on the nature of cultural studies stresses the inter-relatedness of these two spheres.[83] Latour's approach, although it focuses on ambiguity and solidification at the early stages in the life of a technology, appears implicitly receptive to understanding later stages; and he alludes to processes of technology take-up.[84] Ruth Cowan, however, seems to be the writer in the sociology of technology who most explicitly links consumption and production; she sees her work on stoves as extending the social constructivist approach, by applying an actor-network framework to consumers.[85] She does not, however, acknowledge any literature, traditions, themes or concepts which can be drawn on in such an endeavour.

It would seem that there is less scope for a variety of forms of appropriation in work than in the domestic sphere. In the former, users are generally *told* to use particular technologies, and in particular ways. Even within work, however, there may be possibilities for the subjective appropriation of technologies. At home, however, there is far greater choice – starting with whether or not one buys the product in the first place.

'Technologies can be designed . . . to open certain options and close others.'[86] Such options and limitations of use are defined at one level by 'the material, technical possibilities of the object'.[87] Williamson's essay on the walkman illustrates the point clearly. She discusses the personal nature of the personal stereo system, or 'walkman', arguing that it constitutes 'a weapon of the individual

against the communal'.[88] The technology of the walkman – its material construction – effectively ensures the user's solitary (as opposed to communal) consumption of music. The walkman is functional because it allows both the individual *not* to interact with others, and others not to be disturbed by the individual listening to recorded music. Thus, in relation to its social potential, one might conclude that the walkman constitutes a technology which exhibits relative 'closure' – in terms of its social potential and in use (it can be used in one way only). Goodall's suggestion that 'design for use is design of use' is thus particularly poignant in the case of the walkman:[89] its design sharply defines the parameters of its potential use.

In thus suggesting that a technology's social appropriation is shaped, or constrained, by its physical nature, we are not resorting to some sort of technological determinism. For the physical technology itself embodies the social arrangements which gave rise to its production. Hill puts it like this:

> In our experience of contemporary machine systems we therefore confront our own history. Behind the appearance of external facia plates, knobs and dials lies the accumulation of stocks of knowledge from which the industrial fabric has been woven, and also the sedimentation of cultural meanings that paved the way for the system's momentum. Or, as Thomas Hughes observes, 'Durable physical artefacts project into the future the socially-constructed characteristics acquired in the past when they were designed. This is analogous to the persistence of acquired characteristics in a changing environment'.[90]

Hill goes on to discuss Marx's formulation of this in terms of dead and living labour: living labour brings to life the product of dead labour, but in a way which is constrained by the input of that past labour.[91] One is . . .

> . . . only able to bring the machine (and its design) to life through abiding by its background grammar – of technical-systems logic, and inter-connectedness to associated systems. This is a *con*-text . . . the contextual grammar accentuates properties and purposes to which machines are to be put.[92]

As Goodall argues,

> Design for use is design of use, as such design deposits preferred uses, defines them within the parameters of the material technical possibilities of the object.[93]

So, rather than fall into technological determinism, we find a more fruitful approach may be developed by drawing on some of the

insights that Stuart Hall and David Morley have developed in cultural and media studies.[94] Design and development processes may encode preferred forms of deployment in a technology (via its technical possibilities), which are reinforced through marketing. It is in this semiological sense that one might propose that a technology is a form of text.

It is our contention, however, that Goodall offers only a partial account of the constraining nature of technology. For, as well as carrying preferred forms of deployment, the way in which a technology is deployed is also determined by its users: this use is not inevitable, built into the technology, or fixed. 'A new device merely opens a door: it does not compel one to enter.'[95] Technologies facilitate, they do not determine; and they may be used in a variety of ways. In short, there is a crucial role for the decoder of the text.[96] The subjective, social appropriation of a technology is thus a crucial force in the social shaping of technology – one which cannot be 'read off' from either the physical technology, or from the social forces behind its development.

One can consider any number of instances of technologies which are used for purposes which differ from the intentions of their designers or marketers: home personal computer use has ended up being largely for non-utilitarian purposes;[97] early cassette recorders were intended to be used for playing pre-recorded tapes, but were generally used for recording from records; scratch music involves moving a record deck backwards and forwards at discos; video is used to make films as well as to watch them at home, and even within the home, use goes beyond the designers' intentions in that video is used predominantly to 'time shift' television;[98] the Chinese invented gunpowder, but used it only for fireworks; and invented the watchtower, but to watch for the approach of dignitaries so that a proper welcome could be arranged, not to guard prisoners; and the electric telegraph was seen by its inventor in 1787 as useful for besieged towns or distant lovers.[99] In sum, the character of a technology is complex and contradictory; technology leads a 'double life', or has 'dual effects'.[100]

Nevertheless, the range of choice in the deployment of technologies is not limitless; our analysis needs to strike some sort of balance, of freedom within constraint, as Featherstone argues: he seeks to develop a perspective which goes beyond . . .

> . . . the view that lifestyle and consumption are totally manipulated products of a mass society, and the opposite position which seeks to preserve the field of lifestyles

> and consumption . . . as an autonomous playful space beyond determination.[101]

Some technologies are more open than others, more amenable to being used for a range of purposes. A mortar bomb, for example, might conceivably be used as a door stop, but for little more than its intended purpose; whereas a hammer can be used to kill someone, to bang nails into wood, or to mend a car. The relative openness or closure of a technology will also depend on its interaction with other technologies – for instance in the form of software: a walkman can only play tapes, but these might be radical, traditional, educational, or whatever.

It might well be that designed objects are becoming increasingly specific, increasingly closed: they can be used or not, rather than used for a variety of purposes. Such an interpretation is certainly congruent with moves in manufacturing towards flexible specialization.[102] Manufacturers, it is argued, have reduced batch sizes and broadened the range of their products, tailoring these to the requirements of smaller target groups, as markets have become more segmented. Daniel Miller argues that such a trend illustrates the failure of the Sloanism we have discussed, the failure of corporate capital's efforts to create a homogeneous market.[103]

Hall argues that TV texts are all, to some extent, polysemic: there are always several possible readings of the text;[104] or, as Volosinov expresses this, the sign is 'multi-accentual'.[105] Polysemy, of course, does not mean a pluralist diversity without constraint: there always exists a 'preferred reading'. Morley has discussed how the meaning (of television content) is both structured and open to interpretation:

> The TV message is treated as a complex sign, in which a preferred meaning has been inscribed, but which retains the potential, if decoded in a manner different from the way in which it has been encoded, of communicating a different meaning. The message is thus a structured polysemy. It is central to the argument that all meanings do not exist 'equally' in the message: it has been structured in dominance, although its meanings can never be totally fixed or 'closed'.[106]

It is in a similar vein to Morley's that we propose to accommodate a recognition of the active role of the user of a given technology. The subjective, social appropriation of a technology is thus one key element of a technology – not just how it is used, but the meaning that use has for the user: a technology is not merely a physical object, it carries meanings.

This centrality of *meaning* to consumption has been developed in the work of Baudrillard.

> As the 'consumption economy' has developed, so the value of commodities is seen to derive less from the laws of economic exchange governing the market or from the ability of products to satisfy primary needs as from the way they function *culturally* as *signs* within coded systems of exchange.[107]

Baudrillard argues that the distinction between 'real' and 'false' needs in critical theory and Marxist economics is incorrect. Objects do more than signify a use value and exchange value, which can be related to some fixed system of human needs. Consumption is of more than use values (which is not to say that what is consumed has no utility); it has to do with *signs*; and the notion of the commodity as sign points to the crucial role of culture. As Fredric Jameson argues, 'no society has ever been saturated with signs and images like this one'.[108] Consumption has come to be about using commodities to express taste and status differences. The poststructural argument is that, rather than representing, the sign becomes everything; 'the end of the deterministic relationship between society and culture heralds the triumph of signifying culture'.[109] Contemporary, postmodern, consumer culture thus stands in contrast to mass consumption. 'Today there is no fashion; there are only *fashions*. . . . *No rules, only choices*. . . . Everyone can be anyone.'[110] Such a shift is reflected in advertising, which has shifted from product information to advertisements which incorporate looser, lifestyle imagery.[111]

But, despite its importance, compared with production there is relatively little work on consumption. Two important exceptions are those of Miller, and of Douglas and Isherwood.[112] Their work is discussed by Morley and Silverstone and their colleagues.[113] Miller is concerned with the symbolic nature of consumption. He argues that:

> . . . whereas the artefact appears to offer the clarity of realism . . . which is quite illusory . . . the object is as likely as the word to evoke variable responses and invite variety of interpretations.
>
> Although functional purpose must impose a certain constraint on the shape and form of an object, that constraint is generally a very loose one for everyday forms (though obviously not for machine parts).[114]

He gives the example of the enormous variety of shapes of glass bottles in an off-licence, and argues that there is very little relationship between form and fitness for function. Miller criticizes Bourdieu for

the latter's reduction of consumption practices to social class divisions; he argues that Bourdieu's work on different taste publics or interpretive communities is insufficiently sensitive to the creativity and transformatory nature of this cultural activity.

Douglas and Isherwood take a similar approach. They examine goods in terms of their symbolic or expressive function: goods are used to make 'visible and stable the categories of culture'.[115] They stress the non-utilitarian character of consumption, examining goods in terms of their expressive, symbolic and orientational function in social life.

> Goods in their assemblage present a set of meanings, more or less coherent, more or less intentional. They are read by those who know the code and scan them for information.[116]

Choice, and the display of the products of choice, are primary mechanisms for the assertion of identity, as statements about the self; consumption is an activity of self-expression, and is concerned with the production of identity. It is a cultural activity, not merely an economic affair.[117]

All consumption, then, involves the consumption of meanings; indeed, it involves the production of meanings by the consumer.[118]

> Within the available time and space the individual uses consumption to say something about himself, his family, his locality, whether town or country, on vacation or at home . . . Consumption is an active process in which all the social categories are being constantly refined.[119]

Goods, in short, are the visible part of culture: they are not mere commodities, but a major constituent of modern culture.

The text, or good, is not isolated, but exists in the context of the social, political and ideological conditions under which meaning, production and consumption take place. This meaning is not inherent in the object, but related to its context:

> The meanings of modern technological artefacts cannot be found in the objects themselves, but in relating the symbolism of the object to the cultural context and world-views within which the meanings of the immediate object are located.[120]

Decoding is thus not arbitrary but a social process.

> The physical artefact that stands before us is therefore a cultural symbol that is imbued with acquired meanings that are salient within the *overall* cultural grammar of our society.[121]

The production–consumption relationship is thus a complex and changing one.

> Despite the enormous efforts made through advertising, design and the media to create markets for given products . . . profits are always dependent on the reciprocal ability of marketing staff to interpret the changes in the way in which goods are used in social relations.[122]

Miller cites the example of Dick Hebdige's work on the motor scooter, which, in the tradition identified by Johnson, is an account of the dynamic interaction between production and consumption.[123] The scooter was developed in Italy as a feminine equivalent of the motorcycle; but its image was picked up in Britain by 'mods' in ways not intended by its producers. Thus Hebdige, unlike anthropologists, takes account of the interests of consumers; and, unlike Marxists, takes account of the active involvement of consumers. It is such an approach which we feel can be applied usefully to technology.

There is work of this order in media and cultural studies, on video,[124] early radio,[125] home computers,[126] and information and communication technologies in the home.[127] The use and meaning of information and communication technologies in the home, it is argued, can only be understood within the class, gendered, geographical and generational context of its consumption.[128]

Personal Computers

In considering the appropriation of technology we focus on the personal computer (PC). In the UK the presence of PCs in the home is highly significant; Britain has the highest *per capita* ownership of PCs in the world. Before considering its subjective deployment, it is useful to investigate the potentials and limitations of usage which are encoded in the PC. In contrast to the walkman (the usage of which is sharply defined by its design), 'the computer is a particularly rich and varied tool for serving so wide a range of purposes'.[129]

Turkle implicitly recognizes this notion of relative openness and closure in her discussion of PCs and railway transport. Of the latter she suggests that, if you want to use the railway, 'you only have one

choice. You buy a ticket, get on the train, and let it take you to your destination'.[130] The fact that the PC, in contrast, enables such a diversity of deployment is central to any attempt to understand its subjective appropriation. The PC, in other words, goes against any trend in technologies moving from general to more specific tools.

In addition to how the PC's technical qualities may be effective in shaping its subsequent deployment, there is another important dimension to consider: the marketing of the PC.[131] When it was introduced, it did not constitute a technical response to a demonstrated need; it was marketed on the strength of its potential utility.

> For home use, terminals have the potential for catalogue ordering, activity planning, home library and education, and family health, including histories, diagnoses and doctors' speciality lists . . . career guidance, tax records and returns; home safety and property maintenance; and budgeting and banking.[132]

The PC was initially marketed as a work-orientated rather than a leisure-orientated technology. As a consequence, those involved in selling PCs were able to exploit, and in doing so consolidate, a broader ideology of modernity. That the 'computer as a symbol of progress was as undeniable as the relationship between a Rolls Royce and wealth'.[133] Thus, Adamson and Kennedy argue, parents without a micro were made to feel that they were impairing their children's future employment prospects. This is the backdrop against which one might consider the appropriation of PCs; our discussion of this theme draws on the work of Turkle.

One can establish the significance of the appropriation of a technology by citing an apparent inconsistency: while PCs were marketed (and, indeed, often bought) on the strength of their instrumental capacity, their deployment became largely non-instrumental.

> Some justified their purchase of a personal computer by referring to a specific job . . . but in most cases they [PC users] also described a point at which their sense of engagement with the computer had shifted to the non instrumental.[134]

The openness of the PC is demonstrated by its being deployed for non-instrumental purposes.

That the PC epitomizes openness enables it to serve as a projective medium. Turkle suggests that PCs may serve a similar purpose to a Rorschach test (in which an ink blot constitutes a medium upon which individuals may project their own idiosyncratic meanings). They may act as mirrors, reflecting back to the user their own

personality traits. Moreover, by virtue of the fact that different people project different meanings on to the PC, it is meaningless (in itself) in a general sense: the PC is a constructed object, in that its meanings reside in the various users who attribute meaning to it.

However, the PC differs from the Rorschach test in one crucial respect. It enables the user to advance instrumentally and to construct a program which shapes a world created by the user. What does this mean in practice? Turkle suggests that one should not simply judge PCs on instrumental criteria, for such an approach misses what is most fascinating about PCs and their users – 'not for what it might do, but for how it made them feel';[135] hence Turkle investigates the 'subjective computer'. To illustrate the projective and constructive properties of the PC, we refer to Turkle's discussion of one adolescent's deployment of the PC.

Deborah, before she was introduced to the PC, was what one might describe as a problem child. According to her school teachers she tended to be 'withdrawn, frightened, and explosive'.[136] Further, her character was largely stamped by her dependency upon others. A consequence of such dependency was Deborah's lack of confidence to take active control over her life. When initially introduced to the PC, Deborah felt threatened by the power and control with which the PC endowed her. However, she overcame this initial problem by constraining her usage of the machine to a few commands: she would create graphic images only within the confines of a rule which meant that she could only turn right at thirty degrees at a given time. This enabled her to explore a world which was small enough to allow her to feel in control, while being varied enough to give vent to her creativity. Such a relationship with the PC proved valuable to Deborah in a wider social sense, for it enabled her to construct rules in her life so that she could begin to retain a degree of control. This new sense of control allowed her to develop a sense of independence.

Evidently, the PC served not as a determinant of Deborah's action, but as a projective medium: the constraints which she perceived in her PC world reflected what she brought to the computer as a person. Finally, and perhaps most critically, her involvement with the PC gave her a new conception of herself, not just in her PC world but also in the outside social world.

When considering the first generation of adult home PC users, Turkle suggests that they brought a dimension to their relationship with their machines which was not shared by adolescent users. Thus, while the first generation of PC users projected their own specific

relationships with their machines, they tended to share certain general stylistic preferences. The explanation of this apparent paradox resides in what Turkle suggests was the tendency for a specific type of person to become involved in the first generation of home computing. Most came from the computer industry and many of them were computer programmers. These programmers had become dissatisfied with their jobs because of the arrival of structured programming, which took away much of the programmer's autonomy.[137] Work practices became more fragmented: 'good for business, death for the joy of the work', as one of her respondents described the shift.[138] Turkle suggests that such frustrations came to be expressed in the programmers' relations to their home PCs: they tended to work in assembly language which, in contrast to high-level languages, enables the user to obtain a step-by-step unadulterated comprehension and control of the program and computer: their home program became intelligible and transparent in a way quite unlike their programming at work.

Turkle's work is important for the extended social shaping of technology model that we have proposed here, because it highlights the active role of the user in shaping and defining a technology's meaning. Her approach is less useful in that it perpetuates the notion that technologies have no meaning in themselves, ignoring the intent behind their development and the embodiment of this intent in the material technology; and her analysis could be extended by viewing the user as socially constructed, rather than as some kind of free-floating individual. Through Turkle's work, however, one can recognize the social forces in front of the technology, not only those behind it: a technology can be seen as a site on which a number of forces converge; it may bring to the user preferred forms of deployment (symbolic, functional, ideological encodings); while the user may at the same time bring to the technology his or her own specific intentions for the deployment of the technology. The PC is a relatively open technology – one which allows the diversity of uses which Turkle found.

Conclusion

In this paper we have reviewed the SST approach, and discussed modifications which appear to extend it, and allow it to handle the contending social forces involved in a technology with greater

complexity and sensitivity. We have argued that technologies are functionally encoded to facilitate (political) ends – by way of the forms of deployment which they encourage. Further, they are *symbolically* encoded to the same social end – through the practices of design and marketing. By focusing on ideology in the design process we have broadened the SST approach in the sphere on which it has focused – the conception, invention and design of a technology

While bringing the user *preferred* forms of deployment, technologies will vary in their degree of openness or closure. At a functional level, it seems that technologies are becoming more specific (from being more general tools) – which close down the options at the appropriation stage. At the same time, at the symbolic level they may be becoming less specific, with the marketing of 'lifestyles' rather than products.

As well as being encoded, technologies constitute a site on which various social forces converge. This is the sphere of appropriation. The user may bring to bear on a technology an intention which was not foreseen by the technology's designer: the PC exemplifies this process. As well as being encoded, technologies are subjectively deployed; appropriation is the sphere in which these two forces come together, making it an important moment to study. The notion of the (socially constructed) subject is crucial to countering technological determinism: the direction and nature of technology does not follow some inevitable trajectory. By extending our understanding of the scope of social choice that is involved, we are contributing to the possible generation of alternative trajectories.

One important reason why technological determinism is as dominant as it is, is that technology is generally read in that way; and this is a reflection of particular cultural values. It seems fruitful, therefore, to look at technology as a cultural phenomenon. By bringing the questions of both ideology in technology design and marketing, and the subjective social appropriation of technologies into the debate – drawing on work on design, encoding and subjectivity – we hope that we have contributed to an extended debate and research agenda on the socially shaped nature of technology.

• NOTES

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2. Ibid., 'Introductory Essay', 2–25.

3. For an account of the 'social shaping' approach, see ibid.; the quotation is from Langdon Winner, 'Do Artifacts Have Politics?', in ibid., 26–38, at 26.

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5. T.J. Pinch and W.E. Bijker, 'The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other', *Social Studies of Science*, Vol. 14 (1984), 399–441.

6. T.P. Hughes, 'The Seamless Web: Technology, Science, etcetera, etcetera', *Social Studies of Science*, Vol. 16 (1986), 281–92, at 285.

7. See, for example, Michel Callon, 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay', in John Law (ed.), *Power, Action and Belief: A New Sociology of Knowledge?* (London: Routledge & Kegan Paul, 1986), 196–233; Callon, 'The Sociology of an Actor-Network: the Case of the Electric Vehicle', in M. Callon, J. Law and Arie Rip (eds), *Mapping the Dynamics of Science and Technology* (London: Macmillan, 1986) 19–34: Callon, 'Society in the Making: the Study of Technology as a Tool for Sociological Analysis', in Bijker, Hughes & Pinch (eds), op. cit. note 4, 83–103; Bruno Latour, *Science in Action* (Milton Keynes, Bucks.: Open University Press, 1987); J. Law, 'Technology and Hetereogeneous Engineering: The Case of Portuguese Expansion', in Bijker, Hughes & Pinch (eds), op. cit. note 4, 111–34.

8. Law, op. cit. note 7.

9. Harry Braverman, *Labour and Monopoly Capital: The Degradation of Work in the Twentieth Century* (London: Monthly Review Press, 1984); David Knights and Hugh Wilmott (eds), *New Technology and the Labour Process* (London: Macmillan, 1988); Stewart Russell, 'The Social Construction of Artefacts: A Response to Pinch and Bijker', *Social Studies of Science*, Vol. 16 (1986), 331–46.

10. Russell, op. cit. note 9; Winner, op. cit. note 3; see also Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (London & Cambridge, MA: MIT Press, 1977).

11. See, for example, D. Knights, H. Wilmott and D. Collinson (eds), *Job Redesign* (Aldershot, Hants.: Gower, 1985).

12. Pinch & Bijker, op. cit. note 5; see also B. Bimber, 'Karl Marx and the Three Faces of Technological Determinism', *Social Studies of Science*, Vol 20 (1990), 333–51.

13. Jamie Fleck's work (*Innofusion or Diffusation? The Nature of Technological Development in Robotics*, Edinburgh PICT Working Paper No. 4 [RCSS, University of Edinburgh, 1988]) is an exception to this. Fleck criticizes the traditional linear model in which invention, innovation and diffusion are conceptualized as separate stages. In relation to NC machine tools and robots, he found tensions between the conception and implementation of technologies, with the implementation process impacting on

promoters and designers, and thus reconstituting technologies. His argument, which follows D. Sahel (*Patterns of Technological Innovation* [Reading, MA: Addison Wesley, 1981]), is somewhat narrower than we have in mind, being confined to very specific 'configurational' technologies.

14. MacKenzie & Wajcman, op. cit. note 1, 8.

15. R. Williams, *Television Technology and Cultural Form* (London: Fontana, 1974), 14.

16. Ibid., 25.

17. Ibid., 4.

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19. See Winner, op. cit. note 3.

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21. Robert A. Caro *The Power Broker: Robert Moses and the Fall of New York* (New York: Knopf, 1974).

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23. Knights, Wilmott & Collinson (eds), op. cit. note 11; Braverman, op. cit. note 9; Arthur Francis, *New Technology at Work* (Oxford: Oxford University Press, 1986); Stephen Wood (ed.), *The Degradation of Work? Skill, Deskilling and the Labour Process* (London: Hutchinson, 1982).

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27. Winner, op. cit. note 3, 30.

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30. Pam Scott, 'Levers and Counterweights: A Laboratory that Failed to Raise the World', *Social Studies of Science*, Vol. 21 (1991), 7–35.

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32. John B. Thompson, 'Mass Communication and Modern Culture: Contribution to a Critical Theory of Ideology', *Sociology*, Vol. 22 (1988), 359–83.

33. S. Russell and R. Williams, 'Opening the Black Box and Closing it Behind You: On Micro Sociology in the Social Analysis of Technology', paper presented at British Sociological Association Conference (Leeds, April 1987).

34. MacKenzie & Wajcman, op. cit. note 1, 17–18.

35. See, for example, Ian A. Glover and Michael P. Kelly, *Engineers in Britain: A Sociological Study of the Engineering Dimension* (London: Allen & Unwin, 1987); E.T. Layton, *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession* (Cleveland, OH: Press of Case Western Reserve University,

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36. D. Noble, *Forces of Production: a Social History of Industrial Automation* (New York: Knopf, 1984).

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44. Ibid., 6.

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52. Raymond Williams, *Towards 2000* (London: Chatto & Windus, 1983), 27.

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56. Williams, op. cit. note 52, 31.

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61. Christine Frederick, *Selling Mrs Consumer* (New York, 1929), 391–92, cited by Stuart Ewen, *Captains of Consciousness* (New York: McGraw-Hill, 1976), 134–35.

62. Quoted by Ewen, op. cit. note 61, 134.

63. Leiss et al., op. cit. note 40, 284.

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80. Bruce & Mole, op. cit. note 53.

81. Hill, op. cit. note 68.

82. Fleck, op. cit. note 13. Fleck quite explicitly excludes what he refers to as 'discrete technologies', such as consumer durables. He thus assumes that technology take-up is only functional (as opposed to symbolic); nor is he concerned with investigating the diversity of function (or use) to which a given technology can be put.

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84. Jim Johnson, 'Mixing Humans and Nonhumans Together: the Sociology of the Door-Closer', *Social Problems*, Vol. 35 (1988), 298–310.

85. R. Schwartz Cowan, 'The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology', in Bijker, Hughes & Pinch (eds), op. cit. note 4, 261–89.

86. MacKenzie & Wajcman, op. cit. note 1, 7.

87. Phil Goodall, 'Design and Gender', *Block*, Vol. 9 (1983), 50–62, at 58.

88. J. Williamson, *Consuming Passions: The Dynamics of Popular Culture* (London: Marion Boyars, 1986), 209–12, at 210.

89. Goodall, op. cit. note 87, 58.

90. Hill, op. cit. note 68, 51.

91. See Pam Linn, 'Microcomputers in Education: Living and Dead Labour', *Radical Science Journal*, No. 18 (1985), 58–101.

92. Hill, op. cit. note 68, 66.

93. Goodall, op. cit. note 87, 58.

94. See S. Hall, 'Encoding/Decoding', in Hall et al. (eds), *Culture, Media, Language* (London: Hutchinson, 1980), 128–38; D. Morley, *Family Television: Cultural Power and Domestic Leisure* (London: Comedia, 1980); and Morley, *The Nationwide Audience: Structure and Decoding*, BFI TV Monograph No. 11 (London: British Film Institute, 1980).

95. Lynn White, Jr, *Medieval Technology and Social Change* (New York: Oxford University Press, 1978), 28.

96. Hall, op. cit. note 94.

97. Haddon (1988), op. cit. note 39; Sherry Turkle, *The Second Self: Computers and the Human Spirit* (New York: Simon & Schuster, 1984).

98. Bill Keen,' "Play it Again, Sony": The Double Life of Home Video Technology', *Science as Culture*, Vol. 1 (1987), 7–42.

99. Neil Ascherson, 'Inventions Never Quite Set Us Free', *Observer* (London, 13 December 1987), 7.

100. Keen, op. cit. note 98; Ithiel de Sola Pool (ed), *The Social Impact of the Telephone* (Cambridge, MA: MIT Press, 1976), 4.

101. Mike Featherstone, 'Lifestyle and Consumer Culture', *Theory, Culture and Society*, Vol. 4 (1987), 55–70, at 56.

102. See Michael J. Piore and Charles F. Sabel, *The Second Industrial Divide: Possibilities for Prosperity* (New York: Basic Books, 1984); Robin Murray, 'Life after Henry (Ford)', *Marxism Today* (October 1988), 8–13.

103. D. Miller, *Material Culture and Mass Consumption* (Oxford: Blackwell, 1987).

104. Hall, op. cit. note 94.

105. Valentin N. Volosinov, *Marxism and the Philosophy of Language*, translated by L. Matejka and I.R. Titunik (New York: Seminar Press, 1973), 23.

106. Morley, *Nationwide Audience*, op. cit. note 94, 10.

107. See Baudrillard, op. cit. notes 68, 73 and 75; J. Baudrillard, *Selected Writings*, edited by M. Poster (Cambridge: Polity, 1988); the quotation is from D. Hebdige, 'After the Masses', *Marxism Today* (January 1989), 48–53, at 51.

108. F. Jameson, 'Reification and Mass Culture', *Social Text*, Vol. 1 (1981), 130–48, at 131, cited by Featherstone, op. cit. note 101, 58.

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111. W. Leiss, 'The Icons of the Marketplace', *Theory, Culture and Society*, Vol. 1 (1983), 10–21, at 20.

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113. Morley & Silverstone, op. cit. note 39; Silverstone et al., op. cit. note 39.

114. Miller, op. cit. note 103, 116.

115. Douglas & Isherwood, op. cit. note 78, 59.

116. Ibid., 5.

117. Baudrillard, *Selected Writings*, op. cit. note 107; P. Bourdieu, *Distinction* (London: Routledge & Kegan Paul, 1984).

118. Featherstone, op. cit. note 101; M. Featherstone, *Consumer Culture and Postmodernism* (London: Sage, 1991).

119. Douglas & Isherwood, op. cit. note 78, 68.

120. Hill, op. cit. note 68, 46.

121. Ibid., 43.

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130. Ibid., 173.

131. Haddon, op. cit. note 39.

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